












HEALTHY INDOOR ENVIRONMENT PROTOCOLS FOR HOME ENERGY UPGRADES

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
	Measures to help home energy retrofit contractors identify common indoor air quality and safety concerns in homes. This document is not a guide to diagnosing occupant health problems or building-related illnesses.	Critical actions intended to ensure work does not potentially cause or worsen indoor air quality or safety problems for occupants or workers (i.e., “Do No Harm”). EPA recommends these protections for ALL retrofit projects.	Additional actions to promote healthy indoor environments that can be taken during energy-efficiency retrofit projects. EPA recommends considering these improvements when feasible.
CONTAMINANTS			
ASBESTOS			
	<p>Determine potential asbestos hazard. Consider the age of the structure; homes built after 1930 and before the 1970s especially may have asbestos insulation. Asbestos may also be present in other building materials in homes built or renovated prior to the 1990s.</p> <p>Note Possible sources of asbestos are:</p> <ul style="list-style-type: none"> • Attic insulation (especially vermiculite). • Wall insulation (e.g., vermiculite, insulation blocks). • Insulation on steam pipes, boilers and furnace ducts. • Vinyl flooring (including 9-inch by 9-inch or 12-inch by 12-inch floor tiles, vinyl sheet flooring and the mastics and other adhesives used to secure the flooring). • Cement sheet, millboard and paper used as insulation around furnaces and wood- or coal-burning appliances. • 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) combustion vent or transite flue. • Original plaster or plaster that is old enough to potentially contain asbestos. 	<p>If suspected asbestos-containing material (ACM) is in good condition, do not disturb.</p> <p>If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s). For example, separate 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. Only a licensed or trained professional may abate, repair or remove ACM. </p> <p>Note Typically, trained professionals can repair asbestos by:</p> <ul style="list-style-type: none"> • <i>Sealing or Encapsulating:</i> Treating the material with a sealant that either binds the asbestos fibers together or coats the material so fibers are not released. Pipe, furnace and boiler insulation can often be repaired this way. • <i>Covering or Enclosing:</i> Placing a protective layer over OR around the ACM to prevent release of fibers. Exposed insulated piping may be covered with a protective wrap or jacket. • <i>Removing:</i> Removing ACM may be advantageous when remodeling OR making major changes to a home that will disturb ACM, or if ACM is damaged extensively and cannot be otherwise repaired (by covering, enclosing, sealing or encapsulating). 	This cell is intentionally blank.

(Continued on next page)





PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
<p>ASBESTOS <i>(continued)</i></p>	<p>If unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material. Sample and test as needed. </p> <p>Note <i>The EPA vermiculate guidance referenced below includes photos to aid the identification of vermiculite insulation.</i></p> <p>Relevant Guidance/Standards The National Institute of Standards and Technology (NIST) maintains a list of asbestos laboratories accredited under the National Voluntary Laboratory Accreditation Program (NVLAP):</p> <ul style="list-style-type: none"> • Call NIST at (301) 975-4016 or email NVLAP@nist.gov. • NIST/NVLAP: Accredited Laboratories for the Polarized Light Microscopy (PLM) Test Method. • NIST/NVLAP: Accredited Laboratories for the Transmission Electron Microscopy (TEM) Test Method. <p>DOL, OSHA, 29 CFR Part 1926, subpart Z. EPA Asbestos: Asbestos in Your Home. EPA Asbestos: Regional and State Asbestos Contacts. EPA Vermiculite. If working in a pre-1980 building, see: Appendix A: Worker Protection – Asbestos and Confined Spaces. </p>	<p>When working around ACM, do not:</p> <ul style="list-style-type: none"> • Dust, sweep or vacuum ACM debris. • Saw, sand, scrape or drill holes in the material. • Use abrasive pads or brushes to strip materials. <p>Do not remove OR disturb attic insulation that looks like vermiculite unless the material has been tested and found not to contain asbestos.</p> <p>Any asbestos abatement or repair work should be completed prior to 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) unless the material has been tested and found not to contain asbestos.</p> <p>Notes <i>Appropriate identification of ACM is necessary to ensure the continued safety of the occupants and the safety of workers, who may not be aware of asbestos hazards.</i> </p> <p><i>If ACM may be disturbed during a planned retrofit, a competent person needs to conduct an initial exposure assessment to determine potential worker exposures and required exposure controls.</i> </p> <p><i>Asbestos awareness training is recommended for retrofit workers, especially auditors and crew chiefs.</i> </p> <p>Relevant Guidance/Standards BPI Technical Standards: Technical Standards for the Heating Professional. DOL, OSHA, Asbestos. DOL, OSHA, Asbestos – Construction. EPA Asbestos: Asbestos in Your Home. EPA Vermiculite.</p>	



PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
	<p>BELOWGROUND CONTAMINANTS (except radon)</p> <p>Visually evaluate potential sources AND check for odors of gasoline, sewer gas or fuel oil.</p> <p>Visually evaluate the integrity of sewer vent system (e.g., ensure drain traps have water in them, inspect drain lines for breaks or leaks), particularly if there is the odor of sewer gas in the home (e.g., during the initial assessment or a fan depressurization test).</p> <p>If you detect an odor but cannot identify its source and the house is in a known contaminated area, notify local or state authorities AND/OR pursue additional assessment before making additional energy upgrades.</p> <p>If soil or groundwater contamination is suspected on or near the building site (e.g., former industrial site), volatile contaminants or breakdown products may pose an indoor air quality risk through soil gas intrusion. In such cases, 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.</p> <p>Relevant Guidance/Standards ASTM E2600. EPA OSWER Draft Guidance for Evaluating Vapor Intrusion.</p>	<p>Repair or replace failed or unattached sewer vent system components before proceeding with energy retrofits.</p> <p>If the assessments reveal sewer gas odors from drain traps that are dry due to infrequent use, fill the traps with a non-toxic liquid that has a slow evaporation rate (e.g., mineral oil).</p> <p>If soil gas vapor intrusion is suspected, assess AND mitigate in compliance with state or local standards. If there are no such standards, follow EPA guidance, below, for vapor intrusion evaluation and mitigation.</p> <p>Note <i>The causes or sources of contaminants must be identified and corrected before air sealing or other weatherization retrofit actions are performed to ensure the problem is not exacerbated.</i></p> <p>Relevant Guidance/Standards ASPE Data Book.</p> <p>Conduct work in compliance with state and local standards. Otherwise follow: ASTM E2600. EPA OSWER Draft Guidance for Evaluating Vapor Intrusion. EPA Vapor Intrusion Mitigation Approaches.</p>	<p>If there is an untrapped floor drain, consider installing a low-cost floor drain seal like those often used during radon mitigations, as described in ASTM E2121.</p> <p>Relevant Guidance/Standards ASTM E2121.</p>



PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
BUILDING PRODUCTS/ MATERIALS EMISSIONS			
 <p>Review information on the contents of products being considered for purchase and installation during an energy upgrade project to determine whether they contain potentially hazardous compounds. Many of these products and materials (e.g., paints, particle board, pressed wood, insulation, sealants, plywood and cleaning supplies) may contain volatile organic compounds (VOCs), including formaldehyde, or other hazardous compounds to which exposure should be minimized or eliminated during and after an energy upgrade.</p> <p>Assess ventilation to determine compliance with the Minimum Actions and Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p> <p>Note: <i>Dilution using whole-house ventilation will help reduce VOCs and other airborne contaminants from indoor sources in most homes.</i></p> <p>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.</p> <p>If working with materials associated with chemical emissions or dust generation, including spray polyurethane foam insulation, see Jobsite Safety (page 24) and Appendix A: Worker Protection. </p> <p>Relevant Guidance/Standards American Chemistry Council: Spray Polyurethane Foam Health and Safety. DOL, OSHA, Green Jobs Hazards. EPA SPF: Spray Polyurethane Foam, Building Occupants and Other Workers Should Vacate During SPF Installation. Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p>	<p>Minimize occupant and worker exposure to VOCs or other airborne contaminants by:</p> <ul style="list-style-type: none"> • Ensuring that work areas are properly isolated (e.g., by sealing with plastic sheeting) and ventilated to the outdoors during activities that result in VOC emissions (e.g., installing spray foam insulation, painting, sealing, finishing) AND that they are ventilated as close as possible to the source of those emissions. • Using appropriate dust-control and protective equipment. • Thoroughly cleaning work areas and allowing any odors to dissipate before re-occupancy. • Following manufacturers' recommendations, which may indicate the need to evacuate building occupants and other unprotected individuals from work areas during and for some period after the use of a product. <p>Source Control When installing new products and materials, consider using the least toxic product or material feasible to effectively do the job. For example, use products and materials that indicate they have (or are certified as having) low VOC content or low VOC emissions. </p> <p>Note: <i>California Title 17 requires reduced formaldehyde emissions from composite wood products and finished goods that contain composite wood products sold, offered for sale, supplied, used or manufactured for sale in California.</i></p> <p>Ventilation Ensure the home meets the Minimum Actions in the Whole-House Ventilation for Distributed Contaminant Sources section (page 22).</p> <p>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. </p>	<p>New Products Source Control When available, specify products and materials that meet independent certification and testing protocols, such as:</p> <ul style="list-style-type: none"> • California Department of Public Health, Emission Testing Method for California Specification 01350. • Carpet and Rug Institute (CRI) Green Label or Green Label Plus program criteria or equivalent standards for carpet. • Collaborative for High Performance Schools (CHPS) High Performance Products Database. • Green Seal Standard GS-11. • Greenguard Children and Schools Certification Program. • Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2. • Scientific Certification Systems (SCS) Standard EC-10.2-2007, Indoor Advantage Gold. <p>When installing structural plywood or pressed or composite wood products, select those that are certified compliant with California Title 17. If California Title 17 compliant materials are not available, use products that meet section 6.1 of EPA's Indoor airPLUS Construction Specifications.</p> <p>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.</p>	




(Continued on next page)





PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
BUILDING PRODUCTS/ MATERIALS EMISSIONS <i>(continued)</i>		<p>Relevant Guidance/Standards American Chemistry Council: Spray Polyurethane Foam Health and Safety. California Title 17. EPA SPF: Spray Polyurethane Foam. Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p>	<p>Seal composite wood products (e.g., particle board and pressed wood) that are not compliant with California Title 17 or that do not meet section 6.1 of EPA's Indoor airPLUS Construction Specifications with a sealant intended to reduce VOC emissions. Seal all exposed surfaces and holes, as appropriate. Check with vendors for recommendations on sealing their engineered wood products. If these actions do not solve the problem (e.g., persistent odors, occupant complaints), hiring an environmental professional and testing may be necessary.</p> <p>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.</p> <p>Relevant Guidance/Standards California Department of Public Health, Emission Testing Method for California Specification 01350. California Title 17. CARB: Formaldehyde. CHPS. CRI. EPA Design for the Environment. EPA Indoor airPLUS Specification Section 6. Green Seal Standard GS-11. Greenguard Children and Schools Certification Program. MPI GPS-1 and GPS-2. SCS Standard EC-10.2-2007. Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
CARBON MONOXIDE (CO) AND OTHER COMBUSTION APPLIANCE EMISSIONS (NITROGEN OXIDES, VOLATILE ORGANIC COMPOUNDS [VOCs] AND PARTICULATES)			
	<p>Locate and identify any fuel-burning combustion appliances in the home (e.g., gas, oil, kerosene, wood- or coal-burning appliances). See Combustion Safety (page 18) and Wood Smoke and Other Solid Fuel Emissions (page 16) for assessment protocols to complete safety inspections of all combustion appliances in a dwelling.</p> <p>Determine if there is an attached garage. See Garage Air Pollutants (page 8) for ways to locate air leaks from a garage to occupied spaces.</p> <p>Determine whether there are working carbon monoxide (CO) alarms and smoke alarms. </p> <p>Ask occupants whether they have supplemental portable combustion equipment (e.g., generators, unvented gas or kerosene space heaters). </p> <p>Test interior living space for CO. Avoid testing near combustion equipment that has already undergone CO testing.</p> <p>Test for CO outside of the home (e.g., near front entrance) to document general outdoor levels. Avoid testing near obvious sources of CO (e.g., motor vehicles, lawn equipment).</p> <p>Relevant Guidance/Standards BPI-1100-T-2010, Combustion Appliance Testing section.</p> <p>Combustion Safety (page 18).</p> <p>Garage Air Pollutants (page 8).</p> <p>Wood Smoke and Other Solid Fuel Emissions (page 16).</p>	<p>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 conduct air sealing between the garage and the home).</p> <p>Specify and install CO alarms in all homes. See Home Safety (page 23) for details. </p> <p>See Garage Air Pollutants (page 8) for recommendations on how to minimize the movement of air and contaminants (including CO and other combustion appliance emissions) from the garage to the house.</p> <p>See Combustion Safety (page 18) and Heating, Ventilating and Air Conditioning (HVAC) Equipment (page 17), as appropriate, for recommendations on repairing, removing or replacing combustion appliances.</p> <p>Relevant Guidance/Standards Combustion Safety (page 18).</p> <p>Garage Air Pollutants (page 8).</p> <p>Heating, Ventilating and Air Conditioning (HVAC) Equipment (page 17).</p> <p>Home Safety (page 23).</p>	<p>See Home Safety (page 23) for recommended installation of CO alarms that can detect and store peak CO levels of less than 30 ppm. </p> <p>See the Expanded Actions for Garage Air Pollutants (page 8) for additional recommendations on minimizing airflow from the garage to the house.</p> <p>See the Expanded Actions for Combustion Safety (page 18) for additional recommendations on repairing, removing or replacing combustion appliances.</p> <p>Relevant Guidance/Standards Combustion Safety (page 18).</p> <p>Garage Air Pollutants (page 8).</p> <p>Home Safety (page 23).</p>


PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
<p>ENVIRONMENTAL TOBACCO SMOKE (ETS)</p> <p> Single Family Dwelling: Look for signs of smoking indoors (e.g., ashtrays, cigarette packs, odors).</p> <p>Multi-Family Dwelling: Determine whether there is a smoke-free housing policy. Determine whether tenants have complained about smoking odors or smoking related concerns.</p>	<p>Single Family Dwelling: Look for signs of smoking indoors (e.g., ashtrays, cigarette packs, odors).</p> <p>Multi-Family Dwelling: Determine whether there is a smoke-free housing policy. Determine whether tenants have complained about smoking odors or smoking related concerns.</p>	<p>Single-Family Dwelling: See Appendix B: Client Education. </p> <p>Multi-Family Dwelling: If there have been complaints, ask the owner if a smoke-free housing policy is being considered. If a policy has not been adopted, address the complaints through the following actions:</p> <ul style="list-style-type: none"> • Reduce unintended excess airflow from common exhaust ventilation systems due to duct and shaft leakage, excess fan flow and unbalanced unit flows. • Seal enough to enable ventilation systems to increase capture in smokers' units, match flows to remove fan-induced pressure difference between units, and increase outdoor air supply ventilation rates in non-smokers' units. • Reduce ETS transfer from smokers' units by: <ul style="list-style-type: none"> • Air sealing the walls, ceilings and floors that separate the unit from neighboring units, corridors, chases and stairwells. Seal smoker's unit as tightly as possible. • Adjusting outdoor air and exhaust flows so the unit is negative relative to bounding wall and ceiling cavities and the overall ventilation rate for the unit has increased. Smoke current tubes or other air flow tests should show that air flows into the dwelling unit through openings in bounding walls (e.g., electrical outlets). <p>Note <i>The above air sealing strategies are intended to help reduce the exposure of occupants in the non-smoking units adjacent to the smokers' units. These actions may not reduce the risks of ETS to occupants living in the smokers' units.</i></p> <p>Relevant Guidance/Standards ASHRAE 62.2-2010.</p> <p>MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments.</p>	<p>This cell is intentionally blank.</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
ENVIRONMENTAL TOBACCO SMOKE (ETS) <i>(continued)</i>			
		<p>NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust.</p> <p>NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems.</p> <p>NCHH Fact Sheet: Improving Ventilation in New and Existing Multi-Family Buildings with Individual Unit Ventilation Systems.</p>	
GARAGE AIR POLLUTANTS (CO, BENZENE AND VOCS)			
	<p>If there is an attached garage (i.e., sharing at least one wall, ceiling, ductwork, etc.), 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.</p> <p>Determine (visual inspection and/or occupant inquiry) if there are unvented combustion appliances or hobby equipment that may be used in the garage.</p> <p>Note <i>If combustion appliances are present, see Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6), Vented Combustion Appliances (page 18) and Unvented Combustion Appliances (page 20) for recommended actions.</i></p> <p>Relevant Guidance/Standards Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). Energy Conservatory: Blower Door. Unvented Combustion Appliances (page 20). Vented Combustion Appliances (page 18).</p>	<p>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. </p> <p>At a minimum, air seal these locations (if present):</p> <ul style="list-style-type: none"> • Doors (ensure tight closure AND install weather-stripping). • 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. <p>To keep garage air from being drawn into the home, eliminate or disconnect supply diffusers and return grilles in the garage that connect to air handlers serving the occupied space.</p> <p>If heat is needed in the garage, use a properly installed supplemental heating system.</p> <p>Relevant Guidance/Standards ACCA 5 QI-2010. ASHRAE 62.2-2010.</p>	<p>Steps that can reduce air pressure in the garage and minimize flow from the garage to the house include the following:</p> <ul style="list-style-type: none"> • If occupants spend significant time in the garage (e.g., the garage is used as a workshop or playroom), at a minimum, 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 2009 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 in the floor system to assist with air sealing between the garage and living space in homes that have a room above the garage. • Use advanced blower door techniques (see guidance listed below) to identify air leakage pathways between the house and garage and to verify the effectiveness of air sealing. <p>Relevant Guidance/Standards EPA Indoor airPLUS Specification 5.6. Home Energy, Advanced Blower Door Techniques. International Mechanical Code, 2009.</p>




PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
<p>LEAD</p> 	<p>Assume 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.</p> <p>Consider using an EPA-recognized testing method (e.g., X-ray fluorescence [XRF] testing, or an on-site test kit) on suspect surfaces that will be disturbed in order to determine whether the paint is lead-based. The lead-safe work practices minimum and expanded actions apply only to paint assumed to be or tested to confirm that it is lead-based.</p> <p>Relevant Guidance/Standards HUD Title 24. EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. EPA Lead. EPA Lead-Based Paint Renovation, Repair, and Painting Program: Small Entity Compliance Guide to Renovate Right. If working in a pre-1978 building, see Appendix A: Worker Protection – Lead. </p>	<p>Comply with EPA's Lead-Based Paint Renovation, Repair, and Painting (RRP) Program Rule. Among the rule's key elements are:</p> <ul style="list-style-type: none"> • Use a Certified Renovator. • Follow lead-safe work practices if disturbing more than 6 ft² of interior or 20 ft² of exterior painted surfaces. • Contain the work area to avoid resident exposure. • Minimize lead dust and leave no dust or debris behind. • Achieve visual post-cleaning criteria. <p>Comply with state and local lead-related regulations, which may be applicable to lead hazard reduction activities and may require additional certified personnel.</p> <p>Note <i>This is not a complete summary of the regulatory requirements. The intent of this protocol is to 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.</i></p> <p>Relevant Guidance/Standards DOL, OSHA, Lead. EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. EPA Renovation, Repair and Painting (RRP) Program Rule: 40 CFR Part 745. EPA Lead Accredited Training Programs.</p>	<p>Follow the U.S. Department of Housing and Urban Development (HUD) lead-safe rehabilitation practices. In addition to EPA's RRP, these HUD practices:</p> <ul style="list-style-type: none"> • Lower the thresholds for interior painted surface area from 6 ft² to 2 ft². • Require repair of painted surfaces that are disturbed when using lead-safe work practices. • Require meeting lead dust clearance testing standards if more than 2 ft² of paint is disturbed. <p>Note <i>Lead dust clearance testing includes measuring for lead dust on floors, windowsills and window troughs. See NCHH Fact Sheet: Testing for Lead-Contaminated Dust.</i></p> <p>Relevant Guidance/Standards EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. HUD Lead Safe Work Practices. NCHH Fact Sheet: Testing for Lead-Contaminated Dust.</p>
<p>MOISTURE (MOLD AND OTHER BIOLOGICALS)</p> 	<p>Inspect the interior and exterior of the building for evidence of moisture problems. Document the extent and location of the problems, and the proposed repairs, to avoid exacerbating the problems when the repairs are made. Examples of moisture and mold problems are:</p> <ul style="list-style-type: none"> • Water damage or stains. • Foundation cracks that leak water. • Visible mold growth. 	<p>Repair roof leaks before air sealing or insulating the attic.</p> <p>Address surface water pooling near the foundation before insulating basement or crawlspace walls near wet areas.</p>	<p>Repair additional moisture problems identified during the assessment (e.g., plumbing leaks, rain leaks including leaks around windows and flashing, and foundation leaks).</p> <p>Retrofit crawlspaces so that they are unvented, sealed, insulated, properly drained and waterproofed, following guidance in section 1.4 of EPA's Indoor airPLUS Construction Specifications.</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MOISTURE (MOLD AND OTHER BIOLOGICALS) (continued)			
	<ul style="list-style-type: none"> • Wet or damp spots. • Musty odor. • Moisture damage on windows. • Groundwater, surface water and rainwater intrusion. • Plumbing leaks. • Condensation. • Consider temperature, relative humidity and absolute humidity (e.g., dew point temperature and humidity ratio [i.e., pounds or grains of water vapor per pound of dry air]). <p>Determine whether the project requires mold remediation and additional moisture control measures (e.g., as determined during a Weatherization Assistance Program audit).</p> <p>Document which moisture problems will be addressed as part of the energy-conserving project, and which must be repaired by the homeowner or another contractor before certain, specific energy conserving measures can be implemented.</p> <p>If moisture issues cannot be addressed, do not install energy upgrades that will reduce the home's air infiltration rate. Homes where this may be the case include those that have significant condensation or humidity problems, such as condensation on multiple windows, condensation in attics or significant moisture or mold problems that are beyond the scope of the remedies under Minimum Actions.</p> <p>See Appendix A: Worker Protection – Mold and Confined Spaces as appropriate. </p>	<p>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.</p> <p>Ensure proper HVAC condensate drainage.</p> <p>Prevent condensation in the enclosure by:</p> <ul style="list-style-type: none"> • Air sealing the enclosure. <i>Note: This also prevents ice dams in cold, snowy climates.</i> • Managing water vapor flow and condensing surface temperatures to avoid dew point conditions (achieved by selection of materials with appropriate combination of R-value and vapor permeability). • Managing air pressure relationships as needed. • Controlling indoor humidity sources, for example: <ul style="list-style-type: none"> • Ensuring bath fans are operating properly and vented to the outdoors. • Ensuring clothes dryers are correctly vented to the outdoors. • Covering earthen floors in basements and crawlspaces with sealed vapor barriers; seal sump crocks. • If adding an air conditioning (AC) unit, ensure it is sized properly. If the relative humidity or moisture in the air is high, evaluate whether the AC unit is oversized. • Install dehumidifiers, if appropriate. • Remove unvented combustion space heaters. • Ensure proper crawlspace ventilation. • Ensure proper attic ventilation, unless sealed or conditioned. <p>Conduct any required mold remediation following EPA or other professional guidance (see Appendix A, Mold section, page 34). </p> <p>See Mold and Moisture section in Appendix B: Client Education. </p>	<p>Perform additional activities, beyond those required for the weatherization project, in order to remediate any mold growth. Follow EPA or other professional guidance (see Appendix A, Mold section, page 34). </p> <p>Relevant Guidance/Standards EPA Indoor airPLUS Specification: 1.4. EPA Mold Remediation.</p>

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MOISTURE (MOLD AND OTHER BIOLOGICALS) (continued)			
	<p>Relevant Guidance/Standards DOE: Workforce Guidelines for Home Energy Upgrades (under development).</p>	<p>Notes <i>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.</i> <i>If an atmospherically vented combustion device is causing an indoor humidity problem, it should be repaired in accordance with the Combustion Safety section (page 18).</i></p> <p>Relevant Guidance/Standards Combustion Safety (page 18). DOE: Workforce Guidelines for Home Energy Upgrades (under development). EPA Indoor airPLUS Specifications 1.5 and 1.6.</p>	
OZONE			
	<p>Determine if there is any air-cleaning equipment designed to intentionally produce ozone (i.e., ozone generators) in the house.</p> <p>Relevant Guidance/Standards CARB: Ozone.</p>	<p>Do not install air-cleaning equipment designed to intentionally produce ozone (i.e., ozone generators).</p> <p>Recommend removal of air-cleaning equipment designed to intentionally produce ozone, if present.</p> <p>Relevant Guidance/Standards EPA Indoor airPLUS Specification 4.7. EPA IAQ: Ozone Generators that are Sold as Air Cleaners.</p>	This cell is intentionally blank.
PESTS			
	<p>Identify evidence of mice, squirrels or other rodents; termites; birds; bats; cockroaches or other pests. Note the location and identify pest-contaminated materials (e.g., nests, feces). Determine whether rodenticides or pesticides are being used.</p> <p>Remove pest-infested materials OR determine if professional assistance is needed to do so before conducting energy retrofit work in pest-infested areas.</p>	<p>Alert owner of any termite infestations and inform owner of the need to seek assistance from an integrated pest management (IPM) professional (e.g., Greenpro, Greenshield or equivalently trained IPM professional).</p> <p>In areas with evidence of rodent infestations, patch with pest-resistant materials (e.g., copper mesh, hardware cloth, sheet metal, concrete) exterior holes that are larger than ¼ inch by ⅜ inch before applying air sealing materials (e.g., caulk or foam) OR before insulating.</p>	<p>Protect air intakes from potential bird and pest entry (e.g., cover openings with ½-inch screen or galvanized mesh).</p> <p>Protect exhaust vents from rodent, bird and pest entry (e.g., cover openings with louvers). Avoid creating conditions that can clog exhaust, particularly dryer vents.</p>

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
PESTS (continued)	<p>Note Termite and some other types of pest infestations are often an indication of moisture problems. See Moisture (page 9) for diagnosing moisture problems.</p> <p>Relevant Guidance/Standards AFHH. CDC Resource on Rodents.</p>	<p>Advise owner/resident to regularly clean/fix screens or dampers over exterior air intakes and exhausts (e.g., at least semi-annually or when replacing HVAC filters). Remove clutter, eliminate wood piles near house, and remove bushes, trees or other vegetation closer than two feet from the structure. </p> <p>Relevant Guidance/Standards EPA IPM. NCHH IPM. New York City Department of Health and Mental Hygiene.</p>	<p>Follow IPM guidelines for roach control AND, if feasible, apply boric acid or gels in holes for roach issues. Follow relevant state pesticide applicator standards.</p> <p>Note Some states require that pest management professionals be licensed.</p> <p>Provide sealable outside garbage cans OR advise clients to use them.</p> <p>Relevant Guidance/Standards ASHRAE 62.2-2010. EPA IPM. New York City Department of Health and Mental Hygiene.</p>
POLYCHLORINATED BIPHENYLS (PCBs)	<p> Determine whether fluorescent light ballasts containing polychlorinated biphenyls (PCBs) are present.</p> <p>Note Some homes may contain fluorescent light fixtures with ballasts manufactured before 1979 that contain polychlorinated biphenyls (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 clearly marked as electronic.</p> <p>Relevant Guidance/Standards EPA PCB-Containing Light Ballasts.</p>	<p>If fluorescent light ballasts do not have the statement “No PCBs” or are not marked as electronic, assume that the ballasts contain PCBs and replace with new lighting 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 replace with new lighting fixtures.</p> <p>Relevant Guidance/Standards EPA PCB. EPA PCB-Containing Light Ballasts.</p>	<p>The presence of PCBs may not be limited to fluorescent light ballasts. PCBs were also used in other products, including caulk. See EPA’s website on PCBs for a complete list of products of concern, and where possible, remove and replace them.</p> <p>Relevant Guidance/Standards EPA PCB. EPA PCBs in Caulk.</p>
RADON	<p> Follow one of two testing options to determine the radon level as summarized below and in Table 1.</p> <p>Option 1: Test-In/Test-Out – Test for radon before and after energy upgrade work. Option 2: Post-Work Test – Test for radon only after completing energy upgrade work.</p>	<p>Before completing retrofit activities, take precautionary measures listed below in Column 1 of Table 1, depending on pre-work test results. After work, follow the appropriate Minimum and/or Expanded Actions outlined in Table 1, depending on post-work test results.</p>	<p>Additional actions to reduce radon exposure are summarized below and outlined in Table 1.</p> <ul style="list-style-type: none"> • Mitigate according to ASTM E2121 when the post-work radon level is ≥ 4 pCi/L. • If the post-work radon level is between 2 and 4 pCi/L, refer the client to EPA’s Citizen’s Guide to Radon or mitigate in accordance with ASTM E2121.

(Continued on next page)




PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
<p>RADON <i>(continued)</i></p>	<p>Perform radon testing in accordance with applicable state requirements or federal guidance. Individuals conducting tests should be trained or certified by either of these groups:</p> <ul style="list-style-type: none"> • National Environmental Health Association (NEHA) National Radon Proficiency Program. • National Radon Safety Board (NRSB). <p>Notes <i>Two radon tests may be performed simultaneously and averaged to increase confidence in the short-term test result. This approach can be used for both pre- and post-work testing. Another option is to take two tests sequentially. DO NOT average the pre-work and post-work test results.</i></p> <p><i>Long-term testing is the most accurate way to test for radon, but it may not be feasible. See EPA's Citizen's Guide to Radon for information on long-term testing.</i></p> <p><i>The recommended testing protocols are designed to ensure that radon exposure does not increase above EPA thresholds in homes where radon levels are initially below those thresholds. This protocol is not designed to mitigate radon risks that existed prior to the energy upgrade. All clients should be provided with radon testing results.</i></p> <p>Determine whether the home has an active or passive radon mitigation system.</p> <p>Note <i>Active mitigation systems include a radon vent fan, usually located in an attic, in an attached garage or on the building exterior.</i></p> <p>Relevant Guidance/Standards ASHI Radon Mitigation System Inspection Checklist. EPA Radon Guidance: Guidance for Radon Testing and Mitigation. EPA Radon: State Radon Contact Information.</p>	<p>When the pre-work radon level is ≥ 2 pCi/L, complete precautionary foundation air sealing strategies:</p> <ul style="list-style-type: none"> • Cover exposed earthen floors in basements and crawlspaces according to section 1.2 of EPA's Indoor airPLUS Construction Specifications. • Air seal sumps (e.g., install an airtight sump cover) in such a way that water can drain from above and below the sump cover. • Install airtight drain fittings (e.g., trap or flange system) in foundation floor drains. • Seal and caulk penetrations, openings or cracks in below-grade walls and floors that contact the ground with a sealant that meets the requirements of ASTM C920. <p>Note <i>These foundation air sealing strategies are also important elements of radon mitigation according to ASTM E2121, which addresses both foundation air sealing and fan-powered radon mitigation systems.</i></p> <p>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, but the protocols do not necessarily mitigate a prior indoor radon problem in the home. Advise the client to refer to EPA's Citizen's Guide to Radon for more information about radon risk. 🏠</p> <p>Mitigate in accordance with ASTM E2121 if:</p> <ul style="list-style-type: none"> • Option 1: Post-work radon level is ≥ 4pCi/L AND it exceeds the pre-work radon level OR • Option 2: Post-work radon level is ≥ 4pCi/L AND no pre-work levels were taken. 	<p>Relevant Guidance/Standards ASTM C920. ASTM E2121. EPA Radon. State Radon Contact Information. EPA Radon Guidance: Citizen's Guide to Radon.</p>

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
RADON <i>(continued)</i>		<p>For homes equipped with an active radon mitigation system:</p> <ul style="list-style-type: none"> • Verify that the radon vent fan is operating. • If a previously installed radon mitigation system is not operating correctly OR if the post-work tested radon level is ≥ 4 pCi/L, advise the client to consult the state radon office. <p>Relevant Guidance/Standards ASTM C920. ASTM E2121. EPA Indoor airPLUS Specification 1.2. EPA Radon Guidance: Citizen's Guide to Radon.</p>	



Table 1: Radon Testing Options and Reduction Strategies

Pre-Work Test Result and Precautionary Measures	Post-Work Test Result	Minimum Actions	Expanded Actions
<2 pCi/L <i>Consider precautionary radon-reduction actions as part of energy upgrade work, especially covering exposed earth, air sealing open sumps, ensuring floor drains have traps and that traps are not dry.</i>	<2 pCi/L	No action.	
	>2 and <4 pCi/L	Complete foundation air sealing strategies.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L ≥4 pCi/L	Mitigate in accordance with ASTM E2121.	
>2 and <4 pCi/L <i>Take precautionary radon-reduction actions: complete foundation air sealing strategies as part of energy upgrade work.</i>	<4 pCi/L and NOT higher than pre-work level.	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	<4 pCi/L AND higher than pre-work level.	Verify that foundation air sealing strategies were completed appropriately and correct deficiencies.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L	Mitigate in accordance with ASTM E2121.	
≥4 pCi/L <i>Complete all foundation air sealing strategies as part of energy upgrade work.</i>	<4 pCi/L	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L but NOT higher than pre-work level.	Refer client to EPA's Citizen's Guide to Radon and recommend radon mitigation.	Mitigate in accordance with ASTM E2121.
	≥4 pCi/L AND higher than pre-work level.	Mitigate in accordance with ASTM E2121.	
No Pre-Work Test <i>Consider precautionary radon-reduction actions as part of energy upgrade work, especially covering exposed earth, air sealing open sumps, ensuring floor drains have traps and that traps are not dry.</i>	<4 pCi/L	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumers Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L	Mitigate in accordance with ASTM E2121.	


PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
<p> WOOD SMOKE AND OTHER SOLID FUEL EMISSIONS</p>	<p>Determine whether there are wood- or coal-burning appliances (e.g., wood stove or furnace, wood pellet stove, fireplace) in the home.</p> <p>If wood- or coal-burning appliances are present, determine whether there is evidence of wood smoke emissions affecting the home, using any of the following practices or the equivalent (note that many of the following may require input from certified/trained professionals):</p> <ul style="list-style-type: none"> • Look for evidence of soot on the walls or ceiling or creosote staining near the flue pipe. • Determine whether the inside of the home smells like wood smoke. • Ask occupants whether they regularly (i.e., daily) smell wood smoke during the heating season. • If certified/trained professionals are available, consider using a particle counter to quantify particulates in the indoor air. <p>Assess appliance safety by considering:</p> <ul style="list-style-type: none"> • Appliance condition, 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 (Vented Combustion Appliances [page 18] and Unvented Combustion Appliances [page 20]). <p>Determine whether the wood- or coal-burning appliance is EPA-certified (i.e., more energy efficient and cleaner burning).</p> <p>Determine whether a hydronic heater (e.g., outdoor wood-fired boiler) is present.</p> <p>If the wood- or coal-burning appliance is operating during the assessment, observe the opacity of the smoke leaving the chimney.</p>	<p>Assess what the proper size of any wood- or coal-burning appliances will be after the retrofit is complete. If the current unit is oversized, recommend replacement with a properly sized, EPA-certified appliance.</p> <p>If evidence of soot, wood smoke or other health safety concern is apparent, determine the source of the problem and work with the appropriate certified professional (e.g., NFI, CSIA, etc.) to resolve it.</p> <p>Encourage the homeowner to have a certified professional chimney sweep (e.g., certified by the Chimney Safety Institute of America) inspect the chimney and wood- or coal-burning appliance annually. </p> <p>Share EPA Burn Wise tips with the homeowner: http://www.epa.gov/burnwise/pdfs/BurnWiseTips.pdf. </p> <p>Relevant Guidance/Standards CSIA. EPA Burn Wise Guides: Burn Wise Guide for Best Burn Practices for Wood Stoves. EPA Burn Wise Tips. NESCAUM Regulations. NFPA 211.</p>	<p>Replace non-certified wood- or coal-burning appliances with properly sized and installed EPA-certified wood- or coal-burning appliances after the retrofit is complete. Appliances should be installed according to the manufacturer's instructions.</p> <p>Relevant Guidance/Standards EPA Burn Wise Lists.</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
WOOD SMOKE AND OTHER SOLID FUEL EMISSIONS (continued)			
	<p>Note <i>One hundred percent opacity means nothing can be seen through the smoke. At 20% opacity, there is very little smoke and you can see almost completely through it. Smoke with opacity of more than 20% is an indication that unseasoned wood is being burned, a non-EPA approved stove is in use or poor operation.</i></p> <p>Relevant Guidance/Standards EPA Burn Wise Guides: Burn Wise Guide for Identifying Cleaner-Burning Appliances. Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). NFPA 211. Unvented Combustion Appliances (page 20) Vented Combustion Appliances (page 18)</p>		
CRITICAL BUILDING SYSTEMS FOR HEALTHY INDOOR ENVIRONMENTS			
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT			
	<p>Evaluate the condition of the existing HVAC system components (e.g., furnace, boiler, air handler, heat pump, associated ductwork) in accordance with minimum inspection standards of ANSI/ACCA Standard 4 (Maintenance of Residential HVAC Systems), ASHRAE handbooks or other equivalent standards and guidelines.</p> <p>Ventilation requirements are also addressed in Source Ventilation (page 21), Whole-House Ventilation for Distributed Contaminant Sources (page 22) and Multi-Family Ventilation (page 22).</p> <p>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 properly sized in accordance with ASHRAE handbook, or other equivalent standardized guidelines.</p>	<p>Based on an assessment of equipment condition and sizing, repair, modify or replace equipment to meet minimum corrective actions for proper HVAC function.</p> <p>If repairs are needed to restore HVAC to proper functioning, repair in accordance with ANSI/ACCA Standard 6 (Restoring the Cleanliness of HVAC Systems), ASHRAE handbooks or other equivalent standards and guidelines.</p> <p>If replacing equipment, base sizing calculations on post-retrofit conditions. Refer to Sections 4.1 and 4.2 of EPA Indoor airPLUS Construction Specifications.</p> <p>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), ASHRAE handbooks or other equivalent standards and guidelines.</p>	<p>Replace functioning HVAC equipment that is near the end of its service life with new energy-efficient HVAC equipment and base sizing calculations on post-retrofit conditions. Refer to Sections 4.1 and 4.2 of EPA Indoor airPLUS Construction Specifications.</p> <p>Follow ANSI/ACCA Standard 5 (HVAC Quality Installation Specification), Standard 9 (HVAC Quality Installation Verification Protocols), ASHRAE handbooks or other equivalent standards and guidelines. Consider using filters with a high MERV rating (11 or above) if equipment capacity is sufficient to accommodate the pressure drop. For existing systems, check with the manufacturer to determine whether MERV 11 filters can be installed.</p>

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT <i>(continued)</i>			
	<p>If HVAC replacement or modification is anticipated, base sizing calculations on post-retrofit conditions. Refer to Sections 4.1 and 4.2 of EPA Indoor airPLUS Construction Specifications.</p> <p>Relevant Guidance/Standards ACCA 4 QM-2007.</p> <p>ASHRAE Handbooks: ASHRAE Handbook Series.</p> <p>EPA Indoor airPLUS Specifications: 4.1 and 4.2.</p> <p>Multi-Family Ventilation (page 22).</p> <p>Source Ventilation (page 21).</p> <p>Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p>	<p>Ensure newly installed central forced-air HVAC systems have a minimum MERV 6 filter, no filter bypass, and no air cleaners designed to intentionally produce ozone.</p> <p>Relevant Guidance/Standards ACCA 5 QI-2010. ACCA 6 QR-2007. ACCA 9 QIVP-2008. ASHRAE 62.2-2010, Section 6.7. ASHRAE Handbooks: ASHRAE Handbook Series. ASHRAE 52.2-2007. EPA Indoor airPLUS Specifications: 4.1, 4.2 and 4.7. EPA IAQ: Residential Air Cleaners.</p>	<p>Relevant Guidance/Standards ACCA 5 QI-2010. ACCA 9 QIVP-2008. ASHRAE Handbooks: ASHRAE Handbook Series. ASHRAE 52.2-2007. EPA Indoor airPLUS Specifications: 4.1, 4.2 and 4.7.</p>
VENTED COMBUSTION APPLIANCES			
	<p>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, condition of venting, assessment of the potential for backdrafting, integrity of fuel lines, safety of electrical connections and the appliance itself.</p> <ul style="list-style-type: none"> For gas-fired appliances and equipment, make this assessment using applicable installation standards, including the National Fuel Gas Code, ANSI Z223.1/NFPA 54, the applicable ANSI Z21 gas-fired appliance safety standard and manufacturer's instructions. Determine whether gas-fired appliance installations comply with Section 9.3 "Air for Combustion and Ventilation" of ANSI Z223.1/NFPA 54 for proper venting, including influences of other building ventilation and exhausting equipment. 	<p>Complete all applicable actions under the Assessment Protocols AND ensure compliance with applicable codes and standards. Test combustion appliances for proper draft and venting under worst case conditions 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 applicable codes and standards.</p> <p>Note: <i>All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.</i></p> <p>Address depressurization and potential backdrafting problems (e.g., with combustion make-up air, fan interlocks, transfer grilles, jumper ducts, louvered doors or door undercuts) OR disable the exhaust equipment causing the problems.</p> <p>If a whole-house fan is used for cooling at night, advise occupants to open several windows before operating the fan. </p>	<p>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 2010 HVAC Quality Installation Specifications.</p> <p>Relevant Guidance/Standards ACCA 5 QI-2010. EPA Indoor airPLUS Specification 5.1.</p>



PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
VENTED COMBUSTION APPLIANCES <i>(continued)</i>			
	<ul style="list-style-type: none"> For oil-fired appliances and equipment, make this assessment using applicable installation standards, including the Standard for the Installation of Oil-Burning Equipment, ANSI/NFPA 31, the applicable ANSI/UL oil-fired appliance safety standard and manufacturer's instructions. <p>Performance test vented combustion appliances (e.g., boilers, furnaces, space heaters and water heaters) to ensure proper draft under worst case depressurization and perform CO testing.</p> <p>Conduct Combustion Appliance Zone (CAZ) Worst Case Depressurization testing in accordance with BPI-1100-T-2010, Section 7.5, to determine whether there are any combustion safety issues that may result from changes to the building envelope.</p> <p>Note <i>When conducting CAZ testing, a 5 Pa depressurization limit may not be appropriate for all venting conditions. See the BPI CAZ Depressurization Limits table referenced below.</i></p> <p>Relevant Guidance/Standards ANSI Z223.1/NFPA 54. ANSI Z21 Series Standards for Residential Gas-Fired Appliances. BPI-1100-T-2010, Combustion Appliance Testing section. BPI Technical Standards: Technical Standards for the Building Analyst Professional, CAZ Depressurization Limits Table. Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). NFPA 31. NFPA 211.</p>	<p>Relevant Guidance/Standards ANSI Z223.1/NFPA 54. ANSI Z21 Series Standards for Residential Gas-Fired Appliances. ASHRAE 62.2-2010 Section 6.4. BPI-1100-T-2010, Combustion Appliance Testing section. BPI Technical Standards: Technical Standards for the Building Analyst Professional, CAZ Depressurization Limits Table. Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). NFPA 31. NFPA 211.</p>	




PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
	<p data-bbox="172 178 603 204">UNVENTED COMBUSTION APPLIANCES</p> <p data-bbox="426 222 929 335">Identify any unvented gas or kerosene space heaters or vent-free combustion appliances (e.g., fireplaces, cooktops, ovens, kerosene or gas space heaters).</p> <p data-bbox="426 366 929 421">Determine whether any state or local regulations prohibiting these devices apply.</p> <p data-bbox="426 453 929 539">Relevant Guidance/Standards Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6).</p> <p data-bbox="426 553 685 579">State or local regulations.</p>	<p data-bbox="973 222 1482 305">Verify that the kitchen exhaust fan vents to the outdoors. If not, see Source Ventilation (page 21) for recommended actions.</p> <p data-bbox="973 331 1482 501">Identify illegal unvented gas or kerosene space heaters that do not conform to state and local regulations and, with the occupant's permission, remove them as appropriate. If the space heaters are the primary source of heat, replace them with electric or vented, code-compliant heating systems.</p> <p data-bbox="973 522 1482 635">Note: <i>All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.</i></p> <p data-bbox="973 661 1482 890">With the occupant's permission, 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 conformance with ANSI Z21.11.2. Units that are not being operated in compliance with ANSI Z21.11.2 should be removed prior to the retrofit, but may remain until a replacement heating system is in place.</p> <p data-bbox="973 916 1482 942">If the occupant objects to these recommendations:</p> <ul data-bbox="973 947 1482 1524" style="list-style-type: none"> • Provide the occupant with information about the hazards of operating illegal unvented space heaters or operating vent-free appliances contrary to manufacturers' instructions. For example, the manufacturers' instructions may call for open windows because use of the device requires adequate or additional ventilation to remove products of combustion such as CO, nitrogen oxides, CO₂, PM and water vapor.  • For gas-fired unvented space heaters without an oxygen depletion sensor (ODS) shutoff system, suggest the occupant replace with a vented appliance or, at a minimum, consider upgrading the heater to a new model consistent with ANSI Z21.11.2/CSA. • For gas-fired unvented space heaters and vent-free fireplaces that are oversized for the application, advise the occupant of the improper sizing of the appliance. 	<p data-bbox="1532 222 1842 248">This cell is intentionally blank.</p>


(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
UNVENTED COMBUSTION APPLIANCES <i>(continued)</i>			
		<ul style="list-style-type: none"> 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. <p>Relevant Guidance/Standards AHRI. ANSI Z21.11.2/CSA. Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). Source Ventilation (page 21).</p>	
SOURCE VENTILATION			
	<p>Determine whether the home complies with the local exhaust requirements for kitchens and baths of ASHRAE Standard 62.2-2010, Section 5 and Appendix A, as applicable. Determine whether kitchen and bath exhausts are present and vent to the outdoors.</p> <p>Determine whether the home complies with the local exhaust requirements for clothes dryers in ASHRAE Standard 62.2-2010, Section 6. Determine whether clothes dryers vent to the outdoors. (Condensing dryers are exempt.) Inspect or verify that clothes dryer exhaust duct(s) do not discharge into crawlspaces or attics or within walls. Inspect clothes dryer vents for restrictions and lint buildup.</p> <p>Relevant Guidance/Standards ASHRAE 62.2-2010. BPI-1100-T-2010, Indoor Air Quality and Ventilation and Baseload Energy Efficiency sections.</p>	<p>If ASHRAE Standard 62.2-2010 requirements for bathroom, kitchen and clothes dryer exhaust requirements are not met, repair, replace or install local exhaust ventilation to meet the requirements, ensuring ducts are sized, installed and vented properly to the outdoors, OR increase whole-house ventilation airflow to compensate for deficiencies of local exhaust in bathrooms and kitchens using the alternative compliance method (Appendix A of Standard 62.2-2010).</p> <ul style="list-style-type: none"> In multi-family buildings, common spaces should be served by dedicated ventilation systems. Ensure that all clothes dryers exhaust to the outdoors and cannot be readily diverted indoors. (Condensing dryers are exempt.) <p>Relevant Guidance/Standards ASHRAE 62.2-2010. BPI-1100-T-2010, Indoor Air Quality and Ventilation section.</p>	<p>If the home is in compliance with ASHRAE Standard 62.2-2010 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 62.2-2010 requirements, to improve pollutant source removal.</p> <p>For spaces with strong, localized pollutant sources, consider installing additional (dedicated) local exhaust ventilation.</p> <p>Relevant Guidance/Standards ASHRAE 62.2-2010.</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
WHOLE-HOUSE VENTILATION FOR DISTRIBUTED CONTAMINANT SOURCES			
	<p>Determine whether the home complies with the ventilation requirements of ASHRAE Standard 62.2-2010:</p> <ul style="list-style-type: none"> Use Section 4 requirements OR use 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 62.2-2010 requirements. <p>Relevant Guidance/Standards ASHRAE 62.2-2010.</p>	<p>Install additional ventilation measures as necessary to meet ASHRAE Standard 62.2-2010 requirements for whole-building ventilation.</p> <p>If the local exhaust ventilation in bathrooms and kitchens is deficient, use the alternative compliance supplement (Appendix A of Standard 62.2-2010).</p> <p>Relevant Guidance/Standards ASHRAE 62.2-2010.</p>	<p>Install a balanced, whole-house ventilation system (e.g., heat recovery ventilator [HRV]).</p> <p>Relevant Guidance/Standards NAHB Research Center, http://www.toolbase.org. Search “whole-house ventilation” and “HRV” for additional resources.</p>
MULTI-FAMILY VENTILATION			
	<p>Determine ventilation system type (e.g., fan-powered exhaust, fan-powered outdoor supply or a combination of the two) and whether each system serves individual units, each floor or the entire building.</p> <p>Determine whether existing ventilation meets ASHRAE Standard 62.2-2010 requirements using Appendix A – Existing Buildings for each unit. Determine whether all doors between dwelling units and common hallways are gasketed and airtight with weather stripping (except when the ventilation system design requires air transfer from corridors to units). See ASHRAE Standard 62.2-2010 for additional requirements for each dwelling unit.</p> <p>Determine whether ventilation for common corridors meets ASHRAE 62.1-2010 Table 6-1 (0.06 cfm/ft² floor area).</p> <p>Relevant Guidance/Standards ASHRAE 62.2-2010. ASHRAE 62.1-2010.</p>	<p>If each dwelling unit is served by its own ventilation equipment, follow Minimum Actions for Whole-House Ventilation for Distributed Contaminant Sources (page 22) and Source Ventilation (page 21). Be certain to include the sealing measures between dwelling units required in Section 6.1 of ASHRAE Standard 62.2-2010.</p> <p>If multiple dwelling units are served by a single exhaust fan, fan-powered outdoor air, or combination of the two, meet 62.2-2010 requirements, paying special attention to sealing measures in Section 6.1 plus:</p> <ul style="list-style-type: none"> Seal all the holes that can be sealed in the ventilation ductwork. Specify and install a balancing device at each exhaust or supply point that, in combination with a sufficiently high operating pressure, ensures constant continuous ventilation which meets the target ventilation rate during all seasons. Adjust or replace fans so that outlets or inlets have at least 0.2 inches water column (w.c.) pressure difference across the balancing devices in each dwelling unit. Ensure that ventilation systems run continuously or have dampers installed that prevent airflow between dwelling units when the system is off. 	<p>If each dwelling unit is served by its own ventilation equipment, follow the Expanded Actions for Whole-House Ventilation for Distributed Contaminant Sources (page 22) and Source Ventilation (page 21).</p> <p>If multiple dwelling units are served by a single exhaust fan, fan-powered outdoor air, or a combination of the two, meet all the Minimum Actions for Multi-Family Ventilation AND conduct extensive air sealing to compartmentalize each dwelling unit OR design and install individual ventilation systems for each unit to meet the requirements of ASHRAE 62.2-2010 as it applies to new construction.</p> <p>Relevant Guidance/Standards ASHRAE 62.2.2-2010. MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments. NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust. NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems.</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MULTI-FAMILY VENTILATION <i>(continued)</i>			
		<ul style="list-style-type: none"> • Use minimum MERV 6 filters on supply ventilation systems. • In buildings where vertical shafts or ducts and passive rooftop ventilators provide non-fan-powered exhaust to multiple dwelling units, add exhaust fans in combination with the above requirements to provide a more effective ventilation system. <p>Relevant Guidance/Standards ASHRAE 62.2-2010.</p> <p>MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments.</p> <p>NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust.</p> <p>NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems.</p> <p>Source Ventilation (page 21).</p> <p>Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p>	<p>Source Ventilation (page 21).</p> <p>Whole-House Ventilation for Distributed Contaminant Sources (page 22).</p>
SAFETY			
HOME SAFETY			
	<p>Determine whether there are working smoke alarms and CO alarms.</p> <p>Identify knob and tube electrical wiring.</p> <p>Identify harmful chemicals in accessible locations.</p> <p>Check whether there is a fire extinguisher in the home.</p> <p>Determine whether the hot water heater temperature setting is within the allowable limits of the local and state codes.</p> <p>Document other home safety hazards that are observed during the energy audit/assessment/retrofit (e.g., missing handrails, non-intact stairs, insufficient lighting, holes in floors).</p>	<p>Replace non-working smoke and CO alarms. If smoke alarms or CO alarms are not present, install new alarms. If new batteries are used, install 10-year lithium batteries. (It is recommended that CO alarms have a digital display and provide peak level readings.)</p> <p>Correct life-threatening safety risks (i.e., fall hazards) and provide client education on safety concerns. </p> <p>Do not bury unsafe wiring in attic insulation.</p> <p>Relevant Guidance/Standards CPSC Document #466. NFPA 720.</p>	<p>Install CO alarms that can detect and store peak CO levels of less than 30 ppm.</p> <p>Have qualified personnel replace knob and tube wiring in accordance with applicable electrical codes.</p> <p>For households with small children or elderly occupants, discuss scald prevention with clients AND adjust hot water heater set-point to 120 degrees Fahrenheit to prevent scalding.</p> <p>In homes with elderly persons, install grab bars, handrails and lighting as appropriate.</p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
HOME SAFETY <i>(continued)</i>			
	<p>Relevant Guidance/Standards CDC Fall Prevention Checklist. CDC Home Safety Checklists. HUD Notice: Public Housing Assessment System Physical Condition Scoring Process Interim Scoring, Corrections and Republication.</p>		<p>For households with small children, recommend installation of gates at the tops of stairs.</p> <p>Recommend installation of light switches at the top and bottom of stairs.</p> <p>Recommend installation of safety lighting above stairs. Consider energy-efficient LED lighting.</p> <p>Recommend repair of malfunctioning doors, windows, roofs and floors.</p> <p>Recommend appropriate and controlled storage of hazardous chemicals (e.g., strong cleaners, household hazardous materials) and pesticides (e.g., remove from accessible locations).</p> <p>Repair identified safety hazards.</p> <p>Relevant Guidance/Standards ANSI/UL 2034. EPA Design for the Environment.</p>
JOBSITE SAFETY			
	<p>Evaluate existing and potential health concerns and activities. Refer to Appendix A: Worker Protection for recommended evaluation measures and actions. </p> <p>Note <i>By law, employers and supervisors are required to ensure that workers are working with an OSHA written Safety and Health Plan. More details about these requirements and resources are available in Appendix A: Worker Protection.</i></p>	<p>Protect workers and occupants from on-site health and safety hazards by:</p> <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Evacuating building occupants and other unprotected trade workers from the work area. 	<p>For additional information on each of the topics, visit the resources provided under each issue in Appendix A: Worker Protection. </p>

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
JOBSITE SAFETY <i>(continued)</i>		<ul style="list-style-type: none"> • Using appropriate personal protective equipment (e.g., chemical-resistant [nitrile] gloves, appropriate respirator, chemical-resistant clothing) for anyone in work area. • Cleaning the area thoroughly and waiting until the foam cures before allowing unprotected workers or occupants to reoccupy the work area. <p>See Appendix A: Worker Protection for recommended actions to protect worker safety, including available resources. </p>	