National Institute of
Environmental Health Sciences

NIEHS Disaster Recovery

MOLD REMEDIATION GUIDANCE

Health and Safety Essentials for Workers,
Volunteers, and Homeowners

Photo courtesy of Jonathan Rosen

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Preface

Mold is one of the most widespread hazards that hurricane and disaster clean-up workers are likely to encounter. This guidance was developed by the National Institute of Environmental Health Sciences (NIEHS) as a health and safety resource for workers, volunteers, and homeowners who will participate in hurricane and disaster response and clean-up activities to help them understand how to identify and control hazards from mold. Trainers may use this guidance to aid in the development of a mold remediation awareness level course or other awareness level materials such as fact sheets and table-top activities.

Although mold is the focus of this publication, other common hazards encountered in clean-up efforts that merit mention include oil and chemical spills or leaks, debris, unstable work surfaces, electrical lines, sewage, asbestos, and lead. In addition, equipment used for clean-up work may pose hazards, particularly to people not properly trained to use it. Additional information on cleaning up from hurricanes and floods may be found at the **Hurricane Sandy Page of the NIEHS website**. The NIEHS Clearinghouse has produced a companion booklet on general safety and health hazards related to hurricanes and disasters entitled, "Safety Awareness for Responders to Hurricanes, Protecting Yourself While Helping Others." This booklet is available from **the website**.

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Intended Audience

The guidance in this document 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. Environmental Protection Agency, U.S. Department of Housing and Urban Development, and U.S. Centers for Disease Control and Prevention all recommend using the services of a qualified mold assessment and remediation specialist. The New York City Department of Health & Mental Hygiene 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. Please see pages 10-11 for more information about mold contamination definitions and assessment procedures.

NIEHS WETP Background

National Institute of Environmental Health Sciences Worker Education and Training Program (NIEHS WETP) maintains a major responsibility for initiating a training grants program, as provided by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The primary objective of the WETP is to provide funding support to non-profit organizations with demonstrated track records of providing occupational safety and health education to develop and deliver high quality training to workers who are involved in handling hazardous waste or respond to emergency releases of hazardous materials. Since its inception in 1987, the NIEHS WETP has worked to develop a strong network of non-profit organizations committed to protecting workers and their communities by delivering high-quality, peer-reviewed safety and health training to target populations of hazardous waste workers and emergency responders. Since 1987, over 2 million workers have received NIEHS supported safety and health training. More information about the NIEHS WETP can be found on the WETP website at: http://www.niehs.nih.gov/careers/hazmat/index.cfm.

The NIEHS WETP provides support through the following program areas:

Hazardous Waste Worker Training Program (HWWTP)
The HWWTP provides model occupational safety and health training for workers who are or may be engaged in activities related to hazardous waste removal, containment, or chemical emergency response.

Minority Worker Training Program (MWTP)
The MWTP delivers comprehensive training to disadvantaged minority inner-city young adults to prepare them for employment opportunities related to environmental restoration and hazardous materials.

NIEHS/DOE Nuclear Worker Training Program (DOE)
The DOE program focuses on training workers engaged in environmental restoration, waste treatment and emergency response activities at sites in the Department of Energy's nuclear weapons complex.

Hazmat Disaster Preparedness Training Program (HDPTP)
The HDPTP provides enhanced safety and health training to current hazardous materials workers and chemical responders and trains skilled support response personnel. It creates materials and delivers training to response workers, and augments prevention and preparedness efforts in a wide variety of high risk settings.

Advanced Training Technology Program (ATT)
The ATT program helps to facilitate the development of safety and health training products for hazardous materials (HAZMAT) workers, emergency responders, and skilled support personnel. The ATT program also includes the Small Business Innovative Research and Small Business Technology Transfer (SBIR/STTR) programs.

National Clearinghouse for Worker Safety and Health Training

The National Clearinghouse supports the work of WETP in all of its program areas. It supports WETP disaster response and recovery activities by providing training coordination and outreach. It also maintains a website containing an extensive database of information about protecting workers from workplace hazards, organized by subject matter, as well as training materials developed by WETP grantees, including curricula in accordance with OSHA's hazardous waste worker standard (1910.120). The information and training curricula are available to other training organizations for free download on the WETP website.

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What rights do workers, homeowners, and volunteers have?

Both employers and workers have responsibilities

- The Occupational Safety and Health Act (OSHA) requires that employers provide a safe and healthful workplace free of recognized hazards and follow OSHA standards. Employer's responsibilities also include providing training, medical examinations, personal protective equipment, respirators, and recordkeeping. Visit **www.osha.gov** for details.
- Employers should attempt to reduce hazards through engineering controls such as ventilation before assigning workers to wear personal protective equipment. This is called the hierarchy of controls.
- Workers must follow the employer's safety and health rules and wear or use all required gear and equipment, follow safe work practices as directed by the employer, report hazardous conditions to a union representative or supervisor, and consider reporting hazardous conditions to OSHA if employers do not fix them.
- OSHA does not have a specific standard to protect workers from mold. However, standards for personal protective equipment, equipment, respiratory protection, walking and working surfaces, and workplace sanitation may apply.
- Although volunteers and homeowners are not covered by OSHA requirements and enforcement procedures, the protections afforded by OSHA standards provide a good framework for protecting the well-being of people doing mold clean-up work.
- Clean-up workers should always stop what they are doing and ask questions when in doubt about the safety of an activity.

What health conditions may exclude participation in clean-up and recovery work?

Any individual with pre-existing medical conditions may be excluded from any work that includes exposure to mold. These individuals should consult with their medical providers.

- 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.

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

- Training should include the detailed contents in this guidance 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 personal protective equipment
  - Mold remediation work practices, procedures, and methods

For additional information, consult the National Institute of Environmental Health Sciences' publication, "**Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold**." It lists minimum training criteria for building maintenance and mold remediation workers that should be completed before addressing indoor mold growth.

- 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.[1]

What else should be considered in planning training?

- Previous training, knowledge, and experience should be considered in assessing training needs and tailoring training to specific groups.
- Participatory training techniques allow adult learners to play an active role in training programs, thereby increasing their capacity to learn and apply the knowledge and skills that are being conveyed. Small group activities and trying on respirators and PPE are examples of these techniques.
- Homeowners and volunteers should refer to OSHA standards as authoritative guidelines, even though they are not specifically covered by them.
- Contact the National Clearinghouse for Worker Safety and Health Training (202-331-7733) and review the website **http://tools.niehs.nih.gov/wetp/index.cfm** for additional information on hurricane and flood response and clean-up activities.

1 Visit **http://www.osha.gov/** to access OSHA standards. For general industry, the standards are contained in the Code of Federal Regulations 29 CFR 1910 and 29 CFR 1926 for construction. Relevant standards include: Subpart I personal protective equipment and respirators; Subpart D walking-working surfaces such as flooring, holes, stairs, ladders, scaffolding; Subpart J general environmental controls such as toilets, drinking water, sanitation, and confined spaces.; Subpart K first aid; and Subpart Z toxic and hazardous substances. OSHA's webpage on mold: **http://www.osha.gov/SLTC/molds/index.html**

Why should we be concerned with mold following a flood?

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

What is mold and what causes it to grow?

- 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.
- To grow, molds need water or moisture and an organic (carbon-containing) material such as the paper on gypsum wallboard (drywall), ceiling tiles, wood products, paint, wallpaper, carpeting, books, papers, and fabrics. Mold can also grow on moist, dirty surfaces such as concrete, fiberglass insulation, and ceramic tiles.
- Most molds reproduce by forming spores that are released into the air. When spores land on a suitable moist surface they grow and can penetrate porous materials, releasing chemicals and damaging buildings and objects.
- When water damage occurs in buildings and homes, mold growth can be prevented by eliminating the source of the water and effectively cleaning or removing and drying affected building materials.

What are mycotoxins and why are they significant?

As molds grow, some may produce potentially toxic chemical byproducts called mycotoxins (mi ko tox in). But, this byproduct depends upon certain mold growth conditions that are difficult to determine even by trained professionals. While the science is not conclusive, some studies have found that inhalation of mycotoxins, especially those produced by Stachybotrys chartarum (a black mold), may be highly toxic to humans who inhale spores and fine dusts that contain them. Infants may be at even greater risk.

What are the symptoms and main illnesses?

- In otherwise healthy people, exposure to mold usually causes no health effects more severe than irritation of the eyes, nose, or throat, or a headache. These symptoms usually go away quickly when the moldy area is left.
- People who are sensitive to molds, such as people with allergies or asthma, may experience eye and nose irritation, nasal stuffiness, coughing, wheezing, shortness of breath or asthma exacerbations.
- Other mold exposures can be associated with skin irritation and infections like Athlete's foot.
- In a disease called sarcoidosis, inflammation can lead to scarring and abnormal function in the lungs. Many people who have sarcoidosis have no signs or symptoms or mild ones. Often, the disease is found when a chest x-ray is done for another reason (for example, to diagnose pneumonia).
- Hypersensitivity pneumonitis (HP) is a serious, but uncommon, lung inflammation caused by an immunological response to particles inhaled from animals, plants, bacteria, or mold. HP can be acute or chronic. Symptoms of acute HP usually occur within 3-8 hours of exposure and include chills, body aches, coughing and chest tightness. Once the exposure ends, the symptoms generally fade after a few hours or days. Chronic HP may develop if acute HP is not treated early.

- Organic dust toxic syndrome (ODTS) is a respiratory illness caused by breathing in organic dust such as moldy hay or other materials. Symptoms include chills or sweating, cough, shortness of breath, headache, tiredness, loss of appetite, nausea, and muscle aches.

How are people exposed to mold?

Exposure occurs mainly by inhaling microscopic mold spores from the air. Mold concentrations in the air of contaminated homes may be much greater than outside. Some molds also enter the body through eating moldy food.

Who is susceptible to health effects from mold?

- People with any disease that makes them immunocompromised (e.g., HIV|AIDS) or who are undergoing treatment that leaves them immunocompromised (e.g., chemotherapy as cancer treatment) are susceptible to infections from mold, which can be severe. During and even some time after clean-up activities, people with any condition that reduces immunity should not be in a mold-contaminated building.
- Children and elderly are also susceptible to respiratory complications from mold exposures and should not be in an affected building.
- Relatively healthy people can still experience minor irritation from dust or mold odors. Many mold odors are similar to chemicals like alcohol and acetone (e.g., nail polish remover), and may lead to headaches too.

Who may diagnose and treat mold related illness?

- While family physicians are usually the first line for diagnosis of mold related illnesses, some diseases that result from mold exposures are often directed to specialists. When individuals meet with their family physicians, they should be sure to communicate the type and extent of their disaster clean-up activities.
- Occupational physicians are trained to diagnose and treat environmental and work-related illnesses. In New York State, a network of occupational health clinics can be accessed at **http://www.health.ny.gov/environmental/workplace/clinic.htm**. The American Association of Occupational and Environmental Health Clinics website can be used to locate specialists nationwide: **http://www.aoec.org/**.

What are the steps in conducting mold clean-up and treatment?

What preparation should be done of the site and environment?

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.

What about:

Structural safety?

- Severe damage to the internal load-bearing structure, including damage to load bearing walls, severe wood rot, termite damage, or distortion of the structure may make saving the building impractical.
- Most buildings that suffer structural damage will show distinctive outward signs, such as:
  - Roofs that sag in the middle or at the ends due to load bearing walls that have shifted.
  - 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.
- Building inspection personnel typically post occupancy information indicating whether homes have been inspected. A RED posting indicates the home is not safe to enter, YELLOW has important warnings, and GREEN indicates it is safe to enter.

Raw sewage?

- Flood waters may be contaminated with sewage. Even a flooding isolated to a single home can cause this type of problem when a toilet backs up and overflows.
- Raw sewage contamination is commonly referred to as “black water.”
- More than 120 viruses have been identified from 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 be used for clean-up of raw sewage.

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 there is no live current to outlets.

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.

Ventilation?

- 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 before entering. This will allow odors and volatile organic compounds (VOC's)[2] produced by molds to be diluted and thereby reduce exposure to occupants.
- The building should be ventilated any 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.

Containment techniques?

- 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' sheets to build the walkway. Follow these steps to set up the containment:
  - Cover the door opening with 6 mil plastic sheeting - the top two corners should be reinforced with duct tape and stapled. The bottom should be duct taped, with the corners stapled to the floor. The side perimeter should be sealed with masking tape.
  - Cut a slit in the plastic sheeting from about 5" from the floor to about 5" from the door head. This will allow passage into and out of the room.
  - Finally, tape a sheet of 2 to 3 mil plastic as wide as the opening to the top of the door on the clean room side. Let it hang a few inches from the floor. The air current will be blowing from the containment area side pressing it against the cut opening.

Lighting?

- With the electrical service turned off, it is very important to provide portable lighting.
- Inadequate lighting poses trip, slip, and fall hazards.
- Using tools without proper lighting can lead to injuries.

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2 Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

Establishing 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 injuries, 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

Teamwork and communication?

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

Fatigue and traumatic stress?

- 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.

Basic precautions?

- No smoking or eating at the worksite.
- Do not rub eyes, nose, or mouth.
- Provide protection from direct sun and heat stroke.
- Provide drinking water and frequent breaks.

Essential tools and tool safety?

- Power tools should only be used by people who have been specifically trained and equipped with appropriate personal protective equipment to use them.
- Flashlights, waterproof boots or waders.

WARNING: Do not enter a building with deep standing water.

- PPE and respirators are listed on pages 13-17.
- Crowbar, hammer, saws, pliers, crescent wrench, screwdrivers, etc.
- Scrub brushes, spray bottles
- Trash bags

Hazard communication/chemical safety?

- 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 that they work with.
- Chemicals used in mold clean-up and remediation may include cleaning agents, bleach, biocides, and solvents.

Asbestos?

- Homes that were built or renovated 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).
- 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.

WARNING: No one should attempt to handle ACM unless fully certified, licensed, and equipped to do so.

- If friable ACM is suspected, it should be wetted down and the area covered with plastic sheeting until it can be evaluated.

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.
- All areas that might be contaminated by paint debris should be covered with plastic sheeting.
- If you suspect lead is present, a qualified professional should be brought in to test and remove it.
- OSHA's standards for general industry and construction for lead are 29 CFR 1910.1025 and 1926.62 and must be complied with.

WARNING: No one should attempt to handle lead dust unless fully certified, licensed, and equipped to do so.

Carbon monoxide?

- Carbon monoxide (CO) is an odorless, colorless and toxic gas that can cause illness and death.
- At lower levels of exposure, CO causes mild effects that are often mistaken for the flu. These symptoms include headaches, dizziness, disorientation, nausea, and fatigue.
- Red blood cells pick up CO quicker than oxygen. This may lead to the body replacing oxygen in blood with CO. This blocks oxygen from getting into the body, which can damage tissues and result in death.
- Sources of CO include generators, heaters, and power washers or any gas, kerosene, or propane fueled equipment. It is produced as a bi-product of incomplete combustion.
- **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.
- Inexpensive, small CO detection monitors are available that can be worn by workers and will alarm when CO gets too high.

Ladder safety?

- Ladders are often necessary for removing moldy materials such as dry wall or ceiling tiles.
- Using ladders improperly is dangerous.
- OSHA has a detailed standard for ladder safety for general industry and construction that should be consulted. See 29 CFR 1910 Subpart D and 29 CFR 1926.1053.
- 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.

How is a mold assessment conducted?

What is the goal of the assessment?

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

How is mold identified?

- 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.

How is a visual mold and moisture assessment conducted?

- The assessment should not be undertaken until the safety of the building has been fully addressed. (See page 5 for more details)
- Talking to the home-owner 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.

Why are moisture meters used?

- 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.
- They also can be used to monitor the progress of drying damaged materials where readings should generally be 17% or less.
- These direct reading devices have a thin probe that is inserted into the material to be tested or pressed directly against the surface of the material.
- Moisture meters can be used on materials such as carpet, wallboard, wood, brick, plaster, and concrete.

What about testing for mold?

- 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.

Are commercially available test kits useful and accurate?

- Generally, the use of commercially available kits is not recommended. The visual inspection and the use of a moisture meter should suffice as detailed above.
- If testing is performed, a qualified professional should be employed.

What types of samples may be taken?

- Air, surface, dust, and bulk materials may be tested for a variety of molds and their components.
- If environmental samples are collected, a sampling plan should be developed that includes a clear purpose, sampling strategy, and basis for interpreting the results.
- Environmental sampling should be conducted by an individual who is trained in the appropriate sampling methods and is aware of the limitations of the methods used.

How are microorganisms[3] assessed?

- Mold air samples are sent to a qualified laboratory for processing by the professional who submits the samples. After processing, the laboratory then provides a written report of the results.

Does the amount of contamination make a difference?

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 that mold assessment and remediation professionals should be considered when contamination is greater than 10 square feet, listed as level 1 below. The NYC Department of Health & Mental Hygiene recommends consideration of such professionals when contamination is greater than 100 square feet, listed as level 4 below. They all recommend that any mold growth clean-up project that is 10 square feet or less, listed as Level 1 below, may be performed by trained maintenance personnel, volunteers, or homeowners.

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

Contamination size definitions are important because many homeowners and volunteers perform mold clean-up and treatment beyond the recommended level despite strong recommendation not to do so.

3 Microorganisms are microscopic fungi, viruses, bacteria, protozoa, or algae.

What are the best ways to select a qualified mold remediation contractor or mold inspector?

- Florida, Louisiana, Maryland, Texas, and Virginia are states that require licensing of mold remediation contractors or assessors. Several states are considering legislative proposals.
- A trained building or environmental health professional may be employed to assess the extent of the moisture problem and mold growth and develop a site-specific work plan. The presence of a trained professional to provide oversight during remediation can also be helpful to ensure quality work and compliance with the work plan. According to the American Industrial Hygiene Association, a trained professional should have, at a minimum, a relevant science or engineering degree and two years of full-time supervised experience in mold assessment.
- Credentials typically include one of the following: Certified Industrial Hygienist (see **www.aiha.org**), Certified Microbial Investigator/ Consultant/ Supervisor (see **www.iaqa.org**) or Mold Removal Specialist/ Applied Microbial Remediation Technician (see **www.iicrc.org**). A licensed professional engineer (PE) may also be qualified to do the work.
- Ask for 5 references for similar work and check them for customer satisfaction.
- Obtain at least 3 price quotes.
- Require the contractor to provide a written proposal that includes a:
  - detailed scope of work;
  - detailed plan for occupant and worker protection and to isolate the work area; and
  - 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.
- 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.

What are key issues in working with volunteer groups and homeowners?

- Make sure expectations about the role of the volunteers, their capabilities, and limitations are clearly defined.
- Volunteers should never be asked to perform work that they are not prepared to do safely.
- Volunteers must receive appropriate training and safety equipment prior to doing the work.
- Homeowners should know that they are responsible for work that is conducted in their homes by volunteers.

What personal protective equipment should be provided to occupants, workers, and volunteers?

For hands?

- 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.

For eyes?

- 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.

For feet?

- Work boots that have a steel toe and insole. Footwear should be non-skid and water-resistant or water-proof.

For head protection?

- 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.

Body protection?

- Breathable, disposable coveralls with elastic wrists and ankles.

Hearing protection?

- Disposable earplugs or earmuffs to reduce exposure to noise. Clean-up and demolition work can create hazardous noise levels.

What type of respiratory protection should be used?

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

What is a respiratory medical clearance?

- OSHA[4] 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 medical 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.

How are respirators selected?

- 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 respirator cartridges described below.
- OSHA requires employers to evaluate respiratory hazards and base the selection of respirators on the amount and type of contamination that is present.
- The National Institute for Occupational Safety and Health, part of the CDC, certifies air purifying respirators, sometimes called particulate respirators, in the following categories based on the resistance to oil, which can reduce efficiency:
  - **N95, N99, N100** - Filters at least 95%, 99%, 99.97% of airborne particles. Not resistant to oil.
  - **R95, R99, R100** - Filters at least 95%, 99%, 99.97% of airborne particles. Somewhat resistant to oil.
  - **P95, P99, P100** - Filters at least 95%, 99%, 99.97% of airborne particles. Strongly resistant to oil.
- NIOSH approved respirators will be marked “NIOSH” and the N, R, P categories.
- A properly fitted half-face respirator with a P100 cartridge is rated to protect from asbestos and lead up to 10 times the permissible exposure limit (PEL). The PEL is the maximum airborne concentration allowed by OSHA, typically for an 8-hour work day.

4 OSHA Respiratory Protection Standard, 29 CFR 1910.134

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

What are some precautions about wearing respirators?

- Wearing a respirator incorrectly will reduce its effectiveness.
- All of the straps must be used and worn correctly.
- Facial hair interferes with a proper respirator fit. If a respirator is required for the job, facial hair must be removed.

What are disposable filtering respirators?

- Disposable respirators usually have a metal band that is designed to fit over the bridge of the nose and be molded to the individual wearing it. They must be worn over the mouth and nose.
- Some disposable N95s have exhalation valves that improve breathing resistance.
- Studies show an average of 10% leakage around the facial seal with disposable respirators.
- Disposable respirators come in many different shapes and sizes and must be fit tested to ensure a proper facial seal.

What is fit testing?

- OSHA requires employers to conduct a fit test procedure to verify that a respirator is both comfortable and correctly fits the user.
- There are two different types of fit testing that 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, to verify the respirator's fit.
- OSHA requires employers to provide multiple makes, models, and sizes of respirators to ensure a proper fit can be achieved.
- 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 to a contaminant 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.

What is a 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 to ensure an adequate seal.

A seal check is a procedure conducted by the respirator wearer to determine if the respirator is properly seated to the face.

- Procedure for disposable filtering respirator:
  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 if 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.
- Procedure for full face or half-face respirator
  - 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.
  - Negative pressure seal check:
    1. Block the cartridges/filters with the palms of your hands.
    2. Gently inhale and hold for about 10 seconds.
    3. Check to see if the facepiece is collapsing slightly.
    4. 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.

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, soiled, or 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 breakthrough these cartridges depending on factors such as the amount of contaminant in the environment, relative humidity, temperature, and work activities.

What are the procedures for respirator maintenance, cleaning, and storage?

Cleaning and maintaining cartridge respirators

- 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.

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 face pieces should lie in a normal position to prevent the plastic or rubber from being deformed.
- Store respirators to protect them from dust, sunlight, extreme heat or cold, excessive moisture, and damaging chemicals.

What decontamination and clean-up procedures should be followed?

- Contaminated PPE can pose a health risk. Decontamination procedures are critical whenever working with hazardous materials.
- OSHA has specific requirements for decontamination of employees and their PPE in locations where potential for exposure to hazardous materials exists in 29 CFR 1910.120 (k) and 1926.65 (k).
- 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.

What is the work sequence?

After it has been determined that it is safe to enter the home, the work is conducted in six phases:

1. Removal of salvageable possessions.
2. Muck-out: the removal of dirt, sand, debris, and damaged possessions.
3. Gutting: the removal of all damaged building materials.
4. Mold cleaning: cleaning and treating all remaining building components for mold.
5. Drying and dehumidification
6. Rebuilding

What possessions are salvageable and how are they handled?

- Non-porous items such as china, glass, jewelry, porcelain, and metal can be washed.
- Wood furnishings displaying mold growth, but in otherwise good condition, may be salvageable by cleaning with a detergent using a wet abrasive sponge and then refinishing. Professional restoration may be necessary.
- Appliances and electronics that were not water-damaged may be salvageable and can be cleaned with regular cleaning products.
- Window air conditioning units that are housed in moldy rooms should be carefully inspected and should be disposed of if they display visible mold growth.
- TVs, stereo equipment, and other electronics that do not contain fans may be salvageable and can be cleaned with regular cleaning products.
- Photographs and critical documents displaying minor levels of mold growth may be salvageable by wiping with damp paper towels and a mild detergent solution. Freezing these items will retard further growth until professional restoration can be performed.
- Valuable artwork can be HEPA[5] vacuumed to remove surface mold. Frames and backings can be wet wiped with a mild detergent solution. Items can then be set aside for professional restoration.

What is muck-out?

Muck-out is defined as removal and disposal of flood-related dirt, sand, debris, and non-salvageable possessions.

What possessions are non-salvageable?

- Porous items such as upholstery, textiles, clothing, carpeting and padding, rugs, papers, and books and 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.

5 High-efficiency particulate air-filtered vacuum designed to remove contaminated dust.

What is gutting?

Gutting is defined as 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?

- Gutting is necessary in homes where water flooded finished basements and floors and where removal of wet furnishings and wet sheetrock was not promptly performed.
- Gutting is the ultimate mold remediation project, and should be performed only by trained and certified mold remediation personnel. An exception is when gutting takes place within 24-48 hours, prior to mold growth. In those cases demolition would not need certified mold remediators.

How should sheetrock be removed?

- Sheetrock acts like a wick for water, and in homes where flood waters rose to a height of 2 feet on the first floor; severe mold growth may cover the lower 4-6 feet of these walls.
- The paper covering both sides of sheetrock supports mold growth.
- Sheetrock displaying visible mold growth on the front or back side must be removed.
- Before removing sheetrock, spray visibly moldy surfaces with water to reduce dust release, or cover visibly moldy surfaces with plastic sheeting secured by duct tape.
- Remove with minimum possible disturbance. Score with a utility knife and use a crowbar instead of a hammer.
- Remove a minimum of 1-2 feet beyond the high water mark or mold growth on the front and back sides.
- Remove all insulation material in the wall and ceiling cavities where sheetrock is removed.

What about plaster construction?

- Remember, wet dust does not fly, so wet scrape with one hand to remove paint and weakened plaster, brown coat[6] while spraying water with the other hand.
- Remove wood lath boards that were submerged and display visible mold growth.

Should wood trims, doors, frames, and moldings be removed?

- Remove and discard swollen and hollow bore doors. Hollow bore doors may have no visible mold on the exterior, but be moldy inside.
- Remove base moldings and inspect the back side. If visibly moldy, then discard or scrub with detergent solution. Dry before re-installing moldings.
- Wood door frames and window components with visible mold may be salvageable by cleaning with a detergent solution, then set aside for professional restoration.
- Difficult to access areas that were submerged, such as window counterweight cavities and the underneath side of staircases, should be inspected and cleaned.

6 In a 3 coat plaster system, the 2nd coat is called the brown coat.

What about wood cabinetry?

- Discard all cabinetry made of fiberboard or plywood that had been partially or fully submerged or has visible mold.
- Quality wood cabinetry may be salvageable by removing, cleaning, and then setting aside for professional restoration.
- Remove any cabinetry that impairs access to affected walls.

Should wood floors be removed?

- Finished floorboards that were submerged should generally be removed and disposed.
- If underlying sub-floors are wood boards, it may be possible to clean the top surfaces and the accessible portions of the bottom surfaces, accessed from the basement or crawl space.
- If underlying sub-flooring is plywood, which is more susceptible to mold growth than hardwood, then the plywood should be removed and disposed.
- Single-layer wood plank floors nailed directly to joists may be salvageable by cleaning the top surfaces and the accessible portions of the bottom surfaces, from the basement or crawl space.
- Final polyurethane coating will substantially prevent air infiltration from the crawl space below.

CAUTION: Polyurethane is flammable and an inhalation hazard.

- For constructions on slabs, remove and dispose of flooring and sub-flooring that were submerged.

What about ceramic and vinyl flooring?

- Ceramic flooring laid directly onto cement or concrete slabs may require only HEPA vacuuming, then washing with a detergent and cleaning solution.
- Vinyl flooring should be removed and disposed.
- Vinyl or ceramic flooring laid onto plywood should be removed and disposed, including the plywood.
- The underlying cement or concrete should be cleaned and fully dried before rebuilding.

What is mold treatment?

- Mold treatment relates to cleaning structural wood building components and other building components that are not readily removable and replaceable. See the next section for procedures.

How is structural wood cleaned[7]?

- 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[8] 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.

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. See page 22.

- 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.

What is the importance of dehumidification and drying?

- 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 if wood is dry enough (17% or lower) to commence rebuilding. See page 10 for more information.

What are the dangers of crawl spaces under homes and buildings?

- Damage to building materials and accumulation of mold in crawl spaces pose unique hazards.
- Because crawl spaces come in many different shapes, sizes and configurations, access may be difficult and limited, and these spaces are typically dark and dirty.
- OSHA defines a confined space as meeting three conditions:
    1. The space is large enough and so configured than an employee can bodily enter and perform assigned work.
    2. The space has limited means for entry or exit.
    3. The space is not designed for continuous human occupancy.

7 The use of terms cleaning, disinfecting, and treating are often used interchangeably, causing confusion. Cleaning refers to mold removal. Treating generally refers to prevention of recurring mold growth. Disinfecting implies the use of a disinfectant. The key is to use the least toxic materials capable of doing the job. Therefore, many experts recommend detergent and a borate containing product. The exception is when sewage (black water) is present.

8 The US EPA defines borates as, "Borate preservatives (Disodium Octoborate Tetrahydrate or DOT) are low toxicity alternatives for protecting timber and composites from wood destroying organisms such as decay fungi and termites. They have proven effective for more than 70 years in residential and commercial construction, and their efficacy is backed by extensive field testing.

- OSHA classifies confined spaces as permit required and non-permit required. To require a permit for entry, a crawl space must meet any of the following conditions:
  1. Contain or have the potential to contain a hazardous atmosphere, or
  2. Contain material that may cover up the entrant, or
  3. Have an internal configuration that may trap or asphyxiate[9] entrant, such as the walls or floor, or
  4. 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.
- In any crawl space situation, a safety plan and appropriate equipment and safeguards must be in place before work begins.

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.**

How are heating, ventilation, and air conditioning (HVAC) systems cleaned?

- 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.

What are the issues with the 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 for many homeowners.

9 Definition: to suffocate due to lack of air.

Resources & Credits

The material in this document was adapted from:

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

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**

Rebuilding Water-Damaged Homes, A Manual for the safe, healthy, green, and low-cost restoration of housing, Alliance for Healthy Homes, 2009

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/**

Why this guidance was created

This guidance 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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http://tools.niehs.nih.gov/wetp