



National Institute of
Environmental Health Sciences

Mold Clean-up and Treatment:

Health and Safety Essentials for Workers, Volunteers, and Homeowners





Mold Clean-up and Treatment

Preface

Mold is one of the most widespread hazards that hurricane and disaster clean-up workers may encounter. This booklet was developed by NIEHS as a health and safety resource for workers, volunteers, and homeowners who will participate in disaster clean-up activities to help them understand how to identify and control hazards from mold.

Although mold is the focus of this publication, there are many other common hazards encountered in clean-up efforts. Additional information on hazards found during hurricanes and floods may be found on the NIEHS Clearinghouse website. The Clearinghouse has produced a companion booklet on general safety and health hazards related to hurricanes titled, "Safety Awareness for Responders to Hurricanes, Protecting Yourself While Helping Others." This booklet may be ordered through the Clearinghouse website.

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Website: <http://tools.niehs.nih.gov/wetp/>



Mold Clean-up and Treatment

Intended Audience

The guidance in this booklet is primarily intended for workers, volunteers, and homeowners who engage in small-scale mold clean-up and treatment of flooded or water-damaged homes. A small-scale project is considered to be 10 square feet or less. For projects larger than 10 square feet, the U.S. EPA, U.S. HUD, and U.S. CDC all recommend using a qualified mold assessment and remediation specialist. The NYC Health Department recommends professional specialists for extensive contamination larger than 100 square feet. Contamination size definitions are important because many homeowners and volunteers perform mold clean-up and treatment beyond the recommended level.



Far Rockaway homeowner Cynthia Miot Celestin with a Presbyterian Disaster Assistance team from Massachusetts



Mold Clean-up and Treatment

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List of Acronyms

ACM	Asbestos Containing Materials
CDC	Centers for Disease Control and Prevention
CO	Carbon Monoxide
EPA.....	Environmental Protection Agency
HEPA	High-Efficiency Particulate Air Filter
HHS	U.S. Department of Health and Human Services
HP.....	Hypersensitivity Pneumonitis
HUD.....	U.S. Department of Housing and Urban Development
HVAC.....	Heating, Ventilation, and Air Conditioning
NADCA.....	National Association of Air Duct Cleaners Association
NIEHS.....	National Institute of Environmental Health Sciences
NYC DOH&MH	New York City Department of Health and Mental Hygiene
NYC	New York City
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
VOCs	Volatile Organic Compounds
WETP	Worker Education and Training Program



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Workers' Rights

Both employers and employees have responsibilities

- Employers have a “general duty” to provide a workplace free of recognized hazards
- Employer’s responsibilities also include providing training, medical examinations, personal protective equipment, respirators, and recordkeeping
- OSHA enforces safety and health standards for private sector workers
- About half of the states have OSHA plans that also cover public employees
- Homeowners and volunteers are not covered by OSHA
- OSHA does not have a mold standard



www.osha.gov



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Medical Exclusion

Pre-existing medical conditions **may exclude** people from mold clean-up work.

Unsure? Check with your family doctor.

Specific conditions include:

- Heart and lung disease
- Asthma and allergies
- Immune system disorders or treatments for those with lupus, diabetes, cancer, autoimmune disease, multiple sclerosis, and rheumatoid arthritis

Pregnant women may also be excluded.





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Training

What training should be provided to workers, homeowners, and volunteers?

Training should include the detailed contents in this booklet and its companion training tool or an equivalent program. Training topics that should be addressed include:

- Causes of moisture intrusion and mold growth
- Health concerns related to mold exposure
- The use of appropriate respirators and personal protective equipment
- Mold remediation work practices, procedures, and methods

Additional site-specific training must be provided on protection from site-specific hazards, unique to each worksite. This is determined by an appropriate site-specific hazard assessment and control evaluation.

Training on relevant OSHA standards that details minimum requirements must be met by employers to safely and legally perform associated duties.



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Mold 101

Why should we be concerned with post-flood mold?

Most molds are harmless, but some can cause harmful symptoms and illnesses in susceptible people.

What is mold and what causes it to grow?

- Mold is a type of fungus.
- Molds are naturally found indoors and outside. There are more than 100,000 species of mold. While some useful molds are ingredients in the manufacture of cheese or medicines like penicillin, other molds are dangerous and may cause negative health effects.
- Most molds reproduce by forming spores which are released into the air.
- When spores land on a suitably moist surface, they grow, penetrate porous materials, and release chemicals and damage building materials.



Moldy Building Materials

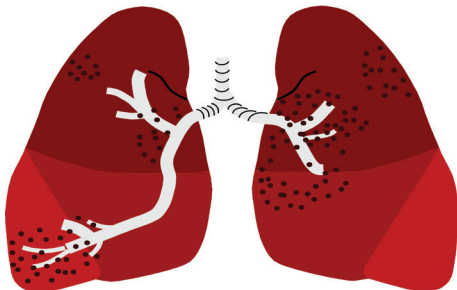




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Exposure

- Exposure occurs primarily by inhaling microscopic mold spores that are suspended in the air.
- Other routes of exposure are skin contact and ingestion.
- Some molds produce mycotoxins, which are suspected of causing severe toxic health effects.
- Mold spore levels in contaminated homes may be more than 100 times greater than outside.





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Symptoms and Main Illnesses

- People who are sensitive to mold may experience eye and nose irritation, nasal stuffiness, coughing, wheezing, and shortness of breath.
- Other symptoms may include skin irritation, infections, and lung scarring.
- Hypersensitivity pneumonitis (HP) is a serious but uncommon, lung inflammation.
- Mold exposure can trigger an asthma attack, a serious event that if left untreated can be fatal.
- Symptoms or illnesses should be reported to personal physicians.





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Site Preparation

WARNING

No site should be entered until it has been fully evaluated and determined to be safe. If there are any doubts, a licensed professional building inspector should be consulted.





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Structural Safety

Look for:

- Severe damage to the structure
- Wood rot, termite damage, or distortion of the structure
- Roofs that sag in the middle or at the ends
- Walls that are not vertical or straight
- A shift in the building where the structure meets the foundation
- Cracks in the masonry exterior of the building





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Building Inspection Postings

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

Foundation needs further evaluation.

Date 11/16/12

Time 2:45 PM

(Caution: Aftershocks since inspection may increase damage and risk.)

Entry occupancy, and lawful use are restricted as indicated below:

Do not enter the following areas: _____

Brief entry allowed for access to contents: _____

Other restrictions: _____

This facility was inspected under emergency conditions for:

(Jurisdiction)

Inspector ID / Agency: _____

Facility Name and Address:

557 Midway

RED = the home is not safe to enter

YELLOW = important warnings

GREEN = it is safe to enter.

*Dennis Braderke PE, MEG
Inspection performed, call
to contact Building Department*



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Raw Sewage

- Flood waters may be contaminated with sewage.
- Raw sewage contamination is commonly referred to as “black water.”
- More than 120 viruses have been identified in human feces and urine. Sewage viruses include: rotavirus, causing severe diarrhea (life threatening in children); hepatitis A, causing gastroenteritis and liver inflammation; adenoviruses, causing respiratory and eye infection; and Norwalk virus, causing gastroenteritis.
- Microbial testing can confirm presence of black water.
- Only trained and properly equipped contractors should clean-up raw sewage.





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Electrical and Natural Gas Lines

If the power supply to the electrical equipment is not grounded or the path has been broken, electrical shock may occur. To ensure safety, confirm that:

- No live electrical lines are on the property or in the house
- The gas line entering the home is turned off
- All electric and gas services in the home are turned off and all main switches and circuits are off

A voltage meter may be used to verify that there is no live current to outlets.





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Water Lines and Plumbing

- The water main should be turned off.
- Water pipes, faucets, sinks, and tubs should be free of leaks.

WARNING: Water should not be used for drinking or cooking, washing food, or clean-up until the utility or public health department has announced that it is safe.





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Ventilation and Containment Techniques

- Before entering a moldy home for the first time, open the front and back doors and windows and allow the house to air out for at least 30 minutes. This will allow the odors and volatile organic compounds (VOCs) produced by molds to be diluted, thereby reducing occupants' exposure.
- The building should be ventilated every time mold clean-up and treatment work is conducted.
- A high-powered exhaust fan should run in the work area to provide ventilation and to prevent infiltration of airborne mold into adjoining spaces.
- **Exercise good judgment:** exhaust fans should not be placed in a window that is too close to a neighbor's window.





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Containment

- Poly-Sheeting to cover doorways and to seal areas
- Fans to move air outside of work area (exhaust)





Mold Clean-up and Treatment

Containment: Creating a Poly Flap Seal

- It is important to keep clean areas separate from the work areas to minimize the risk of contamination.
- Separate the storage and non-contaminated areas from the work areas by hanging plastic sheeting.
- First, set up a plywood pathway throughout the house, especially if there was damage to floorboards or the flooring has been removed. Use 2' x 8' plywood sheets to build the walkway.
- Follow these steps to set up the containment:

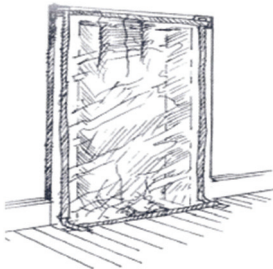
Reinforce all staple points illustrated in the next three slides by covering them with duct tape.



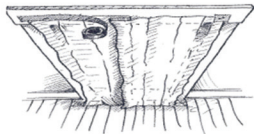
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Step 1

- Cover door with 6 mil plastic.
- Staple all four corners.
- Leave several inches of slack on all sides.
- Use masking tape around perimeter once corners are secured.



slack at top of door





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Containment: Creating a Poly Flap Seal

Step 2

- Cut slit from approximately 5" from floor to about 5" from door head.
- Add duct tape on top and bottom of cut for reinforcement.
- Seal poly to floor with duct tape and staples.



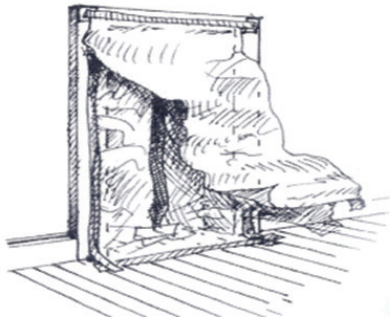


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Containment: Creating a Poly Flap Seal

Step 3

- Place second sheet (2 or 3 mil poly) on side of opening that breeze is coming from so breeze closes flap.
- Tape it to the top of door and let it hang just short of floor.

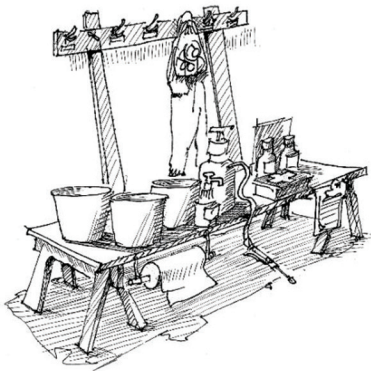




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Establish a Safety and Clean-up Area

- The clean-up area will be used as a place to wash up before taking a break and at the end of the day before going home. The clean-up area will also be used to treat minor accidents, such as cuts and punctures.
- The clean-up area should be set up outside of the home.
- Essential items for the clean-up area include:
 - First aid kit, clean-up buckets and a scrub brush
 - Soap, hand sanitizer, and an eye wash station
 - A list of emergency phone numbers
 - Bottled drinking water
 - Paper towels and trash bags





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Basic Precautions

- Don't smoke or eat at the worksite.
- Don't rub your eyes, nose, or mouth.
- Protect yourself from direct sun and heat stroke.
- Take breaks and drink water frequently.





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Teamwork and Communication

- Teamwork is key to safety.
- A buddy system may be appropriate.
- It is advisable to assist a coworker with donning and removing Personal Protective Equipment (PPE).
- Strains and sprains may be avoided by working together on heavy or awkward work.
- Communication is key to avoiding errors and conflicts.





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Fatigue and Traumatic Stress

- Exposure to the disaster zone and the work can cause stress reactions.
- Pace yourself and take frequent rest breaks.
- Watch out for each other. Coworkers may not notice a hazard nearby or behind.
- Be conscious of those around you. Those who are exhausted, feeling stressed, or even temporarily distracted may place themselves and others at risk.
- Maintain as normal a schedule as possible: regular eating and sleeping are crucial.
- Be sure to drink plenty of fluids, such as water or sports drinks.
- Be sensitive to people living in the disaster zone who may be upset or traumatized by the devastation to their homes and disruption in their lives.
- Don't hesitate to ask for help if you need it.





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OSHA Hazard Communication

- The OSHA Hazard Communication standard gives you the right to know about the chemical hazards on your job and ways to protect yourself.
- The OSHA Hazard Communication Standard, 29 CFR 1910.1200 requires all employers to train workers about the chemical hazards that they will be exposed to on the job, prior to their work assignment.
- All workers must be trained about potential health effects, routes of exposure, protective measures, chemicals that should not be mixed together, and how to identify and handle chemicals with which they work.
- Chemicals used in mold clean-up and remediation may include cleaning agents, bleach, biocides, and solvents.





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Asbestos

- **WARNING!** Homes that were built before 1970 may contain asbestos.
- Asbestos is commonly found in insulation for pipes, furnaces, and boilers. It can also be in vinyl floor tiles, floor coverings, mastic, sprayed-on ceiling insulation, roofing shingles, felts, tars, and siding shingles.
- Floor tiles that are 8" x 8" or 9" x 9" often contain asbestos.
- Asbestos is hazardous when it is broken and reduced to tiny particles, also called friable. People are at risk when they breathe in asbestos fibers.
- Exposure to asbestos increases the risk of lung cancer, asbestosis, and mesothelioma. Symptoms usually do not appear for several years or decades.
- If material is suspected of containing asbestos, it must be evaluated by a qualified professional. Any material that contains more than 1% asbestos is considered asbestos containing material (ACM).





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Asbestos *continued*

- Removal of ACM requires that certified, trained personnel follow detailed procedures in applicable regulations to protect workers and building occupants.
- The OSHA standards for asbestos for general industry and construction are 29 CFR 1910.1001 and 1926.1001. Once asbestos has been identified, OSHA standards apply.





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Lead-Based Paint

- Homes constructed prior to 1978 may contain lead-based paint.
- The most common source of lead poisoning in children is from ingesting contaminated dust and soil. Peeling paint may be a source of lead dust.
- Lead poisoning can cause problems with high blood pressure, fertility, digestion, joint pains, and memory loss. Lead can cause learning disabilities in children and miscarriages in pregnant women.
- Cover all areas that might be contaminated by paint debris with plastic sheeting.
- If you suspect lead is present, hire a qualified professional to test and remove it.
- **Warning:** No one should attempt to handle lead dust unless fully certified, licensed, and equipped to do so.





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Carbon Monoxide

- Pictured is a gas-fueled power washer being used inside a building, emitting carbon monoxide (CO).
- CO is an odorless, colorless, and toxic gas that can cause illness and death.
- At lower levels of exposure, CO causes mild effects often mistaken for the flu. Symptoms include headaches, dizziness, disorientation, nausea and fatigue.
- Sources of CO include generators, heaters, and power washers or any gas, kerosene, or propane fueled equipment.
- Never use fuel-powered equipment indoors. CDC recommends keeping fuel-generated equipment at least 20 feet from doors, windows, or any other building opening.
- In the aftermath of Hurricane Sandy, nine deaths were reported due to CO poisoning.



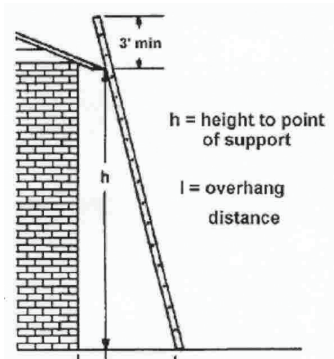


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Ladder Safety

Using ladders improperly is dangerous!

- Ladders are often necessary for removing moldy materials, such as dry wall or ceiling tiles.
- Using ladders improperly is dangerous.
- Ladders should never be placed on an uneven or slippery surface.
- Ladders should be inspected for cracks and broken or defective parts.
- Place ladders to avoid electrical wires.
- Ladders should be positioned at a 75 degree angle to extend at least 3 feet above the landing.
- **Warning:** Ensure weight on the ladder does not exceed its design capacity.



The base of a straight ladder should be one foot out of every four of height to the base of support.



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Visual Mold and Moisture Assessment

The goal of the exposure assessment is to determine the extent of the moisture and mold growth problem and to develop a safe and effective site-specific work plan.

- The assessment should not be undertaken until the safety of the building has been fully addressed.
- Talking to the homeowner and doing a visual assessment are the most important initial steps.
- Look for standing water, water damage and signs of mold growth.
- Mold is often hidden in materials, so check behind wallboard, carpet backing and padding, wallpaper, under moldings and flooring, insulation, and hollow bore doors.
- The inspection should include an evaluation of crawl spaces and attics.





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Identification of Mold

- Signs of a possible mold problem may include a musty or earthy odor, staining, discoloration on walls or surfaces, and fuzzy growth on building materials and furnishings.
- Mold may appear as cottony, velvety, granular, or leathery growth and may be many different colors.





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Hidden Mold in Hollow Bore Door



Close-up



Mold on the Back of Drywall





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Hidden Mold on the Bottom of Plywood Flooring





Wet Moldy Insulation





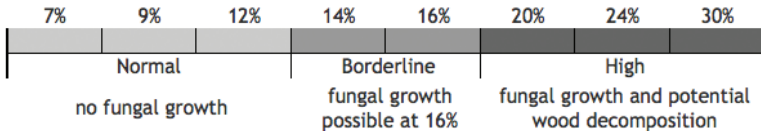
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Moisture Meters

Moisture meters are used to measure moisture levels in building materials. Mold will begin to accumulate on surfaces that contain approximately 20% moisture, although this value varies based on the type of meter and the material being tested.



Wood Moisture Content (for a typical softwood)

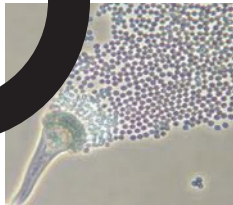




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Mold Testing

- Testing is generally not necessary to identify water damage and mold growth or to develop an effective clean-up and treatment plan. A visual assessment is usually sufficient.
- There are no industry standards for environmental sampling of mold. Testing can be expensive and difficult to interpret.
- In some cases, air sampling may be useful when conducted by a qualified professional to determine whether a mold remediation project has been successfully completed or when there are concerns about safe occupancy for persons with allergic sensitivities or other health problems.





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Does the amount of contamination matter?

The potential for harmful exposure increases with the amount of contamination. The assessment should characterize the extent of mold growth. There is not a standard regarding categories of mold contamination.

The CDC, HUD, and EPA recommend mold assessment and remediation professionals when contamination is greater than 10 square feet.

The NYC Health Department recommends using professionals when contamination is greater than 100 square feet. They all indicate that any mold clean-up project that is 10 square feet or less may be performed by trained maintenance personnel, volunteers, or homeowners.

- Level 1: Small Area – 10 ft² or less
- Level 2: Mid-Sized Area – >10 ft² to 30 ft²
- Level 3: Large Area – >30 ft² to 100 ft²
- Level 4: Extensive Contamination – >100 ft²

Many homeowners and volunteers perform mold clean-up and treatment beyond the recommended level despite strong recommendation not to do so.



Mold Clean-up and Treatment

Selecting a Contractor or Inspector

- Some states require licensing of mold remediation contractors.
- A trained professional may be employed to assess the extent of the moisture problem and mold growth and develop a site-specific work plan. The professional may provide oversight during remediation to ensure quality work and compliance with the work plan.
- Ask for 5 references for similar work and check them for customer satisfaction
- Obtain at least 3 price quotes.
- Require the contractor provide a written proposal that includes:
 - A detailed scope of work
 - A detailed plan for occupant and worker protection and for isolating the work area.
 - A provision that final payment depends on a satisfactory 3rd party final inspection that documents no visible mold, no mold odors, and 17% or less moisture content as read by a moisture meter.



Mold Clean-up and Treatment

Selecting a Contractor or Inspector *continued*

- Require contractor to provide proof of insurance naming the property owner as insured, as well as general liability, contractual liability, and pollution (mold) liability.
- The final inspection report should be performed by a qualified person who is completely independent of the mold clean-up contractor. This report assures that it is safe to rebuild and may also be used with prospective buyers when homes are being sold.
- **Warning:** Do not allow contractors to use chemical foggers or sprays to kill mold. Moldy materials must be removed, not disinfected.



Mold Clean-up and Treatment

Personal Protective Equipment (PPE)

Use:

- Heavy, waterproof, cut-resistant **gloves** to protect hands from cuts, chemicals, temperature extremes, and abrasions. A glove liner may make it easier to wear and remove gloves.
- **Goggles or safety glasses with side shields or a full-face shield.** Debris, dust, and foreign objects could cause eye or face injuries. Vented goggles are appropriate except when there is a potential for splash or vapor exposure.





Mold Clean-up and Treatment

Personal Protective Equipment (PPE) *continued*

- **Work boots** that have a steel toe and insole. Footwear should be non-skid and water-resistant or water-proof. Clean and bag them at the end of the day.
- A **cap with a brim or other protective head cover**. A hard hat should be used if there is any danger of falling debris such as ceiling or overhead drywall removal.
- Breathable, **disposable coveralls** with elastic wrists and ankles.
- Disposable **earplugs or earmuffs** to reduce exposure to noise. Clean-up and demolition work can create hazardous noise levels.





Mold Clean-up and Treatment

Respiratory Protection

Warning: failure to wear an appropriate, fit-tested respirator places a person at high risk of inhaling allergens and toxins from mold and other construction dust.

N95–Disposable Dust Respirators

- Minimum recommended protection
- Lightweight and easy to use
- Requires no maintenance



Half-face, reusable with P100 filters

- Provides greater protection, better seal
- Requires regular inspection, cleaning and maintenance



Full-face

- Also protects the face and eyes





Mold Clean-up and Treatment

Respiratory Protection *continued*

- OSHA, CDC, EPA, and NYC DOH & MH recommend using a N95 disposable respirator as minimum protection from mold and dust.
- A half-face or full-face elastomeric respirator with a N, P, or R100 cartridge will provide greater protection and a better facial seal and should be considered when mold contamination is more than small scale. The full-face also protects the face and eyes. These respirators require cartridges described on a later page.
- OSHA requires employers to evaluate respiratory hazards and base the selection of respirators on the amount and type of contamination that is present.

Warning: Selection of respirators for protection against specific chemicals should be done in consultation with a qualified industrial hygienist.



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OSHA Respiratory Requirements

- OSHA requires that whenever an employer requires respiratory protection, there must be a medical evaluation to determine that the worker can wear a respirator without compromising his or her health.
- Usually, this is done by a medical questionnaire administered by a healthcare worker under the supervision of a physician. A physician exam is given to those who indicate conditions that may prevent them from wearing a respirator.
- If workers have heart or lung disease, facial scarring, asthma, or other pre-existing medical conditions, they **may be excluded** from wearing a tight fitting, air purifying respirator, such as those that are used for mold-related work.
- Although volunteers and homeowners are not covered by OSHA, medical clearance is equally important for their well-being.





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Fit Testing

- OSHA requires employers to conduct a fit test procedure to verify that a respirator is comfortable and correctly fits the user.
- Two different types of fit testing can be performed by a trained person.
 - In a **qualitative test**, a test substance is used to challenge the wearer's sense of taste, smell, or involuntary cough (irritant smoke).
 - A **quantitative test** uses an instrument to measure particles inside and outside of the respirator in order to verify the respirator's fit.
- OSHA requires employers to provide multiple makes, models, and sizes of respirators to ensure a proper fit.
- Fit testing must be done on each model of respirator that will be used before the work begins.
- OSHA has specific procedures for conducting qualitative and quantitative tests that should be followed to ensure an acceptable fit.
- Higher than expected exposures may occur if users have poor face seals.
- A fit test only qualifies the user to put on the specific brand, make, model, and size of respirator with which an acceptable fit testing result was achieved.



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Change-out of Respirators and Cartridges

How often should respirators be changed?

- If disposable respirators are used, they should be replaced at least daily.
- All respirators should be changed if they become damaged.

How often should cartridges be changed?

- Particulate cartridges should be changed if they become damaged or soiled or if it becomes difficult to breathe through them.
- Cartridges for gases and vapors require a specific cartridge change-out schedule to be calculated by an industrial hygienist. These cartridges collect contaminants by adsorption onto activated carbon. Contaminants will break through these cartridges depending on factors such as the amount of contaminant in the environment, relative humidity, temperature, and work activities.



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Disposable Respirator User Seal Check

- Once a fit test has been completed, a user seal check should be done by the user every time the respirator is to be worn so as to ensure an adequate seal.
- A seal check is a procedure conducted by the respirator wearer to determine whether the respirator is properly sealed to the face.

User seal check

1. Cup both hands over the front of the mask to cover the filter and inhale. Do not push on the mask.
2. Check to see whether the facepiece pulls in toward your face.
3. If the facepiece is drawn in and no air leaks, there is a proper fit. If any leakage of air is detected, try readjusting the nosepiece and/or the straps until a good fit is achieved.



Photo courtesy of
IUOE National HAZMAT Program



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Full-face, Half-face Respirator User Seal Check

Positive pressure seal check

1. Block the exhalation valve with the palm of your hand.
2. Gently exhale and hold for about 10 seconds.
3. Check to see if the facepiece is bulging slightly.
4. If the facepiece remains bulging and there are no air leaks between the face and the facepiece, the respirator fits properly. If leaks are detected, readjust the straps and check again for a proper fit.



Photo courtesy of Gempler's



Mold Clean-up and Treatment

Full-face, Half-face Respirator User Seal Check

Negative pressure seal check

- Block the cartridges/filters with the palms of your hands.
- Gently inhale and hold for about 10 seconds.
- Check to see if the facepiece is collapsing slightly.
- If the facepiece remains collapsed and there are no air leaks between the face and facepiece, the respirator is properly fitting. If leaks are detected, readjust the straps and check again for a proper fit.



Photo courtesy of Gempler's



Mold Clean-up and Treatment

Respirator Maintenance and Cleaning

- Clean respirators after each use with non-alcohol wipe pads that can be obtained from respirator vendors. Alcohol can degrade elastomeric respirators.
- Disassemble the respirator.
- Inspect the parts and replace any that are damaged or worn.
- Wash reusable face pieces with a mild disinfecting soap. Rinse and air dry before storing.
- Do not use strong cleaning agents and solvents. They can damage rubber or plastic respirator parts.
- Clean the inhalation and exhalation valves in a mild soap solution.
- Air-dry the parts that have been cleaned. They must be completely dry before they can be reassembled.
- After reassembling, check seals and gaskets for tightness and leaks.
- Wash hands before and after cleaning.



Mold Clean-up and Treatment

Storing Respirators

- Before storing respirators, clean them and let them dry. Store them as soon as they are dry so they do not collect dust.
- Store clean, dry respirators in a zip-sealed plastic bag.
- Store cleaned respirators separately from cartridges.
- Store respirators in a cool, dry place specifically designated for storage.
- When stored, position the respirator so that it keeps its natural shape.
- Exhalation valves and facepieces should lie in a normal position to prevent the plastic or rubber from becoming deformed.
- Store respirators to protect them from dust, sunlight, extreme heat or cold, excessive moisture, and damaging chemicals.





Mold Clean-up and Treatment

Decontamination and Clean-up

It's a good idea to stand in a garbage bag so that gloves, Tyvek® suits, and disposable respirators can be directly disposed of after they are removed.

- Contaminated PPE can pose a health risk. Decontamination procedures are critical whenever working with hazardous materials.
- OSHA has specific requirements (29 CFR 1910.120 (k) and 1926.65 (k)) for decontamination of employees and their PPE in locations where potential for exposure to hazardous materials exists.
- Tools used on the job should be decontaminated first.
- Gloves and disposable coveralls should be removed and bagged for disposal.
- Respirators should be cleaned and stored.
- Boots should be cleaned, bagged, and stored.
- The final step is hand and face washing with soap and water.



Mold Clean-up and Treatment

What is the work sequence?

After it has been determined that it is safe to enter:

- **Removal** of salvageable possessions
- **Muck-out** of dirt, sand, debris, and damaged possessions
- **Gutting** of all damaged building materials
- **Mold cleaning** and treating all remaining building components for mold
- **Drying and dehumidification**
- **Rebuilding**

See the NIEHS Disaster Recovery Mold Remediation Guidance at https://tools.niehs.nih.gov/wetp/public/hasl_get_blob.cfm?ID=9795 for details on what possessions are salvageable and how to handle them.



Mold Clean-up and Treatment

Muck Out

What possessions are non-salvageable?

- Porous items, such as upholstery, textiles, clothing, carpeting and padding, rugs, papers, and books, as well as other items that were submerged, became wet, or display significant visible mold growth should be discarded.
- To the extent practical, items for disposal should be placed in heavy duty trash bags to limit the potential for exposure to sanitation workers who will be handling the trash.





Mold Clean-up and Treatment

What is gutting?

Gutting is the removal and disposal of moldy and flood-saturated non-structural porous building components, including sheetrock and all underlying insulation, plaster walls and ceilings, wood lathe behind plaster, non-structural wood studs and floor sills, wood flooring laid on sub-flooring, sub-flooring, cabinetry and trims, vinyl flooring, submerged window components, and water damaged ductwork and air handlers.

When is gutting necessary?

- In homes where water flooded finished basements and floors and where wet furnishings and sheetrock were not promptly removed.
- Gutting is the ultimate mold remediation project and should be performed only by qualified mold remediation personnel. An exception is when gutting takes place within 24-48 hours, prior to mold growth.

Refer to the NIEHS Disaster Response Mold Guidance for details on removal of sheetrock, plaster, wood trim, doors, frames, and moldings. It also details removal of floors, cabinetry, and ceramic and vinyl flooring.



Gutting





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Mold Clean-up and Treatment

Gutting





Mold Clean-up and Treatment

Mold Treatment

- Mold treatment is cleaning structural wood building components and other building components that are not readily removable and replaceable.
- Cleaning of moldy surfaces with detergent and borax is effective and less toxic than using biocides or bleach.





Mold Clean-up and Treatment

Biocides Are Not Necessary!

WARNING: The use of bleach is discouraged because its reaction with many household products poses a risk to users. However, its use is recommended for treating non-porous and semi-porous surfaces affected by contaminated water.





Mold Clean-up and Treatment

Reasons Not to Use Biocides

- Many biocides are **corrosive** and can damage wood and building materials.
- Biocides, by definition, are **poisons** and must be used with caution.
- Biocides are almost always water-based and **reintroduce water** to the wood.
- Biocides may kill mold and spores, but they **don't remove or clean them** from the wood surface. Only scrubbing does this.
- Biocides are often **incompatible with other household products**. For example, chlorine bleach reacts with household ammonia to produce trichloramine, a strong respiratory irritant responsible for many deaths in the U.S.
- Biocides offer a **false sense of protection**. Homeowners think the problem is solved. It's not.
- Biocides are **a surface treatment only**. The mycelium of mold penetrates into wood and is untouched by the biocide.
- Biocides are **NOT 100% effective**. Assume an active colony of 1 million spores per square inch, then a biocide that is 99% effective will leave 10,000 spores alive to continue contamination.
- Biocides are **expensive** and used by contractors to pump up costs.



Mold Clean-up and Treatment

Cleaning Structural Wood

- Structural wood—such as studs, sill plates, floor and ceiling joists, and sheathing—displaying mold growth should be bristle brushed with a detergent solution (dishwashing liquid). Some experts also recommend mixing a borate with the detergent.
- Treating the wood with a borate product after the wood is dry may also provide protection against mold, termites, and other pests. Certified pest control applicators may also treat the wood with borates to provide protection against both insects and mold.
- Cleaning and treatment should be done with low-toxicity products that are not hazardous to workers who use them.
- Similarly, many commercially available products are no more effective than detergent and borax, but may have greater toxicity.
- When the wood is completely dry, some mold remediation contractors may also paint the wood with a low-toxicity fungicidal protective coating encapsulant. However, in future flooding events, wood coated with an encapsulant may dry much more slowly and be more vulnerable to wood rot.



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Mold Clean-up and Treatment

Cleaning Structural Wood





Mold Clean-up and Treatment

HEPA Vacuums

- HEPA stands for high-efficiency particulate air filter.
- These vacuums are especially designed to remove contaminated dust.
- Regular vacuum cleaners will stir up dust into the air.

If you have a HEPA Vacuum:

- and the mold is dried out...
 - then vacuum surfaces
 - and then wet, scrub, and remove
- and the mold is fresh/wet...
 - then wet, scrub, and remove
 - and after all is visibly clean, HEPA vac the entire area.

If you do not have a HEPA vacuum:

- then wet, scrub, and remove





Mold Clean-up and Treatment

Dehumidification and Drying

Dry out area thoroughly before rebuilding. This can take weeks...

- After cleaning and treating the structural wood and before rebuilding, all interior wood studs, floor sills, sheathing and joists must be dry to prevent mold conditions from recurring.
- Dehumidifiers work best in warm conditions (80°F+) and in conjunction with fans to move humid air away from wet surfaces.
- Drying can generally be accomplished in 4 to 7 days when performed properly.
- Use a moisture meter to determine whether wood is dry enough (17% or lower) to commence rebuilding.





Mold Clean-up and Treatment

Drying or Venting

Dehumidifiers are the best.

- Large 65 pint
- Full speed, dryest setting
- Middle of room
- Elevated, if possible
- Windows closed



If you have no dehumidifiers, then

- Use heaters
- Use small fan for window
- Use large box fan for room circulation
- Create negative pressure (air goes out)
- Heat then vent
- Heat + Circulation + Exhaust = Success!





Mold Clean-up and Treatment

Moisture Meter Readings to Verify Drying

- Check with manufacturer's instructions on the level of acceptable moisture in various building materials.
- Generally, should be Less than 17%





Mold Clean-up and Treatment

Crawl Spaces

What are the dangers of crawl spaces?

- Access may be difficult and limited; these spaces are typically dark and dirty.
- They also pose a source of water intrusion and therefore, mold growth.
- Typically a vapor barrier is put in place to prevent water intrusion.

OSHA defines a confined space as meeting three conditions:

- The space is large enough and so configured that an employee can bodily enter and perform assigned work.
- The space has limited means for entry or exit.
- The space is not designed for continuous human occupancy.



Crawl Spaces *continued*

OSHA classifies a permit required confined space must meet one of the conditions below:

- Contain or have the potential to contain a hazardous atmosphere.
- Contain material that may cover up the entrant.
- Have an internal configuration that may trap or asphyxiate entrant, such as the walls or floor.
- Have any other recognized safety or health hazard.

If the crawl space meets these definitions, it should not be entered without following the extensive requirements in the OSHA confined space standard, 29 CFR 1910.146.



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Mold Clean-up and Treatment

Crawl Spaces





Mold Clean-up and Treatment

Exterior of Buildings

- In brick homes, the underlying plywood and fiberboard on the exterior side of the structural wall studs frequently supports substantial mold growth. In such cases, the accessible surfaces of the sheathing should be HEPA vacuumed and cleaned with a bristle brush and detergent solution, then treated.
- In homes that were partially submerged in flood waters, the materials on the exterior face of the building can also be expected to have sustained mold growth. However, it is recognized that accessing these surfaces and the spaces between the structure and the siding would require substantial dismantling of building components and may not be economically feasible.

How should painted brick and painted cement be treated?

- HEPA vacuum to remove deposits. Then wet wire brush with a detergent solution to remove discoloration.
- The water in storm-related flooding may contain sewage, bacteria, and viruses. Therefore, non-porous surfaces, such as ceramic tile, and semi-porous surfaces, such as concrete and brick, should be cleaned and then disinfected with a solution of one cup of bleach to two gallons of water.

WARNING: Never mix bleach with ammonia.



Mold Clean-up and Treatment

Cleaning Heating, Ventilation, and Air Conditioning (HVAC) Systems

- Remove and dispose of all ductwork and air handling equipment that was submerged.
- Inspect non-submerged air handlers and ducts for visible mold.
- Fiberglass insulation on the interior surfaces of air handlers and air supply ducts is highly susceptible to mold growth and should be removed.
- The interior surfaces of flexible duct are also highly susceptible to mold growth, and any flexible duct displaying visible mold growth should be replaced.
- A qualified HVAC engineer should be employed to determine the proper methods for cleaning and repairing HVAC systems. A National Association of Air Duct Cleaners Association (NADCA) certified professional should conduct any HVAC cleaning. This is especially important as improperly cleaned ventilation systems can spread spores throughout a building.



Mold Clean-up and Treatment

Why This Booklet Was Created

This booklet was created by the National Clearinghouse for Worker Safety and Health Training under a contract with the NIEHS Worker Education and Training Program (WETP). WETP has trained more than two million emergency responders and hazardous waste workers since 1987 to do their jobs safely. WETP is a part of the U.S. Department of Health and Human Services (HHS), which is a cooperating agency under the Worker Safety and Health Support Annex of the National Response Plan and under the National Disaster Recovery Framework. Recovery efforts following Hurricane Sandy prompted the need for guidance for those engaged in mold remediation. Additional materials pertaining to the health and safety of those cleaning up following hurricanes and floods are available at <http://tools.niehs.nih.gov/wetp>.

If you are in need of training in mold remediation, please contact one of the NIEHS grantees.



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Resources and Credits

- Guidance for Clinicians on the Recognition and Management of Health Effects related to Mold Exposure and Moisture Indoors. Eileen Storey, et al., 2004 <http://oehc.uchc.edu/clinser/mold%20guide.pdf>
- Mold Clean-up Guidance for Residents Whose Homes Have Been Flooded during Hurricanes and Other Natural Disasters, Bill Sothern and Ray Lopez and the National Center for Healthy Housing (www.nchh.org)
- Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold. NIEHS and the National Clearinghouse for Worker Safety and Health Training operated by MDB, Inc., 2005, http://tools.niehs.nih.gov/wetp/public/hasl_get_blob.cfm?ID=2034
- Rebuild Healthy Homes, Safe Rehabilitation of Hurricane Damaged Homes Student Guide. U.S. Department of Housing and Urban Development, Consolidated Safety Services, http://www.hud.gov/offices/lead/library/misc/HUD_CSS_Booklet.pdf
- Creating a Healthy Home: A Field Guide for Clean-up of Flooded Homes. National Center for Healthy Housing, 2008, <http://www.extension.uconn.edu/documents/CreatingAHealthyHome.pdf>



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- Rebuilding Water-Damaged Homes, A Manual for the safe, healthy, green, and low-cost restoration of housing, Alliance for Healthy Homes, 2009, http://portal.hud.gov/hudportal/documents/huddoc?id=afhh_water_damaged.pdf
- *U.S. EPA Mold Course*, <http://www.epa.gov/mold/moldcourse/>
- IICRC S520 - 2008, Standard and Reference Guide for Professional Mold Remediation, 2nd Edition
- NIOSH Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings <http://www.cdc.gov/niosh/docs/2013-102/>



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Additional Credits

- CPWR – The Center for Construction Research and Training
- Hunter College and the University of Medicine and Dentistry of New Jersey for use of their photos and slides
- World Cares Center, Inc., for access to their operations



Notes



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