



Marshall Fire Mitigation Assessment Team: Homeowner's Guide to Risk Reduction and Remediation of Residential Smoke Damage

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1. Introduction

On December 30, 2021, a wind-driven wildfire affected over 2,000 residential structures and several commercial facilities in unincorporated Boulder County, the City of Louisville, and the Town of Superior, Colorado. Data gathered after the fire indicates that a significant number of additional residential structures experienced damage from smoke and ash infiltration.

Because of the unique nature of the incident, where extreme winds coupled with long term drought, high temperatures, and limited wildfire regulatory adoption, a fast-moving low-intensity grass fire became a highly destructive urban fire directly and indirectly impacting several communities and greater Boulder County area. The Federal Emergency Management Agency (FEMA) deployed its first-ever wildfire Mitigation Assessment Team (MAT) to evaluate building performance during the fire. The MAT was deployed to Louisville, Superior, and unincorporated areas in Boulder County, Colorado, to evaluate damaged homes and commercial structures. MAT members evaluated components and systems of primarily residential structures to determine the effectiveness of various building materials, design, and construction practices for wildfire resiliency. The MAT used the information gathered to evaluate how wildfire-urban interface (WUI) building codes and standards, as well as design, construction, and defensible space practices can be improved to increase community wildfire resilience. This is important as the landscape is continuously evolving due to climate change and putting more communities at risk.

2. Purpose

The purpose of this document is to provide recommendations to homeowners for pre-wildfire measures to help reduce the risk of smoke damage and do-it-yourself (DIY) steps that homeowners can take to remediate light to moderate smoke damage. This document also includes recommendations for selecting and monitoring a professional cleaning services contractor for heavy smoke damage.

3. Key Issues

- **What is Smoke?** Smoke is a mixture of gases including carbon monoxide, carbon dioxide, and other chemicals as well as particulate matter. When smoke from a wildfire dissipates, many of the gases are absorbed into the surrounding air and porous materials, while the particulate matter carried by the smoke settles to the ground and other surfaces as soot and ash. Soot is the remains of incomplete combustion and is composed of small, dark-colored particles measuring 0.1 micrometer in diameter. Ash is the solid remains of a fire and is composed of larger, light-colored particles measuring 1 to 10 micrometers in diameter.
- **What are the Consequences of Smoke Damage?** Smoke can cause significant physical damage as well as health issues, even if the home is not destroyed or burned by fire. Although smoke does not result in the complete loss of structures, contents, or landscaping, it can still result in devastating impacts (e.g., costly cleaning, repair or replacement of materials, displacement of residents, disruption of businesses, health issues). Examples of smoke, soot and ash damage

include soot and ash deposition, unpleasant odors, metal corrosion, plastic deterioration, and staining of materials. If not removed from surfaces in a timely manner, fire residue can permanently etch metal surfaces due to its extreme levels of alkalinity or acidity. Soot and ash can damage porous materials such as upholstery and clothing, making them nearly impossible to clean. Additionally, smoke, soot and ash can lead to a range of health impacts, including respiratory irritation, shortness of breath, worsening of asthma, potential exposure to carcinogens, and other short-term and long-term medical conditions.

- Levels of damaging smoke infiltration into the residence may be reduced if precautions are taken prior to a fire event. Many of the mitigation measures that can be implemented to reduce ember ignition also are effective at reducing smoke and ash infiltration (see Marshall Fire MAT document *Wildfire Resilient Detailing, Joint Systems and Interfaces of Building Components*). Additionally, the impacts of smoke damage can be reduced if timely and effective measures are employed by homeowners after the actual fire danger has passed.
- Although it is nearly impossible to completely eliminate the risk of smoke damage, there is evidence to suggest that homes that are tightly sealed against ember intrusion may also be more effective at limiting smoke damage.

4. Pre-Event Smoke Risk Reduction Measures

This section focuses on short-term measures to reduce the risk of smoke infiltration in the hours prior to a wildfire. You can take additional actions well in advance of a wildfire to protect against ember and hot gas intrusion that also can help protect against smoke, soot and ash infiltration. See Marshall Fire MAT document *Wildfire Resilient Detailing, Joint Systems and Interfaces of Building Components* for additional information.

4.1. Recommended Measures

If a fire evacuation notice is issued, use the Pre-Event Wildfire Evacuation Checklist below to ensure you have packed essential items and confirmed transportation to evacuate. Once this is done, the following specific pre-event measures should be taken within 1 hour of an impending fire or evacuation notice if time and circumstances allow to reduce the risk of smoke infiltration:

- Shut down the heating, ventilation, and air conditioning (HVAC) system by switching off the power at the breaker panel.
- Shut all windows, doors, skylights, and other openings, but leave them unlocked.
- Seal openings like “pet doors” and vents where possible.
- Consider spraying metal fixtures in the bathrooms and kitchen with moisture-displacing lubricant such as WD-40 to prevent flash corrosion due to high / low pH soot residues.
- Cover or move outdoor furniture indoors to protect against smoke, soot and ash.

Pre-Event Fire Preparedness Checklist

In addition to pre-event measures listed above for reducing the risk of smoke and ash infiltration, the following pre-event preparedness checklist is recommended for use within 24 hours of a fire evacuation notice. **Start by getting a notebook or binder and begin a journal of your actions and conversations surrounding this event.** Keeping a log of dates, times, and names of individuals spoken to can be invaluable if your property should become damaged. If you need to file an insurance claim, remember that documentation describing the “who, what, where, when, and why” of activities that support your decisions can be just as important as damage photographs and receipts.

- Identify two or more safe places for evacuation that are well outside the area of potential fire spread.
- Fill vehicles with fuel or fully recharge, or secure transportation to evacuation site.
- Withdraw cash for purchases in the days following the fire.
- Charge cellphones, laptops, other critical electronics, and purchase and charge power banks.
- Pre-pack prescription medications and other valuable items (cash, jewelry).
- Identify and pack critical documents (passports, birth records, insurance binders, social security information). Keep emergency cash with these documents and take it with you.
- Take digital photographs to document valuables and other contents of every drawer, closet, storage container, freezer, and refrigerator.
- Take digital photographs to document the exterior of the house with attention to the roof, yard vegetation around the house, and neighbor's structures.
- Consider packing perishable foodstuffs as wildfires can result in power outages for extended periods of time.
- Consider preparing an Initial Assessment Kit, as described in the text note below, including proper clothing to conduct the assessment (i.e., long-sleeved shirt, long pants, and boots).

5. Steps to Remediate Smoke Damage

5.1. Initial Assessment

Before trying to remediate smoke damage, it is important to conduct an initial assessment of the level of fire and smoke damage to determine what resources will be needed to remediate or repair your home. Once you are allowed by local officials (e.g., fire department, building department, and utility providers) to return to your home and have assembled the necessary items for an Initial Assessment Kit (see side note), perform an assessment as follows:

1. Wear personal protective equipment (PPE) and clothing to protect yourself – including goggles, an N95 or P100 respirator, gloves, long pants, long sleeve shirt, and closed toe shoes.
2. Walk exterior of home and look for obvious signs of fire and smoke damage. Focus particular attention on damaged roofs, overhangs, windows and doors, electrical service and equipment, and damaged HVAC components. Check for signs of smoke and ash buildup on the exterior siding, doors, and windows.
3. If you have found damage to roof, overhang, wall, windows and/or doors, make a note, photograph these areas, and document them for your insurance carrier prior to undertaking any remediation or restoration efforts. Contact a contractor to seal any penetrations as soon as possible to prevent further damage.
4. If any visible damage is noted to electrical service or wiring, or if you suspect a gas leak, do not touch the damaged part, contact your utility company immediately or your electrician. If it is safe to enter the home, turn off the main breaker in your electric panel (see Steps 5 and 6 for details).
5. If any visible damage is noted to your outdoor HVAC components, contact your HVAC contractor. If it is safe to enter the home (i.e., there is no visible fire or smoke damage), turn off the main breaker in your electric panel (see Step 6 for details). If you are unfamiliar with the location and operation of your electric panel, contact an electrician.
6. Enter the home if it is safe to do so wearing PPE (goggles, N95 or P100 respirator, gloves) and check utilities:

Initial Assessment Kit – Items to Bring

- Cell phone
- Camera or cell phone camera
- Flashlight
- Goggles
- Dust masks (N95 or better)
- Rubber gloves
- Hand cleaning wipes
- Box of alcohol wipes
- First aid kit
- Small, clear plastic zip lock bags
- Permanent marker
- Phone numbers for your insurance agent, local utility providers, and contractors (electrician, HVAC, and restoration)

- **Electricity:**
 - If the power is on, be aware of any noises (sizzling or crackling) and burning odors as you turn on lights and use devices. If you notice any of these conditions, shut off the device immediately and call an electrician.
 - If the power is off, and the outside electric service is not visibly damaged, go to your electrical panel and shut off your main breaker and all other breakers. Turn on the main breaker first. One by one, turn on each breaker. If the main breaker or any individual breaker trips, leave that breaker off and contact your electrician.
 - **Natural Gas:**
 - Check with the gas utility to determine whether gas service has been restored and pilot lights have been re-lighted. If it has not been restored, or if pilot lights on gas appliances need to be re-lighted, contact your gas utility company.
 - If a gas leak is detected or suspected, leave, and call 911 immediately, and contact your utility company as soon as possible.
 - **HVAC:**
 - If the air handling system is operating, shut it down until you determine the condition of the home.
 - If the air handling system is not operating, shut off all breakers related to the HVAC system and contact your HVAC contractor.
7. Although not directly related to smoke damage, check refrigerators and freezers for spoiled food from power outages. Remove from the home to minimize odor problems that could mask smoke odors and photo document for possible insurance claim.
8. Walk the entire home and determine the smoke, soot and ash condition of each room.
- **Smoke:** To check for the presence of smoke, simply “follow your nose”. If there is a noticeable smoke odor, then you likely have some level of smoke damage.
 - **Soot and Ash:** To check for the presence of soot and ash, check horizontal surfaces for presence of soot and ash by using a wipe test. To conduct a wipe test, put on a clean pair of gloves and open a small, prepackaged alcohol wipe to wipe a horizontal surface that is unfinished (such as unpainted and unvarnished wood), then check the wipe for the presence of soot and ash. The wipe test will help decide where and how much soot and ash is present, if this is a cleaning project that you can undertake yourself, or if a professional cleaning service will be needed.
- Table 1 provides the categories of soot and ash conditions based on a wipe test and provides a recommended restoration approach. After classifying the soot and ash condition in each room, using Table 1, consider placing each wipe sample in a clear plastic zip lock bag, then label each bag with the date and room where the sample was collected before sealing it.
9. Document all rooms and wipe test results with notes and digital photographs to give to your insurance company. Be sure to keep all original notes and photographs for your file. Consider keeping test wipe samples as well.

Table 1. Categories of Smoke, Soot and Ash Conditions and Smoke Remediation Recommendations

Category	Description of Smoke, Soot and Ash Conditions	Smoke Remediation Recommendation
None	No visible soot or ash on horizontal surfaces, no visible airborne particulate, <u>and</u> no noticeable smoke odor. Wipe test can be used to confirm no soot/ash.	No smoke remediation by homeowner is necessary.
Light	No visible soot or ash on horizontal surfaces and no airborne particulate, <u>but</u> noticeable smoke odor. Wipe test confirms no soot/ash. (No visible soot/ash on exterior siding or windows.)	Homeowner can undertake simple steps to clean the home
Moderate	Presence of light soot and ash on horizontal surfaces (see Figure 1), visible airborne particulate, and noticeable smoke odor. Soot Wipe test shows a light amount of soot/ash. (Soot/ash may be visible on exterior siding and/or windows.)	Homeowner can undertake detailed steps to clean the home if simple cleaning steps are unsuccessful.
Heavy	Presence of heavy soot and ash on horizontal surfaces and floors (see Figure 2), visible airborne particulate, and noticeable smoke odor. Wipe test shows a heavy amount of soot/ash. (Soot/ash likely visible on exterior siding and/or windows.)	Retain a professional cleaning/restoration service contractor if detailed steps to clean the home are unsuccessful.
Other	Visible fire damage to structural elements or contents.	<u>Do not enter home until cleared by the fire department</u> , then keep professional contractor(s) to address structural fire damage and smoke damage.

5.2. Light Smoke, Soot and Ash Damage: Recommended Restoration Steps

For light smoke, soot and ash damage (i.e., where there is only an odor of smoke, but no visible presence of soot or ash), the homeowner can undertake the following four basic restoration steps:

1. **Aerate/Ventilate.** Open all windows and doors to air out the interior of the home. Note: This first step should be avoided if heavy smoke and particulates remain in the air outside.
2. **Filter.** Install a new air filter in your air handling unit with a Minimum Efficiency Reporting Value (MERV) rating of MERV 11 or higher to help filter smoke particles and operate the unit using constant fan mode.

3. **Absorb.** Place activated charcoal bags or containers throughout the home to absorb smoke odors. These bags/containers can be found at most home improvement stores or available online. Avoid the use of odor masking products or perfume-based odor counteractants. These products are not effective at eliminating smoke odors and may result in new odors that are difficult to identify.
4. **Clean.** If the odor is particularly strong in one or more rooms of the home, consider cleaning all absorbent materials in that room(s), such as linens and other fabrics.

If the smoke odor is not removed after completing these four steps, then a deeper cleaning of the residence will most likely be required. After coordinating with your insurance company, review and apply the necessary restoration steps and techniques for moderate smoke, soot and ash damage in the next section for deeper cleaning.

5.3. Moderate Smoke Damage: Recommended Restoration Steps

For moderate smoke, soot and ash damage, where there is a light level of soot on horizontal surfaces and visible airborne particulates (see Figure 1), in addition to a noticeable smoke odor, the homeowner can undertake the following six detailed restoration steps:



Figure 1. Photos of light soot levels associated with moderate smoke and ash damage. (Photos provided by John DiMenno of Romualdi Davidson & Associates and used with permission.)

1. **Protect Yourself.**
 - Wear PPE, including safety goggles and an N95 or P100 respirator, to protect your eyes and lungs from irritation by smoke and ash. Additionally, dress in long-sleeved shirts, long pants, close toe shoes and socks to minimize skin contact.
 - Use extreme caution when cleaning electrical devices and appliances. Make sure to turn off power to these items prior to cleaning, and do not over-wet the devices. Shut down all electronics (televisions, computers, printers, etc.), then HEPA vacuum rather than wet clean surfaces; follow manufacturer's recommended methods and products.
 - Contact your doctor or medical provider about cleaning and use of affected medications and medical equipment. You may need to contact your medical equipment provider for additional assistance.
2. **Stop the Spread.**
 - Keep in mind that if soot and/or ash is visible on hard flooring surfaces, then it is present on carpeted surfaces. Therefore, avoid walking through the home excessively, prior to cleaning, as this will only spread and further embed the soot into the flooring surfaces.

- Do not turn on the air handler for your HVAC system until the bulk of the soot/ash has been removed (see Step 6.) Operating the air handler prior to removing the bulk of the soot/ash throughout the home will only result in spreading the particulate and re-contaminating surfaces that have already been cleaned.

3. Initial Cleaning.

- Start by removing any visible soot/ash or debris from exterior siding and windows. Use a pressure nozzle attached to a garden hose to wash off light soot or ash off exterior siding; consider using a pressure washer to remove any stubborn soot or debris. Clean exterior windows with a gentle mixture of dish soap and water applied with a microfiber towel and be sure to carefully separate clean towels from dirty ones already used.
- Move to the interior and start by cleaning all hard floor surfaces using a damp cloth or cleaning pad sweeper. Note that several passes may be needed to remove all the soot from hard floors.
- Next, clean all carpets using a high-efficiency particulate air (HEPA) filtered vacuum. As with hard floor surfaces, several passes may be needed to remove all soot from carpets.
- Use a clothes washer to clean all bedding, towels, and clothes that have visible soot on the surfaces.
- Clean all soft goods such as couches, mattresses, pillows, pet beds, and plush toys with a HEPA filtered vacuum. Note that several passes may be needed to remove all soot from various soft surfaces.

4. Detailed Cleaning.

- First, damp wipe ceilings and walls using water and a mild detergent or all-purpose cleaner. Start by cleaning high surfaces then work your way downward. Use caution when working on ladders. Prior to cleaning, test clean a hidden area of a ceiling or wall to ensure that the surface will not be damaged by the water and/or cleaner. Note it may be necessary to clean the surfaces multiple times.
- Next, damp wipe hard contents and furniture using water and a mild detergent or all-purpose cleaner. As with ceilings and walls, test clean a hidden area before proceeding to make sure that the surface will not be damaged by the water and/or cleaner. Also note that it may be necessary to clean the items multiple times.
- All dishes, utensils, glasses, which have visible soot can be cleaned in the dishwasher or hand washed using dish soap and warm water. Additionally, you may have to clean items in cabinets, depending on the extent and severity of the soot deposition.
- Use caution when damp cleaning framed and unframed photos and wood furniture as they can easily be damaged by water and cleaning products.
- Most un-opened boxed and canned pantry items can be wiped clean.

5. Discard Unsalvageable Items.

- Food items left open or in partially opened containers such as cereal boxes should be discarded. Photo document all discarded items.

- Consider replacement of baby items, especially pacifiers and baby bottles, as well as medical devices such as oxygen and continuous positive airway pressure (CPAP) masks and tubing instead of cleaning.

6. Clean HVAC System.

- Wipe all HVAC register covers. Be sure to tape a lightweight fabric, such as cheesecloth, over the register prior to starting the air handler.
- Once most of the soot has been removed in the previous steps, install a new air filter in your air handler with a Minimum Efficiency Reporting Value (MERV) rating of MERV 11 or higher to help filter smoke particles, and operate the unit on constant fan mode.
- It is recommended to have all ducts and the furnace professionally cleaned.

5.4. Heavy Smoke Damage: Recommended Restoration Steps

For heavy smoke, soot, and ash damage where there is a heavy amount of particulate on horizontal surfaces as well as visible airborne particulates, in addition to a noticeable smoke odor, the homeowner should take the following six steps to retain a professional cleaning service to conduct the restoration.

1. **Make the Call.** Contact your insurance company and let them know that you will be retaining a professional cleaning service. Your insurance company may have a list of companies from which you can choose.
2. **Select a Contractor.** Research the cleaning companies in your area using the checklist with tips for selecting a professional cleaning service contractor provided below. Using local companies is generally best. Be cautious when working with out-of-town companies, especially after a major disaster.

Checklist for Selecting a Professional Cleaning/Restoration Service

Given the high cost of smoke, soot and ash restoration, it is strongly recommended that you follow this checklist when selecting a professional cleaning/restoration service contractor.

- Get References.** Ask for the names of past customers. Call those customers and ask relevant questions on how their project went. Confirm that the contractor is licensed by the state or county to do the work and has the necessary bonding and liability insurance coverage.
- Discuss Insurance.** Ask the contractor if they work with your insurance company. Call your insurance agent and ask them if they have worked with the prospective contractor.
- Request Certifications.** Ask the contractor for company and employee certifications, such as from the Institute of Inspection Cleaning and Restoration Certification (IICRC) and the Restoration Industry Association (RIA).
- Get an Estimate.** The contractor must provide you with an estimate. Do not begin work on the project without an estimate.

- Review the Contract.** The contractor must provide you with a contract that includes the ***project amount, as well as a start and completion date***. Do not work a contractor who will not provide specific cost and schedule information written into the contract. Make sure to review and understand the terms of the contract and what is required by you, such as payment of your homeowner's insurance deductible.
3. **Sign and Start.** Once a professional cleaning service contractor is selected and the contract is reviewed (see contractor selection checklist), you and the contractor must sign the contract to start the work. *Do not allow the contractor to begin work on the project without a contract signed and dated by both parties.*
 4. **Work with Insurance.** Know who your insurance adjuster is and how to contact them (cell phone, e-mail). Keep in constant contact with the adjuster, as well as your insurance agent, who are your advocates. Be sure you understand how the insurance company will pay for the services rendered by the contractor. Claims are typically paid in installments or with partial payments based on achieving specific milestones. Note that contractors may request a partial payment prior to the start of work on the project. Make sure to discuss this issue with your adjuster prior to paying any funds. Do not pay the contractor in full until the project is complete to your satisfaction (see step 6).
 5. **Monitor Contractor Performance.** Ask who the project manager will be for the restoration work, and obtain that person's contact information, including cell phone and e-mail. Find out the planned working hours of the crew. Many restoration crews typically work weekday shifts from 8 am to 5 pm. Monitor what days the crew worked, how many crew members worked, and the names of the crew members when possible. Be sure to communicate with the project manager on a regular basis during the project. If restoration work requires removal and replacement of insulation or other work that requires a building permit, check to be sure the project manager understands the local permitting requirements. When an issue arises where an aspect of the restoration work is either not in accordance with contract terms or not to your satisfaction, contact the project manager immediately to discuss the situation as well as plan to resolve the issue.
 6. **Finish the Job.** When the work conducted by the restoration contractor is completed to your satisfaction and in accordance with the contract requirements, contact your insurance adjuster and tell them that the project is complete. This will aid the carrier with issuance of final payment as well as closing their file.

6. Resources and Useful Links

FEMA Technical Fact Sheet Series FEMA P-737: *Home Builder's Guide to Construction in Wildfire Zones*. https://defensiblespace.org/wp-content/uploads/2021/01/FEMA_2008_P-737-Home-Builders-Guide-to-Construction-in-Wildfire-Zones.pdf

American Industrial Hygiene Association (AIHA). Technical Guide for Wildfire Impact Assessments for the OEHS Professional. Edited by Enrique Medina. 2018. https://online-ams.aiha.org/amsssa/ecssashop.show_product_detail?p_mode=detail&p_product_serno=1558

Centers for Disease Control and Prevention (CDC). Preparing for Wildfires webpage. <https://www.cdc.gov/disasters/wildfires/beforefire.html>

EMSL Analytical, Inc. Fire & Smoke Damage Testing Pocket Guide. <https://emsl.com/>

International Environmental Standards Organization (IESO)/Restoration Industry Association (RIA) Standard 6001. Evaluation of Heating, Ventilation and Air Conditioning (HVAC) Interior Surfaces to Determine the Presence of Fire-Related Particulates as a Result of a Fire in a Structure. 2012 Edition.

Restoration Industry Association (RIA). <https://www.restorationindustry.org/>

Reviewed.com Article: How to Clean Smoke Damage, Ash and Soot from Your Home. <https://www.reviewed.com/cleaning/features/how-clean-smoke-damage-ash-and-soot-your-home>