IUOE National Training Fund

National HAZMAT Program

Protecting Ourselves From Mold

Awareness Training for Operating Engineers

Instructor Manual

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Name:

(304) 253-8674 • hazmat@iuoehazmat.org • www.iuoehazmat.org

IUOE National Training Fund
National HAZMAT Program
1293 Airport Road
Beaver, WV 25813
(304) 253-8674
Fax (304) 253-7758
hazmat@iuoehazmat.org
www.iuoehazmat.org

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- It is not the intent of the content developers to provide compliance-based training in this presentation, the intent is to address hazard awareness in the hazardous waste operations and emergency response (HAZWOPER) industry, and to recognize the overlapping hazards present in many construction workplaces.
- It should NOT be assumed that the suggestions, comments, or recommendations contained herein constitute a thorough review of the applicable standards, nor should discussion of “issues” or “concerns” be construed as a prioritization of hazards or possible controls. Where opinions (“best practices”) have been expressed, it is important to remember that safety issues general and HAZWOPER jobsites specifically will require a great deal of site- or hazard-specificity – a “one size fits all” approach is not recommended, nor will it likely be very effective.

To: Users of IUOE National Training Fund Programs

The IUOE National Training Fund -- National HAZMAT Program offers a broad spectrum of safety and health training, as well as training support to other users of the National HAZMAT Program's resources. The National HAZMAT Program has available, at ***no cost***, the following:

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- New instructor mentoring for HAZWOPER and other safety and health related classes
- Safety and health regulations and standards interpretation assistance
- Technical safety and health, emergency/disaster response, and energy security and restoration assistance
- Training data information from the National training database for Local Union members and others who have completed training through the National HAZMAT Program
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The IUOE National Training Fund encourages all workers to take advantage of the National HAZMAT Program's services to assist you to be employable, competitive, and safe in the workplace.

Sincerely,

Jeffrey R. Vincent
Executive Director,
IUOE National Training Fund

Table of Contents

Using this guide 1

Introduction 2

Section 1 - What is mold? 3

Section 2 - What health problems are caused by mold? 7

Section 3 - How are workers exposed to mold on the job? 10

Section 4 - How can workers be protected from mold? 17

Section 5 - What laws and guidance are there for mold? 23

Appendix A 26
New York City Department of Health & Mental Hygiene
Guidelines on Assessment and Remediation of Fungi in
Indoor Environments

Appendix B 49
United States Environmental Protection Agency:
Mold Remediation in Schools and Commercial Buildings

Appendix C 56
National Institute for Environmental Health Sciences:
Guidelines for the Training and Protection of Workers Engaged in
Maintenance and Remediation Work Associated with Mold (May 2005)

Appendix D 58
National Institute for Occupational Safety and Health (NIOSH):
Interim Recommendations for the Cleaning and Remediation of
Flood-Contaminated HVAC Systems: A Guide for Building
Owners and Managers

Appendix E 63
United States Occupational Safety and Health Administration:
A Brief Guide to Mold in the Workplace

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LIPPY GROUP

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15 Wyndcrest Avenue, Baltimore,
Maryland, 21128
www.thelippygroup.com

Protecting Ourselves From Mold:
Awareness Training for Operating Engineers

INSTRUCTOR GUIDE

Using this Guide

This is a mold awareness class that has been designed for stationary engineers and heavy equipment operators, but will hopefully have broader usefulness. The Powerpoint presentation and accompanying instructor and student manuals can be used in a variety of ways depending on the time available for the training, ranging from one to two hours, and the preferred teaching style of the particular instructor. The outline presented below is a lesson plan for conducting a 1 to 2-hour version of the class. It includes time and instructions for introduction of the participants and instructor and a number of small group activities (SGA) that are interspersed throughout the training.

Notes written as guidance for you, the instructor, will be in red.

Tailor this course to your students and time requirements. PowerPoint has an excellent feature in the "slide sorter" view that allows you to turn off individual slides temporarily without deleting them. There is considerable information here. Don't rush through it, adjust it to your class and the time available.

Activity 1: Introductions

Take time to introduce yourself and your experience that would qualify you to present this training. Then have the students introduce themselves. Ask them to mention:

- Years of experience
- Where employed
- If IUOE member, whether H&P or stationary engineer

Activity 2: Opening remarks and icebreaker

Ask the class to divide into groups (4-6 participants/group). Consider using this Small

group activity (SGA) to determine participants' experience with airborne hazards in the workplace.

Each group selects a recorder/reporter and is given 5 minutes to briefly respond to the following questions:

- Provide two examples of toxic substances that are airborne hazards where you work
- What measures did you take to protect yourself and others from being exposed?

Report back and discussion:
Limit each group's report to 2 minutes
Record hazard (e.g. asbestos, lead) and key words (e.g. containment, monitoring, PPE)

As the instructor, summarize the following principles and emphasize that they also apply to mold:

- Understanding nature of the substance and its health effects
- Identifying location of hazards and assessing risk posed
- Determining appropriate methods to prevent exposure and correct problems
- Being aware of applicable laws, guidance, contractual provisions

Begin PowerPoint presentation.

INTRODUCTION

Concern about indoor exposure to mold has been increasing as the public becomes aware that exposure to mold can cause a variety of health effects and symptoms, including allergic reactions. This introductory training and manual are intended to make you familiar with mold and moisture in buildings and how to safely and effectively evaluate and correct these problems.

(Slide Number 3)

Review each of these questions so the class knows where they are headed.

This training is divided into 5 sections based on these questions:

1. What is mold?
2. What health problems are caused by mold?
3. How are operating engineers exposed to mold on the job?
4. How can operating engineers be protected from mold?
5. What laws and guidance are there for mold?

Emphasize with the class that this is an Awareness Level class only.

It will NOT prepare workers to perform mold remediation. Some states (Texas and Louisiana at time of this manual preparation) require mold remediation workers to attend approved courses. This class is not an approved course. It is intended to make students aware of problems that can be caused by mold and the additional training and work practices that are required to safely address mold problems. The main goal is to teach workers how to avoid exposures to mold.

SECTION 1
What is mold?

OBJECTIVES:

Review these objectives with the class.

After completing this section, you will be able to:

1. Describe what mold is.
2. List different parts of mold.
3. Explain what mold needs to grow and spread.

Molds are organisms that may be found indoors and outdoors. They play an important role in the natural environment by breaking down and digesting organic material, such as dead leaves. Also called fungi or mildew, molds are neither plants nor animals; they are part of the kingdom Fungi.

It is important to stress with the class that:

- "mold" is really an artificial tem like "weed." Fungi is the more correct term. (Fungi is plural, fungus is singular).
- We use the term to refer to visible colonies of fungi growing indoors. We use the term to contrast it with large structures (such as toadstools and mushrooms) growing outside.
- "Mildew" is a another general, non-scientific term used by layperson's to refer to mold growing on substances such as fabrics and wood.

How do fungi differ from green plants? (Slide 5)

Get the class talking about the differences. Make sure the following points are covered:

1. Fungi are not green because, unlike all green plants, they do not use chlorophyll and do not need light to produce food.
2. Fungi get their food by eating other plants and animals through the release of enzymes that break down organic materials into water-soluble food that they can absorb. This is why they are so destructive on construction materials like wood and drywall.
3. Unlike green plants, fungi do not have tubes inside the body to carry nutrients, they produce threads that grow along the organic materials they are absorbing.
4. The toadstool or mushroom (like in the photo) is really a kind of fruiting body that makes spores, which is how they reproduce.

Common toadstool

Parts of mold

Most molds grow by producing spores that float through the air.

Make sure the class understands that spores cannot be eliminated from indoor environments, either from the air or dust.

Molds multiply by producing microscopic spores (2 - 100 microns [µm] in diameter), similar to seeds spread by plants. Spores are found most everywhere both indoors and outdoors. Spores are so small they easily float through the air and can be carried for great distances by even the gentlest breezes. The number of mold spores suspended in indoor and outdoor air fluctuates from season to season, day to day, and even hour to hour. This is one of the difficulties of air monitoring for spores, the results can change dramatically in a short period of time. According to the EPA, over 1,000 different types of fungi have been identified in homes. (**Slide 9**).

Note that sexual reproduction results in the formation of spores, which may be produced in a structure called a fruiting body, which is the visible part of mushrooms and toadstools. Spores are generally too small to be seen by the naked eye.

Spores can be found everywhere. (Slide 10)

Make the following points:

- Outdoor air normally contains mold spores – they are found all over the world.
- Hundreds or even thousands of mold spores are in each cubic foot of outdoor air.
- Dry, maintained carpet typically contains at least 100,000 mold spores per gram of carpet dust.

Hyphae (hi fee)

As the instructor, it is important that you feel comfortable pronouncing the technical terms. Dictionaries exist on the web that will pronounce words you look up.

In this manual, pronunciations will be in parentheses with the syllable that should be accented in bold, e.g. Aspergillus (as per **jill** us) spores.

(Slide series 11, 12, 13)

The hyphae are the branching network of filaments that you can see after spores have landed and begun to grow on a surface. They are quite small compared to a human hair.

(Slide 14)

Mold parts affect human health. (Slide 15).

Be sure to make the point that it isn't just the spores that cause health problems. In fact, some researchers think that fragments of hyphae and other parts of the mold may be more responsible for health issues.

What are mycotoxins and why should operating engineers care?

(Slides 16 and 17)

As molds grow, some (but not all) of them may produce potentially toxic byproducts called mycotoxins (mi ko **tox** in), under some conditions. These chemicals can occur in parts of the mold, in the spores and the materials on which mold is growing. Mycotoxins are nearly all toxic to human cells, disrupting various cellular structures such as membranes, and interfering with vital cellular processes such as protein, RNA and DNA synthesis.

Some of the molds that produce mycotoxins are commonly found in moisture-damaged buildings. They include metabolites that result from what molds digest and chemicals they give off. Examples of molds that produce mycotoxins include:

- aspergillus
- fusarium (foo **sare** ree um)
- penicillium (pen nis **sill** ium)
- stachybotrys (stack ee **bot** tris)

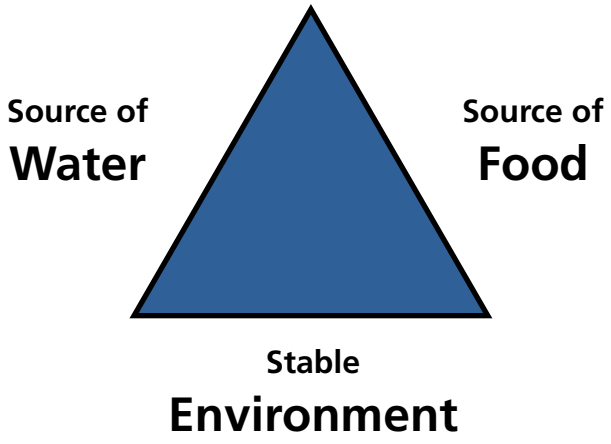
More than 200 mycotoxins from common molds have been identified, and many more remain to be identified. The amount and types of mycotoxins produced by a particular mold depends on many environmental and genetic factors. Some mycotoxins are known to affect people, but for many mycotoxins little health information is available. Killing mold growth with a biocide like bleach does not destroy mycotoxins, which is the reason surfaces need to be cleaned as well as disinfected.

Triangle of Mold Growth (Slide 18)

Although mold spores are floating through the air and in settled dust, they will not grow unless moisture is present and there is a source of food. This is a key point that will be repeated many times during this training – the key to preventing mold problems is to control moisture.

Mold is not usually a problem indoors unless mold spores land on a wet or damp spot and begin growing. As molds grow they feed on whatever they are growing on. Mold can grow on virtually any organic

This triangle is important!
Take one side away to stop growth.



substance. In buildings mold can use paper, cloth, wood, or other materials for food.
In most cases, temperature is not an issue; some molds grow in warm areas, while others prefer cool locations. The amount of moisture, light, and temperature that are present may favor one species of mold over another, however, it is common for more than one type of mold to be found growing in the same area.

If allowed to grow, mold can damage furnishings, rot wood, damage drywall, and eventually cause structural damage to buildings. Mold can cause cosmetic damage, such as stains, to furnishings.

SECTION 2
What health problems are caused by mold?

OBJECTIVES:

Review these objectives with the class.

After completing this section, you will be able to:

1. Identify the ways mold enters a person's body.
2. List the most common symptoms and ailments caused by mold.

Some molds are good tasting and even good for you. (Slide 19)

Make sure that you start this session by pointing out that not all molds are harmful.

Blue cheese is caused by a mold and is greatly prized for its taste. The discovery of penicillin

Slide 21 is just an interesting anecdote. Feel free to skip it in the interest of time.

The most famous mold is the genus Penicillium, from which we get the antibiotic penicillin. The name Penicillium comes from the Latin word for brush because under the microscope, the mold has a brush-like appearance. In 1928, while working on influenza virus, Alexander Fleming observed that mold had developed accidentally on a staphylococcus culture plate. Mold had created a bacteria-free circle around itself. Mold culture prevented growth of staphylococci, even when diluted 800 times. Fleming named the active substance penicillin.

Routes of entry into the body are the same as for other contaminants. (Slide 22)

Mold exposures are by the same routes of entry that we observe for other contaminants in construction. By far, the most common way that people are exposed to molds is by breathing in mold spores. It is also possible to have reactions to mold through skin contact or swallowing. Eating mold-contaminated foods can make you ill.

You may want to ask the class:

1. What is the main route of entry? [inhalation, like nearly all contaminants]

2. How can mold get into our skins? [mold goes through cuts or openings in skin]

The health effects are primarily allergic, but mold can cause serious illnesses. (Slide 21)

The health effects caused by exposure to mold fall into two general categories: allergic reactions and specific illnesses.

Allergic reactions to mold produce common symptoms. (Slide 24)

The most common health effects caused by mold are allergic reactions. Molds produce allergens (substances that can cause allergic reactions), irritants, and, in some cases, potentially toxic substances or chemicals (mycotoxins). Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Mold does not have to be alive to cause an allergic reaction. Allergic responses include hay fever-like symptoms such as:

- headache
- sneezing, runny nose
- asthma
- eye irritation
- skin rash (dermatitis)

Molds can cause asthma attacks in people with asthma who are allergic to mold.

These effects can occur right away or appear later. Single or repeated exposures to mold, mold spores, or mold fragments may cause individuals to become sensitive to mold. Additional exposure has the potential to increase sensitivity. This process is known as sensitization.

Conditions caused by mold can make people very sick, too. (Slide 25)

Stress the seriousness of these diseases caused by mold.

Hypersensitivity pneumonitis (HP) (hi per sen sih **tiv** i tee nu mun **eye** tis)

Breathing in mold may also cause hypersensitivity pneumonitis, an uncommon disease that resembles bacterial pneumonia. Hypersensitivity pneumonitis may develop following either short-term (acute) or long-term (chronic) exposure to molds.

Pulmonary hemosiderosis (pull mun air ee hee **mo** sid e ro sis)

Pulmonary hemosiderosis is bleeding in the lungs. There have been reports of this illness among construction workers as well as infants in buildings where they were exposed to mold.

Opportunistic infections (op per toon **is** tic)

Mold exposure can cause opportunistic infections, such as aspergillosis, in persons whose immune systems are weakened or suppressed. Chemotherapy, organ transplants, or infection with HIV/AIDS are reasons why people have a compromised immune system. Aspergillosis is caused by Aspergillus, a fungus that is very common in the environment, such as is in soil,

decaying plant matter, household dust and building materials. There are lots of different types of Aspergillus, but the most common ones are Aspergillus fumigatus (foo mi got us) and Aspergillus flavus (flay vus). Invasive aspergillosis most commonly affects the lungs, but can also cause infection in many other organs.

Histoplasmosis (his toe plaz mo sis)

Histoplasmosis is a disease caused by the fungus Histoplasma capsulatum that primarily affects the lungs. This fungus grows in soil and material contaminated with bat or bird droppings. Infection occurs when spores become airborne and are inhaled. Although uncommon, histoplasmosis is a potential hazard when workers disturb soil or buildings where droppings have accumulated. Histoplasmosis is a potential health risk workers involved in construction and repair work on buildings, roads, overpasses, and other infrastructure.

Aflatoxin is a potent mycotoxin that can cause cancer. (Slide 26)

Although not a concern in terms of exposure to mold in buildings, it is worth mentioning that aflatoxins are one of the most potent toxic substances that occur naturally. This mycotoxin is produced by Aspergillus and contaminates food products such as nuts, cereal, and spices.

SECTION 3
How are workers exposed to mold on the job?

OBJECTIVES:

Review these objectives with the class.

After completing this section, you will be able to:

1. Explain the importance of water infiltration and humidity.
2. List the sections of building systems where mold is most likely to grow.
3. Explain where it can be found inside buildings that could impact the work of stationary engineers.
4. Differentiate between white mold and effluorescence on masonry.
5. Broadly describe how mold can be measured on surfaces and in the air and the limitations of both types of sampling.
6. Explain where mold can be found in work that heavy equipment operators perform.

Workers can be exposed to mold in many jobs. Hazard assessment is key. (Slide 28)

Workers can be exposed to mold in numerous jobs so hazard assessment is critical. It is important to identify where and how moisture enters a facility and how to find places where mold growth has occurred.

Stress that we have to deal with moisture, but some sources can be uncontrollable. Also note that mold can grow in areas that aren't visible.

There are instruments called boroscopes that can be used to look into hidden areas to observe mold.

If you have time, do the following small group activity. (Slide 29)

Give each group 3 minutes to provide:

- examples of uncontrolled sources of moisture that can impact buildings
- examples of controllable sources of moisture that can impact buildings

Have groups report back and record answers on flip chart or board. Then show Slides 30 and 31 to reinforce the answers.

INTRODUCTION

The key to preventing mold problems is to find and correct the conditions that allow mold to grow. It is important to identify where and how moisture enters a facility and how to find places where mold growth has occurred. This includes mold that can be seen and where mold and moisture may be hidden. Moisture can enter a building from uncontrolled and controllable sources of moisture. Examples of uncontrolled sources of moisture include:

- natural disasters such as floods, hurricanes, or tornadoes
- broken water distribution pipes
- sewer backups

Examples of moisture sources in buildings that need to be identified and controlled in order to prevent water intrusion include:

- leaky pipes
- water seeping into the foundation
- condensation
- roof ponding and leaks

Mold is usually found by visual observation. You can sometimes smell it.

(Slide 32)

Walk-through of facility

Surveys need to be systematically conducted for mold by a multidisciplinary team that should include maintenance staff and building engineers for the facility being evaluated. The team must look for obvious visible signs of mold and be alert to a damp, musty smell because these odors suggest that water is or was present and mold growth is likely. Occupant complaints of odors and health problems also should be investigated.

Awareness of present and past leaks and condensation

A key step when looking for mold in a building is to determine whether there is a history of water leaks. Maintenance personnel are frequently among the first to know when moisture problems have occurred. In some cases, management or health and safety personnel will have been notified. Either way, touring the building with maintenance or other personnel involved with the water problem may be helpful. If possible, crawl spaces should be included when examining the building. Complaints of past water problems or water leaks should be investigated to determine how much water was involved and how quickly it was removed.

The building's air-handling system should be inspected to determine whether it is moldy. Moisture may collect in the ventilation system due to poor condensate pan drainage, poor roof drainage, or high humidity in the ventilation ducts. In some cases, water may enter the ventilation ducts from a leaky pipe. A contaminated ventilation system may spread mold spores throughout the building and should be considered a high priority for investigation and repair. Ventilation system mold contamination should be mitigated as soon as possible in a manner that does not expose building occupants to dust and mold spores.

Reports of occupants' symptoms

Too often investigations focus only on the building and not the occupants, even if the investigation was initiated because of complaints. Team members must ask occupants about their work environment and maintain an open mind about the possibility that the symptoms that are expressed may be related to the building environment. Not showing empathy for occupants who express concerns can doom any investigation.

(A white, soluble fibrous material on the soil of the crawl space may be alkaline salts, not mold, indicating moisture has been a problem and suggesting that the area should be more extensively inspected.) Moldy or musty odors should alert an investigator to the possible presence of mold.

Where have you seen mold growth in buildings? What colors? (Slide 33)

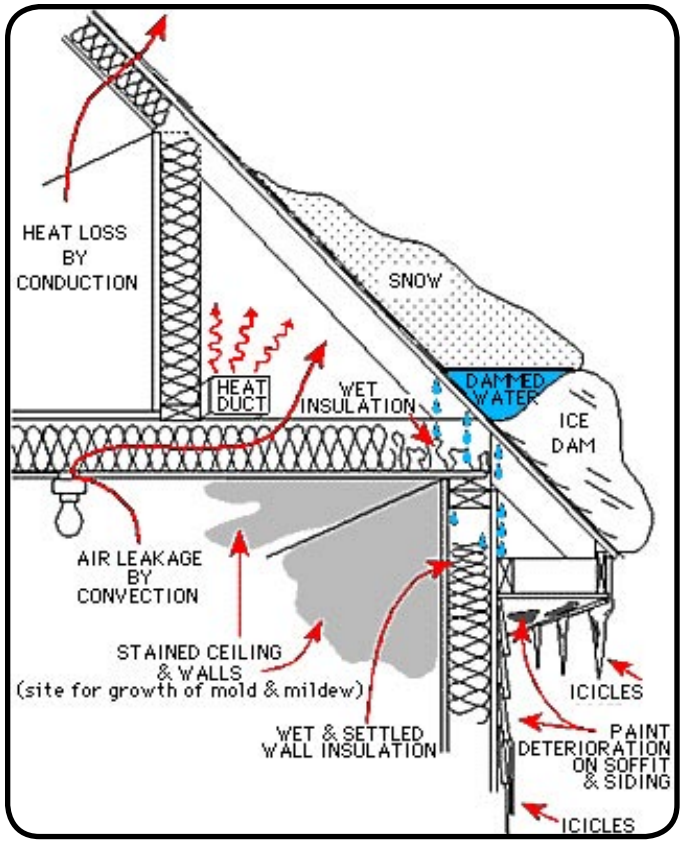
Get the class to talk about where they have seen mold and what colors they have seen. Use this exercise to get them to talk about most likely locations of mold. Focus on HVAC systems for stationary engineers and demolition for equipment operators.

Slides 34 and 35 show places that you may see mold growing.

Attic heat can cause ice dams that release water into the building. (Slide 36)

Ice dams are another source of water intrusion into a building. They are caused by poor attic ventilation where poor circulation allows warm air to accumulate at the peak of an attic while the eaves remain cold. After a heavy snowfall, escaping attic heat melts snow at the ridge of the roof, and the melted water runs down the roof. At the eaves, the water refreezes, into an "ice dam" that holds back build-ups of snow. Some of the trapped water can seep through the roof, damaging shingles, the roof deck and soaking interior insulation that can then host mold growth. This mold will be hidden, in all likelihood.

Point out to the class the blue free water that can get into the building.



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Mold in HVAC systems pose risks to stationary engineers. (Slide 37)

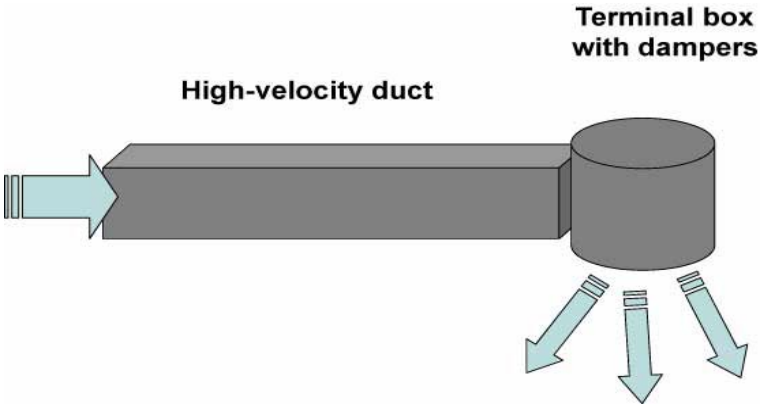
Review each of these images to point out that stationary engineers are at risk from mold that settles in the dust in systems or that actively grows in the parts of the system where water is present, most commonly in the drip pans and on the coils.

Point out that Stationary Engineers have a key role to play in participating in investigations.

Even if the other team members have a good working knowledge of HVAC systems they won't be as familiar with the system in that building as the stationary engineers who work there everyday. But while helping with an inspection of the system, they need to be concerned about generating dust that may contain spores.

Where in the ventilation system will spores accumulate? Why? (Slide 39)

Use this diagram to ask the question and wait for comments.



This is an important question for stationary engineers. Spores will stay entrained in high velocity air, but as the air is slowed down at terminal boxes, like variable air volume or mixing boxes, the spores can drop out of the air stream and settle into dust that contains organic materials where they can grow if moisture is present. "Any component that changes the air velocity or direction is more suspect for mold growth than straight runs of the mechanical systems ductwork." (AIHA's 2008, Recognition, Evaluation and Control of Indoor Mold).

Be sure to point out to stationary engineers that they are much more likely to get exposed while dealing with terminal ends of ventilation systems and the filtration at the very beginning.

Is it mold? How can we tell? (Slide 40)

Not everything that looks like mold is mold. Paint on the backside of drywall or wood may look like mold growth. Some inexpensive and quick tests can be conducted if mold is suspected. The person in this photo is using clear plastic tape to collect a sample that will be analyzed with a microscope to find out if the substance is mold or soot. In the case of carpets, a small portion of the suspect material can be submitted to a laboratory for identification. Most microbiology laboratories need only a little of the suspected mold on a clear strip of sticky tape to determine, using a microscope, whether it is actually a mold spore.

It is important to know that this approach is quicker and cheaper, but not as good as culturing samples by growing them on an agar plate and then observing the growth under a microscope. The spores of species from Aspergillus and Penicillium look so much alike under a microscope that they cannot be told apart and are reported together. The presence of mold spores in dust does not mean they are viable and would actually grow under the right conditions.

Also, sampling of dust with a tape wipe will almost always find spores. The important question is whether the spores found inside are different than those found outside the building, which might indicate mold is growing in the building.

Laboratory tests for mold are the best method to be sure. (Slide 41)

Be sure to allow this slide sufficient time to work through the full animation of growth on a agar plate.

Effluorescence

Ask the class if the white material between the brick is mold. Generate a discussion or take a vote before clicking on the answer which is "No."

This is a condition called effluorescence that occurs when water seeps through the mortar around brick and creates salt crystals that are generally white and can look like mold.

You can draw the triangle again on the board and ask what is missing from this brick wall. The answer is that there is water, but no food. The mortar does not contain carbon materials.

Hidden moisture and hidden mold should be checked for, too. (Slide 43)

In some cases, indoor mold growth may not be obvious. Mold does not need light to grow: it can grow in dark areas and on hidden surfaces, such as the backside of drywall, wallpaper, and paneling; the top side of ceiling tiles; and the underside of carpets and pads. Possible locations of hidden mold also include damp areas behind walls and in crawlspaces, inside pipe chases and utility tunnels (areas in walls where water and other pipes are run), on acoustic liners in ventilation ducts, and on roof materials above ceiling tiles.

Tramex Moisture Meter (capacitance type)

Investigators may use moisture meters to find wet areas where mold may be growing. These meters measure the moisture in many types of building materials. They also can monitor the process of drying these materials. A moisture meter typically has a thin probe that can be inserted into the material to be

tested or pressed directly against its surface. Moisture meters can be used on carpet, wallboard, wood, brick, and concrete. Because mold often grows where moisture is high, a moisture meter can help an investigator locate hidden areas of mold growth.

It is important to point out that for mold to grow there must be water that is biologically available. The total moisture content of a building material is different because not all of that water is available to fungus. Moisture meters just measure total water content. They can still be a very useful tool, but they give general information about the potential for mold growth. There are two types: conductance meters (also called pin meters). Capacitance meters do not have pins and do not leave any pin holes in the building material (above). Both types give instant readings.

Limitations to looking for hidden mold

Concealed mold is likely where an organic food sources is exposed to water for more than 1 or 2 days. However, there must be a reason to conduct destructive testing. The American Industrial Hygiene Association provided this guidance in their 2008 document, "Recognition, Evaluation and Control of Indoor Mold."

Feel free to read the quote directly:

"If there are no smells, no complaints and no significant moisture damage, we can be reasonably sure there is no problem and no reason for further investigation."

Small Group Activity: You may want to pass out special tape wipe kits for your students, either in groups, or individually, to collect a sample. It is easy. Just follow the manufacturers recommendations. If a moisture meter is available, have some group demonstrate it to the rest of the class.

Air sampling has value, but it is limited.

Usually, if the mold can be seen, sampling is unnecessary. After finding mold, the goal is to clean it up and fix the underlying water problem. Unless the results would or could make a change in your plans, you don't need to sample. Under certain circumstances, such as when litigation is involved, the source of the mold is unclear, or health concerns are a problem, you may consider sampling as part of your site evaluation. However, routine sampling for mold is not recommended.

Any sampling for mold that is done should be conducted by professionals who have specific experience in designing mold sampling protocols, sampling methods, and interpreting the results. Several problems can occur when sampling. For example, there may be too few samples, sampling protocols may not be followed consistently, samples may become contaminated, or outdoor control samples may be omitted. Sampling can be expensive and sufficient funds may not be available to sample and to fix the water/mold problem. Professional advice may be necessary to determine if the project budget will allow enough samples to be taken to characterize a problem. If sampling cannot be done properly and enough samples to answer the questions posed cannot be taken, then it is preferable not to sample at all. Inadequate sample plans may generate misleading, confusing, and useless results.

Emphasize the last point on this slide, that money spent on sampling could go into fixing the problem. Most of your students are familiar with asbestos air sampling. Tell them there is a big difference: unlike asbestos, mold keeps growing! (Slide 46)

EPA has good moisture control recommendations. (Slide 47)

These EPA recommendations are commonsense, but worthwhile to review with the class. You should suggest the class visit the EPA mold website or use it as a quick group exercise, if connected to the web.

Here are some of the most important ways to control moisture:

- Keep the building clean and dry. Dry wet or damp areas within 48 hours.
- Fix leaky plumbing and leaks in the building envelope as soon as possible.
- Watch for condensation and wet spots. Fix the sources of moisture problems as soon as possible.
- Prevent moisture due to condensation by increasing surface temperature or reducing the moisture level in air (humidity). To increase surface temperature, insulate or increase air circulation. To reduce the moisture level in air, repair leaks and increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid).
- Keep heating, ventilation, and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed.
- Vent moisture generating appliances, such as dryers, to the outside where possible.
- Maintain low indoor humidity, below 60 percent relative humidity (RH), ideally 30 percent to 50 percent, if possible.
- Perform regular building and HVAC inspections and maintenance as scheduled.
- Don't let foundations stay wet. Provide drainage and slope the ground away from the foundation.

SECTION 4
How can workers be protected from mold?

Review these objectives with the class.

OBJECTIVES:

After completing this section, you will be able to:

1. Describe what respiratory protection and other PPE is recommended for protection against airborne mold spores and also surface concentrations of mold.
2. Differentiate between PPE recommended for mold remediation work and PPE for operating a piece of equipment on a demolition job.
3. Describe the importance of basic hygiene in relation to mold exposure.
4. Describe the two basic steps to disinfection.
5. Describe the methods of mold remediation, particularly the relationship between size of the mold contamination and the appropriate remediation approach.

Worker protection increases as the potential exposure increases. (Slide 49)

The protective measures that are selected should be based upon an accurate assessment of the workers' exposure to mold. Work practices, protective equipment and other measures will depend on the level of risk that is likely to be present. Workers need training that will prepare them to safely perform their work where mold is involved. The New York City Department of Health has created the most widely recognized set of guidelines for increasing protection as the size of the job increases.

New York City Department of Health Guidelines on Assessment and Remediation of Fungi in Indoor Environments, 2008 (Slide 50)

Note that the entire NYCDOH guidelines are in the appendices. If time doesn't allow a close review of the 5 levels, you can direct the class to review the appendix on their own time.

Small Isolated Area

The New York guidelines divide remediation jobs into categories. Small isolated areas are 10 square feet or less. The following are recommendations directly from the 2002 version:

- Remediation can be conducted by regular building maintenance staff. Such persons should receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard

N-95 minimum

Eye protection

Communication Standard (29 CFR 1910.1200).

- Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended.
- Gloves and eye protection should be worn.
- The work area should be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons recovering from recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).
- Containment of the work area is not necessary.

Medium-Sized Isolated Areas (Slide 51)

The New York City Department of Health Guidelines set the next catagory as 10-100 square feet. Here is the guidance:

- Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mold exposure. This training can be performed as part of a program to comply with the requirements of the OSHA HazCom standard
- Respiratory protection (e.g., N-95 disposable respirator), in accordance 29 CFR 1910.134 is recommended. Gloves and eye protection should also be worn.
- The work area should be unoccupied.
- Cover the floor, egress pathways, and items left in the work area with plastic sheeting and seal with tape before remediation.
- Seal ventilation ducts/grills and other openings in the work area with plastic sheeting. The HVAC system servicing this area may need to be shut down to properly seal vents.
- Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shroudedtools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.
- Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. Plastic sheeting should be discarded after use. There are no special requirements for disposal of moldy materials.
- The work area and areas used by workers for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution.
- All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see Quality Insurance Indicators) have also been met.

Large Areas greater than 100 square feet in a contiguous area (Slides 52 and 53)

This category must be handled by trained mold remediators. An example is mold on separate walls in a single room, more than 100 square feet of extensive contamination.

Louisiana and Texas have specific requirements for workers in their state.

NYCDOH recommends:

Personnel must be trained in the handling of hazardous materials and equipped with:

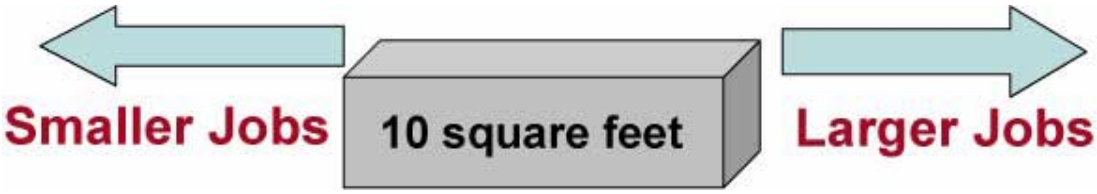
- Half-face elastomeric respirators with P-100 filters (at a minimum);
- Disposable protective clothing covering both head and shoes; and
- Gloves.

Consider containing the affected area through:

- Complete isolation of work area from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts/grills, fixtures, and any other openings);
- The use of an exhaust fan with a HEPA filter to generate negative pressurization; and
- Airlocks and decontamination room.

Remediation of HVAC systems (Slide 54)

Refer to the graphic to make it clear that NYDOH feels that any mold cleanup that is less than ten square feet can be handled by regular building maintenance staff, which would include stationary engineers.



For HVAC clean-up the dividing point is 10 square feet. Less than that is considered a "small isolated area of mold growth" that can be cleaned up by trained maintenance staff, including stationary engineers. Such persons should receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA HazCom Standard (29 CFR 1910.1200).

The following are recommended by NYDOH:

- Respiratory protection (e.g., N95 disposable respirator) following 1910.134.
- Gloves and eye protection.
- The HVAC system should be shut down prior to any remedial activities.
- The work area should be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.
- All areas should be left dry and visibly free from mold, dust and debris. Check that other quality assurance indicators (see Quality Insurance Indicators) have also been met.

HVAC cleaning jobs larger than 10 square feet are to be handled by professional mold remediators. There is a guidance document for them to follow that is produced by the National Air Duct Cleaners Association; the guidance is called the "NADCA General Specifications for the Cleaning of Commercial Heating, Ventilating and Air Conditioning Systems."

Copies are available from:

National Air Duct Cleaners Association
1518 K Street, N.W., Suite 503
Washington, DC 20005
(202) 737-2926 · Fax (202) 347-8847
E-mail nadca@aol.com · Web Site http://www.nadca.com

Cleaning usually doesn't involve biocides, just vacuuming, water and detergent. (Slide 56)

There are two ways to safely clean surfaces that have mold: HEPA vacuum or damp wiping surfaces with water and a small amount of detergent. Biocides are not usually needed and can pose exposure issues for workers. Some are licensed by the EPA and must be handled only by a licensed applicator.

Save or Discard? How would you decide? (Slide 57)

Use this slide to generate a discussion.

A decision will have to be made as to whether building furnishings and materials can be salvaged or have to be discarded. In this photo, a carpet is being dried with a commercial specialty blower with a built-in heater.

Commercial blower with heater drying wet hotel lobby carpet. Photo courtesy of EPA.

Ask them what might drive their decision on whether to discard an item or not. You should get the majority of the following:

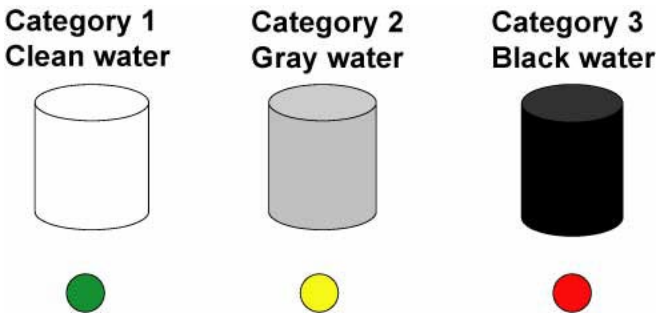
1. Whether the object actually got wet.
2. Whether the object had a hard surface or was porous. This is the basic demarcation line for throwing out objects that have started growing mold.
3. Whether the object is valuable. (The IICRC520 guidance has a section on saving heirloom quality items).
4. How long the object has been wet. (Most guidelines indicate that if it is dry within 48 hours, mold shouldn't grow).
5. Whether the water was clean. (Objects wetted with sewage, if porous, need to be thrown out).

Building materials, furnishings and equipment that cannot be effectively decontaminated should be discarded.

The type of water affects decisions about saving porous belongings. (Slide 58)

Point out that the source of the water is a major criterion for whether a porous belonging can be saved. Ask the class what they think these categories represent and why the green, yellow and red coding has been applied

The Institute for Inspection Cleaning and Restoration in their S500 manual called "Standard Guide for Professional Water Damage Restoration" has three categories of water. Category 1 is clean water that leaks from the piping or comes in as rain. Gray water is clean water that has pooled and is growing bacteria and fungus. Black water is sewage-related and poses a serious threat. The color scheme at the bottom is to remind us to toss out any porous material that is contacted by black water.



IICRC Categories of water from S500 manual.

If in doubt, throw it out! (Slide 59)

The American Industrial Hygiene Association in its 2008 mold guide, "Recognition, Evaluation, and Control of Indoor Mold" makes this strong recommendation on page 75: "If in doubt, throw it out." Hard-surfaced materials can be disinfected, but unfortunately most porous materials will have to be disposed of if there is mold growth. Truly important heirlooms should be turned over to professionals who should follow the IICRC S520 Guide for Professional Mold Remediation.

The training must match the job. (Slide 60)

As when dealing with any other hazard, workers must receive the training they need in order to perform their jobs without being injured or made ill. In general, the bigger and more complex the project involving mold, the greater the potential for exposure and the more training that is necessary. This is similar to the different levels of training that workers must undergo when they need to prevent exposure to asbestos.

Experts on mold developed excellent training guidelines in 2005 for the National Institute of Environmental Health Sciences that recommend training for workers who are involved in maintenance and remediation work involving mold. This guidance, called "Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold," like most materials available, has a graded approach that increases the level of worker protection as the job gets larger. For small repairs and simple cleaning, limited personal protective equipment is adequate. The document can be found at: http://tools.niehs.nih.gov/wetp/

Major mold remediation jobs look more like large asbestos abatement projects. At a minimum, workers should wear full-face respirators with high efficiency particulate air (HEPA) cartridges, along with gloves and disposable protective clothing covering both head and shoes. When there is extensive contamination, the area should be completely isolated from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts/grills, fixtures, and any other openings). An exhaust fan with a HEPA filter to generate negative pressure should be used along with airlocks and a decontamination room. Air monitoring should be conducted prior to occupancy to determine if the area is fit to reoccupy.

Point out for any stationary engineers in the class that the guidance included what training was appropriate for cleaning HVAC under 10 square feet (Level V).

Table 10 from the document gives a breakdown of an 8-hour training that workers should receive in order to perform a lower level job (less than 10 square feet) involving a HVAC system.

Table 10. Low-level HVAC mold maintenance work course.

(Never to exceed 10 square feet in size)

1.	Respiratory Protection in accordance with OSHA respiratory protection standard (29 CFR 1910.134) (e.g., use of the N95 disposable respirator)	2 hours
2.	Proper PPE selection, i.e. gloves and eye protection	0.5 hours
3.	Area containment to avoid mold from spreading to other areas. How to create a positive or negative pressure with your facilities HVAC system and the benefits of doing so. Mold suppression methods. Lockout/tag out.	1 hour
4.	Removal of contaminated material and proper disposal, discussion on the variety of biocides used by HVAC manufactures.	0.75 hours
5.	Final area cleanup using a HEPA vacuum and cleaned with a damp cloth and/or mop with a detergent solution.	0.75 hours
6.	Areas left to dry and visibly free from contamination and debris.	0.5 hours
7.	Prevention fixing-the-leak discussion on the causes of HVAC contamination, humidification, dehumidification, and condensation.	1.5 hours
8.	Performance based test.	1 hour

Prevent exposure during demolition and renovation. (Slide 61)

Minimize Dust

A major strategy to preventing worker exposure is to keep dust down to a minimum as much as possible. Keeping materials wet is a common dust suppression method on demolition sites that can reduce exposures to mold spores as well.

"It is clear that high levels of spores in the air may present a health hazard to exposed workers." (Slide 62)

Read this quote and ask the class, "What are the most likely ways for heavy equipment operators to generate large amount of airborne spores during their work?"

SECTION 5
What laws and guidance are there for mold?

Review these objectives with the class.

OBJECTIVES:

After completing this section, you will be able to:

1. Explain why there is no Occupational Safety and Health Administration (OSHA) standard for mold.

2. Name at least two guidance documents available for work involving mold.

There are no federal regulations and only a few state regulations that protect mold workers.

"No federal agency in the United States is specifically authorized to regulate exposure to indoor mold growth." (Direct quote from AIHA 200 Mold guidance, p.21) There are, however, at least two states that have regulations.

- In 2003 Louisiana passed Act 880 that requires licensure and regulation of mold remediators. It requires that a written mold assessment report clearly identify mold is present before remediation is conducted.

- Texas, in 2004, passed the Mold Assessment and Remediation Rules, which requires licensing and registration of individuals and companies performing mold assessment and remediation. It also licenses mold labs.

There is no OSHA standard for mold!

There are a number of reasons that there is no OSHA standard for mold. Although mold is known to cause a wide range of health problems, there is uncertainty about the relationship between exposure and health effects. Reactions among different people to mold vary widely. No safe level of exposure has been established. Measuring mold and interpreting results is another difficulty. In addition to medical and scientific considerations, decisions about whether and how to regulate substances are always in part political decisions. There has also been no inclination on OSHA's part to establish enforceable rules specifically for mold.

The NIEHS mold training guidance pointed out, however, that mold cleanup may be covered under HAZWOPER:

It should be noted that the OSHA Hazardous Waste Operations and Emergency Response standard at 29 CFR 1910.120 (a)(3)(B) defines hazardous substances to include:

> *Any biologic agent and other disease-causing agent which after release into the environment and upon exposure, ingestion, or assimilation onto any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring.*

Review each of the appendices with the participants and point out that the IICRC guidance is available only through purchase. Also point out the NYC guidelines are being revised and expected to be available in the Fall of 2008.

Guidance for Mold

Although there is no OSHA standard, there is an abundance of useful guidance on how to assess mold problems and protect workers during maintenance and remediation operations. The highlighted documents are included in the appendices of your manual.

- New York City Department of Health & Mental Hygiene: Guidelines on Assessment and Remediation of Fungi in Indoor Environments 2008. (**App. A**)
- United States Environmental Protection Agency: Mold Remediation in Schools and Commercial Buildings (**App. B**)
- National Institute for Environmental Health Sciences: Guidelines for the Training and Protection of Workers Engaged in Maintenance and Remediation Work Associated with Mold 2005 (**App. C**)
- National Institute for Occupational Safety and Health (NIOSH): Interim Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers (**App. D**)
- United States Occupational Safety and Health Administration: A Brief Guide to Mold in the Workplace (**App. E**)
- Institute of Inspection, Cleaning, and Restoration Certification (IICRC): S500 Standard Guide for Professional Water Damage Restoration and S520 Standard and Reference Guide for Professional Mold Remediation. (**Available for purchase**)
- American Industrial Hygiene Association (AIHA): Recognition, Evaluation and Control of Indoor Mold 2008, Edited by Prezant, B., Weekes, D.M. & Miller J.D., (Available for purchase)
- National Air Duct Cleaners Association (NADCA) Assessment, Cleaning and Restoration of HVAC Systems 2002. (Available for purchase)

APPENDICES
Guidelines for Mold

The following documents provide useful guidance on safely performing work involving mold.

Appendix A

New York City Department of Health & Mental Hygiene:

Guidelines on Assessment and Remediation of Fungi in Indoor Environments

Appendix B

United States Environmental Protection Agency:
Mold Remediation in Schools and Commercial Buildings

Appendix C

National Institute for Environmental Health Sciences:

Guidelines for the Training and Protection of Workers Engaged in Maintenance and Remediation Work Associated with Mold (May 2005)

Appendix D

National Institute for Occupational Safety and Health (NIOSH):

Interim Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers

Appendix E

United States Occupational Safety and Health Administration:

A Brief Guide to Mold in the Workplace

APPENDIX A

http://www.nyc.gov/html/doh/html/epi/moldrpt1.shtml

New York City Department of Health & Mental Hygiene Guidelines on Assessment and Remediation of Fungi in Indoor Environments

November 2008

Preface

This 2008 document revises existing guidelines and supersedes all prior editions. It is based both on a review of the current literature regarding fungi (mold) and on comments from a review panel consisting of experts in the fields of mycology/microbiology, environmental health sciences, environmental/occupational medicine, industrial hygiene, and environmental remediation.

These guidelines are intended for use by building owners and managers, environmental contractors and environmental consultants. It is also available for general distribution to anyone concerned about indoor mold growth. The attached fact sheet, "*Mold Growth: Prevention and Cleanup for Building Owners and Managers*," is a simplified summary of these guidelines, which may be useful for building owners, managers and workers. It is strongly recommended that the complete guidelines be referred to before addressing the assessment or remediation of indoor mold growth.

In 1993, the New York City Department of Health and Mental Hygiene (DOHMH) first issued recommendations on addressing mold growth indoors. In 2000, DOHMH made major revisions to the initial guidance and made minor edits in 2002.

The terms *fungi* and *mold* are used interchangeably throughout this document.

This document should be used only as guidance. It is not a substitute for a site-specific assessment and remediation plan and is not intended for use in critical care facilities such as intensive care units, transplant units, or surgical suites. Currently there are no United States Federal, New York State, or New York City regulations for the assessment or remediation of mold growth.

These guidelines are available to the public, but may not be reprinted or used for any commercial purpose except with the express written permission of the DOHMH. These guidelines are subject to change as more information regarding this topic becomes available.

The New York City Department of Health and Mental Hygiene would like to thank the following individuals and organizations for participating in the revision of these guidelines. Please note that these guidelines do not necessarily reflect the opinions of the participants or their organizations.

Donald Ahearn, PhD	Georgia State University
Scott Armour, MS	Armour Applied Science LLC
John Banta, CAIH	Restoration Consultants
Don Bremner	Environmental Abatement Council of Ontario – Restoration Environmental Contractors
Terry Brennan, MS	Camroden Associates Inc.
Armando Chamorro, CIH	CIH Environmental
Ginger Chew, ScD	Columbia University
Sidney Crow, PhD	Georgia State University
Susan Conrath, PhD, MPH	US Public Health Service, Indoor Environments Division
Dorr Dearborn, MD	Rainbow Childrens Hospital
Marie-Alix d'Halewyn	Institut National de Santé Publique du Québec
Eric Esswein, MPH, CIH	US National Institute for Occupational Safety and Health
Elissa Favata, MD	Environmental and Occupational Health Associates
Jean Goldberg, MS, CSP, CIH	The New York University Langone Medical Center
Ling-Ling Hung, PhD	US Public Health Service, Division of Federal Occupational Health
Bruce Jarvis, PhD	University of Maryland at College Park Dept of Chemistry and Biochemistry
Eckardt Johanning, MD, MS	Fungal Research Group Foundation, Inc.
Susan Klitzman, DrPH	Hunter College of the City University of New York
Laura Kolb, MPH	US Environmental Protection Agency, Indoor Environments Division
Ed Light, CIH	Building Dynamics
Bruce Lippy, PhD	The Lippy Group
Gerald Llewellyn, PhD	State of Delaware, Division of Public Health
J David Miller, PhD	Carleton University, Department of Chemistry
Philip Morey, PhD, CIH	Environ Corporation
David Newman, MA, MS	New York Committee for Occupational Safety and Health
Ted Outwater	US National Institute of Environmental Health Sciences
Alex Potievsky	New York City, Citywide Office of Occupational Safety and Health
Ken Ruest	Canada Mortgage and Housing Corporation
Virginia Salares, PhD	Canada Mortgage and Housing Corporation
AnnMarie Santiago	New York City Department of Housing Preservation & Development
Bill Sothern, MS, CIH	Microecologies Inc.
Cole Stanton	Fiberlock
Bruce Stewart, CIH, ROH	Environmental Abatement Council of Ontario – Pinchin Environmental Ltd.
John Tancredi	Environmental Contractors Association of New York City – Pinnacle Environmental Corp.
Donald Weekes, CIH, CSP	InAIR Environmental Ltd.
Chin Yang, Ph.D.	Prestige EnviroMicrobiology Inc

We would also like to thank the many others who offered opinions, comments, and assistance at various stages during the development of these guidelines.

These guidelines were prepared by the Environmental and Occupational Disease Epidemiology Unit of the New York City Department of Health and Mental Hygiene. This document, and any future revisions, is available online at nyc.gov/health. For further information please call 311 or (212) NEW-YORK (from outside the City).

Introduction

Fungi (mold) are present almost everywhere. In an indoor environment hundreds of different kinds of mold are able to grow wherever there is moisture and an organic substrate (food source). They can grow on building and other materials, including: the paper on gypsum wallboard (drywall); ceiling tiles; wood products; paint; wallpaper; carpeting; some furnishings; books/papers; clothes; and other fabrics. Mold can also grow on moist, dirty surfaces such as concrete, fiberglass insulation, and ceramic tiles. It is neither possible nor warranted to eliminate the presence of all indoor fungal spores and fragments; however, mold growth indoors can and should be prevented and removed if present.

The purpose of these guidelines is to provide an approach to address potential and observed mold growth on structural materials in commercial, school, and residential buildings. Mold growth in critical care areas of health-care facilities such as intensive care units or surgery suites may pose significant health concerns to patients. This document is not intended for such situations. Please visit the US Centers for Disease Control and Prevention (CDC) at www.cdc.gov for more information on dealing with mold growth and its cleanup in health-care facilities.[1] Mold on bathroom tile grout, in shower stalls, and on bathtubs is a common occurrence. Occupants can control this growth through frequent use of household cleaners.

Water accumulation in indoor environments can lead to mold growth (and other environmental problems), which has been associated with human health effects (see ***Appendix A***).[2-6] Indoor mold growth can be prevented or minimized, however, by actively maintaining, inspecting, and correcting buildings for moisture problems and immediately drying and managing water-damaged materials. In the event that mold growth does occur, this guide is intended to assist those responsible for maintaining facilities in evaluating and correcting this problem.

Removing mold growth and correcting the underlying cause of water accumulation can help to reduce mold exposures and related health symptoms.[7,8] Prompt remediation of mold-damaged materials and infrastructure repair should be the primary response to mold growth in buildings. The simplest, most expedient remediation that properly and safely removes mold growth from buildings should be used. Extensive mold growth poses more difficult problems that should be addressed on a case-by-case basis in consultation with an appropriate building or environmental health professional. In all situations, the source of water must be identified and corrected or the mold growth will recur.

Effective communication with building occupants is an important component of all remedial efforts. Individuals who believe they have mold-related health problems should see their physicians. Individuals who may have an occupationally related illness should be referred to an occupational/environmental physician for evaluation, following any needed initial care. Clinic contact information is available from the New York State Department of Health at www.health.state.ny.us/environmental/workplace/clinic_network.

Environmental Assessment

The presence of mold growth, water damage, or musty odors should be addressed quickly. In all instances, any sources of water must be identified and corrected and the extent of water damage and any mold growth determined. Water-damaged materials should be removed or cleaned and dried. For additional information on cleaning water-damaged materials and personal belongings, refer to the EPA document "Mold Remediation in Schools and Commercial Buildings."[9]

A trained building or environmental health professional may be helpful in assessing the extent of the moisture problem and mold growth and developing 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.[10]

Visual Inspection

Ceiling tiles, paper-covered gypsum wallboard (drywall), structural wood, and other cellulose-containing surfaces should be given careful attention during a visual inspection. Ventilation systems should be visually checked for damp conditions and/or mold growth on system components such as filters, insulation, and coils/fins, as well as for overall cleanliness.

Equipment such as a moisture meter or infrared camera (to detect moisture in building materials) or a borescope (to view spaces in ductwork or behind walls) may be helpful in identifying hidden sources of mold growth, the extent of water damage, and in determining if the water source is active.

Using personal protective equipment such as gloves and respiratory protection (*e.g.* N-95 disposable respirator) should be considered if assessment work might disturb mold. Efforts should also be made to minimize the generation and migration of any dust and mold.

Environmental Sampling

Environmental sampling is **not** usually necessary to proceed with remediation of visually identified mold growth or water-damaged materials. Decisions about appropriate remediation strategies can generally be made on the basis of a thorough visual inspection. Environmental sampling may be helpful in some cases, such as, to confirm the presence of visually identified mold or if the source of perceived indoor mold growth cannot be visually identified.

If environmental samples will be collected, a sampling plan should be developed that includes a clear purpose, sampling strategy, and addresses the interpretation of results.[11,12] Many types of sampling can be performed (*e.g.* air, surface, dust, and bulk materials) on a variety of fungal components and metabolites, using diverse sampling methodologies. Sampling methods for fungi are not well standardized, however, and may yield highly variable results that can be difficult to interpret.[11-17] Currently, there are no standards, or clear and widely accepted guidelines with which to compare results for health or environmental assessments.

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. Using a laboratory that specializes in environmental mycology is also recommended. The laboratory should be accredited in microbiology by an independent and reputable certifying organization.

For additional information on sampling, refer to the American Conference of Governmental Industrial Hygienists' publication, "Bioaerosols: Assessment and Control" and the American Industrial Hygiene Association's " Field Guide for the Determination of Biological Contaminants in Environmental Samples."[11,18]

Remediation

The goal of remediation is to remove or clean mold-damaged materials using work practices that protect occupants by controlling the dispersion of mold from the work area and protect remediation workers from exposures to mold. The listed remediation methods were designed to achieve this goal; however, they are not meant to exclude other similarly effective methods and are not a substitute for a site-specific work plan. Since little scientific information exists that evaluates the effectiveness and best practices for mold remediation, these guidelines are based on principles used to remediate common indoor environmental hazards. These guidelines are not intended for use in critical care facilities such as intensive care units, transplant units, or surgical suites.

Prior to any remediation, consideration must be given to the potential presence of other environmental hazards, such as asbestos and lead. These guidelines are based on possible health risks from mold exposure and may be superseded by standard procedures for the remediation of other indoor environmental hazards.

Moisture Control and Building Repair

In all situations, the underlying moisture problem must be corrected to prevent recurring mold growth. Indoor moisture can result from numerous causes, such as: façade and roof leaks; plumbing leaks; floods; condensation; and high relative humidity. An appropriate building expert may be needed to identify and repair building problems. An immediate response and thorough cleaning, drying, and/or removal of water-damaged materials will prevent or limit microbial growth.

Relative humidity should generally be maintained at levels below 65% to inhibit mold growth.[19] Short-term periods of higher humidity would not be expected to result in mold growth.[20] However, condensation on cold surfaces could result in water accumulation at much lower relative humidity levels. Relative humidity should be kept low enough to prevent condensation on windows and other surfaces.

Emphasis should be placed on ensuring proper repairs of the building infrastructure so that water intrusion and moisture accumulation is stopped and does not recur.

Worker Training

Proper training of workers is critical in successfully and safely remediating mold growth.[21,22] 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, 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" lists minimum training criteria for building maintenance and mold remediation workers that should be completed before addressing indoor mold growth.[23]

Trained building maintenance staff can address limited and occasional mold growth. For larger jobs, more extensively trained mold remediation workers may be needed.

Cleaning Methods

Non-porous materials (*e.g.* metals, glass, and hard plastics) can almost always be cleaned. Semi-porous and porous structural materials, such as wood and concrete can be cleaned if they are structurally sound. Porous materials, such as ceiling tiles and insulation, and wallboards (with more than a small area of mold growth) should be removed and discarded. Wallboard should be cleaned or removed at least six inches beyond visually assessed mold growth (including hidden areas, see ***Visual Inspection***) or wet or water-damaged areas.[24] A professional restoration consultant should be contacted to restore valuable items that have been damaged.

Cleaning should be done using a soap or detergent solution. Use the gentlest cleaning method that effectively removes the mold to limit dust generation. All materials to be reused should be dry and visibly free from mold. Consideration should also be given to cleaning surfaces and materials adjacent to areas of mold growth for settled spores and fungal fragments. A vacuum equipped with a High-Efficiency Particulate Air (HEPA) filter could also be used to clean these adjacent areas.

Disinfectants are seldom needed to perform an effective remediation because removal of fungal growth remains the most effective way to prevent exposure. Disinfectant use is recommended when addressing certain specific concerns such as mold growth resulting from sewage waters. If disinfectants are considered necessary, additional measures to protect workers and occupants may also be required. Disinfectants must be registered for use by the United States Environmental Protection Agency (EPA). Any antimicrobial products used in a HVAC system must be EPA-registered specifically for that use.

The use of gaseous, vapor-phase, or aerosolized (*e.g.* fogging) biocides for remedial purposes is **not** recommended. Using biocides in this manner can pose health concerns for people in occupied spaces of the building and for people returning to the treated space. Furthermore, the effectiveness of these treatments is unproven and does not address the possible health concerns from the presence of the remaining non-viable mold.

Quality Assurance Indicators

Measures to ensure the quality and effectiveness of remediation should be undertaken regardless of the project size. Evaluations *during* as well as *after* remediation should be conducted to confirm the effectiveness of remedial work, particularly for large-scale remediation. At minimum, these quality assurance indicators should be followed and documented:

- The underlying moisture problem was identified and eliminated
- Isolation of the work area was appropriate and effective
- Mold removal and worksite cleanup was performed according to the site-specific plan
- Any additional moisture or mold damage discovered during remediation was properly addressed
- Upon completion of remediation, surfaces are free from visible dust and debris.
- If environmental sampling was performed, the results of such sampling were evaluated by a trained building or environmental health professional.[10]

Restoring Treated Spaces

After completing mold remediation and correcting moisture problems, building materials that were removed should be replaced and brought to an intact and finished condition. The use of new building materials that do not promote mold growth should be considered. Anti-microbial paints are usually unnecessary after proper mold remediation. They should not be used in lieu of mold removal and proper moisture control, but may be useful in areas that are reasonably expected to be subject to moisture.

Remediation Procedures

Three different sizes of remediation and the remediation of heating, ventilation, and air-conditioning (HVAC) systems are described below. Currently, existing research does not relate the amount of mold growth to the frequency or severity of health effects. However, as the presence of moldy materials increases, so does the potential for exposure[8] and the need to limit the spread of mold-containing dusts and worker exposures. As such, the size of the area impacted by mold growth as well as practical considerations were used to help define remedial procedures.

Since the following areas were arbitrarily selected, site-specific conditions must be considered in choosing adequate remediation procedures. For more information on the unique characteristics of building types and occupancies that may influence remediation procedures refer to the American Industrial Hygiene Association's publication, "Recognition, Evaluation, and Control of Indoor Mold."[25]

Small Isolated Areas (10 square feet or less) – *e.g.* ceiling tiles, small areas on walls

(a) Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mold exposure. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g., N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should also be worn.

(c) The work area should be unoccupied.

(d) If work may impact difficult-to-clean surfaces or items (e.g. carpeting, electronic equipment), the floor of the work area, egress pathways, and other identified materials/belongings should be removed or covered with plastic sheeting and sealed with tape before remediation.

(e) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(f) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in a sealed plastic bag(s). Plastic sheeting should be discarded after use. There are no special requirements for the disposal of moldy materials.

(g) The work area and areas used by workers for egress should be HEPA-vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) or cleaned with a damp cloth and/or mop and a soap or detergent solution.

(h) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see ***Quality Insurance Indicators***) have also been met.

Medium-Sized Isolated Areas (10 – 100 square feet)

(a) Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mold exposure. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g., N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should also be worn.

(c) The work area should be unoccupied.

(d) Cover the floor, egress pathways, and items left in the work area with plastic sheeting and seal with tape before remediation.

(e) Seal ventilation ducts/grills and other openings in the work area with plastic sheeting. The HVAC system servicing this area may need to be shut down to properly seal vents.

(f) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(g) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. Plastic sheeting should be discarded after use. There are no special requirements for disposal of moldy materials.

(h) The work area and areas used by workers for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution.

(i) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see ***Quality Insurance Indicators***) have also been met.

Large Areas (greater than 100 square feet in a contiguous area) – *e.g.* on separate walls in a single room

Properly trained and equipped mold remediation workers should conduct the remediation. The presence of a trained building or environmental health professional (see ***Environmental Assessment***) to provide oversight during remediation may be helpful to ensure quality work and compliance with the work plan. The following procedures are recommended:

(a) Personnel trained in the handling of mold-damaged materials equipped with:

i. A minimum of half-face elastomeric respirators with P-100 filters used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134)
ii. Full body coveralls with head and foot coverings
iii. Gloves and eye protection

(b) Containment of the affected area:

i. The HVAC system servicing this area should be shut down during remediation.
ii. Isolation of the work area using plastic sheeting sealed with duct tape. Furnishings should be removed from the area. Ventilation ducts/grills, any other openings, and remaining fixtures/furnishings should be covered with plastic sheeting sealed with duct tape.
iii. Consider using an exhaust fan equipped with a HEPA filter to generate negative pressurization.
iv. Consider using airlocks and a clean changing room.
v. Egress pathways should also be covered if a clean changing room is not used.

(c) The work area should be unoccupied.

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) Moldy materials, that can be cleaned, should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a soap or detergent solution or HEPA-vacuumed in the work area (or clean changing room) prior to their transport to unaffected areas of the building. There are no special requirements for the disposal of moldy materials.

(f) Before leaving isolated areas, workers should remove disposable clothing to prevent the tracking of mold-containing dusts outside of the work area.

(g) The work area and egress pathways (and clean changing room if present) should be HEPA-vacuumed and cleaned with a damp cloth and/or mop with a soap or detergent solution and be visibly clean prior to the removal of isolation barriers. Plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see ***Quality Insurance Indicators***) have also been met.

Remediation of HVAC Systems

Mold growth in heating, ventilation, and air-conditioning (HVAC) systems can pose building-wide problems. Obtaining professional help should always be considered in addressing even small amounts of mold growth or moisture problems within an HVAC system. Recurring problems, regardless of size, may indicate a systemic problem and appropriate professional help should be sought.

Small Isolated Area of Mold Growth in the HVAC System (<10 square feet)

– *e.g.* box filter, small area on insulation

(a) Remediation can be conducted by trained building maintenance staff that are familiar with the design and function of the impacted HVAC system. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (*e.g.* N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.

(c) The HVAC system should be shut down prior to any remedial activities.

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) The use of plastic sheeting to isolate other sections of the system should be considered.

(f) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Growth-supporting materials that are moldy, such as the insulation of interior-lined ducts, flexible ducts, and filters, should be removed and sealed in plastic bags. There are no special requirements for the disposal of moldy materials.

(g) The work area and areas used for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution. Any plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mold, dust and debris. Check that other quality assurance indicators (see ***Quality Insurance Indicators***) have also been met.

Large Area of Mold Growth in the HVAC System (>10 square feet)

Properly trained and equipped mold remediation workers with specific training and experience in HVAC systems, should conduct the remediation. The presence of a trained building or environmental health professional (see Environmental Assessment) with experience and specific knowledge of HVAC systems, to provide oversight during remediation can be helpful to ensure quality work and compliance with the work plan. The following procedures are recommended:

(a) Personnel trained in the handling of mold-damaged materials equipped with:

i. A minimum of half-face elastomeric respirators with P-100 filters used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134)
ii. Full body coveralls with head and foot coverings
iii. Gloves and eye protection

(b) The HVAC system should be shut down prior to any remedial activities.

(c) Containment of the affected area:

i. Isolation of work area from the other areas of the HVAC system using plastic sheeting sealed with duct tape
ii. The use of an exhaust fan equipped with a HEPA filter to generate negative pressurization should be considered
iii. Consider using airlocks and a clean changing room
iv. Egress pathways should also be covered if a clean changing room is not used

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Growth-supporting materials that are moldy, such as the insulation of interior-lined ducts, flexible ducts, and filters, should be removed in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a soap or detergent solution or HEPA-vacuumed prior to their removal from the isolated work area. There are no special requirements for the disposal of moldy materials.

(f) Before leaving isolated areas, workers should remove disposable clothing to prevent the tracking of mold-containing dust outside of the work area.

(g) The work area and egress pathways (and clean changing room if present) should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution prior to the removal of isolation barriers. Plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see ***Quality Insurance Indicators***) have also been met.

Communication with Building Occupants

Communication with occupants of affected spaces is important regardless of the size of the project but is especially important when mold growth requiring large-scale remediation is found. When large-scale remediation is performed, the building owner, management, and/or employer should notify occupants in the building. Notification should include a description of the remedial measures to be taken and a timetable for completion. Group meetings, held before and after remediation, with full disclosure of plans and results, can be an effective communication mechanism. Building occupants should be provided with a copy of all inspection reports upon request. For more detailed information on risk communication refer to the American Industrial Hygiene Association's publication, "Recognition, Evaluation, and Control of Indoor Mold."[26]

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Appendix A

Health Effects

Several comprehensive reviews of the scientific literature on the health effects of mold in indoor spaces have been published in recent years.[1-3] This appendix reflects these reviews but has also considered more recently published articles.

Potential for Exposure and Health Effects

Fungi are common in both indoor and outdoor environments and play a vital role in the earth's ecology by decomposing organic matter such as dead trees and leaves. As a result, all people have routine exposure to fungi, which may occur through inhalation, ingestion, and touching moldy surfaces.
The main route of exposure to mold for people living or working in moldy indoor environments is inhalation of airborne fungal spores, fragments, or metabolites.[2] Ingestion and dermal exposures are less understood in these scenarios and can easily be minimized or prevented by workers through proper hygiene and work practices. Therefore, the remaining discussion will focus on the adverse health effects of mold due to inhalational exposure.

Adverse health effects may include: allergic reactions; toxic effects and irritation; and infections.[1-5] The mere presence of mold growth does not necessarily indicate that people present in the area will exhibit adverse health effects. However, as the amount of mold-impacted materials increases, so do potential exposures. Certain exposures may represent a significant risk such as occupational exposures to high concentrations of fungi and chronic (long-term) exposures, especially of individuals with underlying health conditions such as asthma, compromised immune systems, or allergies.

Evidence linking mold exposures to severe human health effects is documented in reports of occupational disease, particularly in forestry and agricultural settings where inhalation exposures were typically high and/or chronic.[2,6-11] The intensity of mold exposure and associated health effects experienced in undisturbed indoor environments is usually much less severe than that experienced by agricultural or forestry workers.[2,7,12-14] With the possible exception of exposures from mold remediation work, such high-level exposures are not expected indoors.[15-16] Although high-level exposures are unlikely to occur in undisturbed indoor settings, chronic exposures to lower levels may still raise health concerns.

Several factors influence the likelihood that individuals might experience health effects following exposure to mold in indoor environments. These include: the nature of the fungal material (e.g., allergenic, toxic/irritant, or infectious); the degree of exposure (amount and duration); and the susceptibility of exposed people. Susceptibility varies with genetic predisposition, age, state of health, concurrent exposures, and previous sensitization. It is not possible to determine "safe" or "unsafe" levels of exposure for the general public because of variation of individual susceptibility, lack of standardized and validated environmental exposure sampling methods, and lack of reliable biological markers. [17]
In addition to the adverse health effects associated with exposure to mold, in 2004, the Institute of Medicine (IOM) reported health risks associated with living in damp indoor environments. The IOM

reported evidence suggesting an association between damp indoor environments and the development of asthma. Reported respiratory symptoms included, wheezing, coughing, and exacerbation of asthma.[2]

Allergic and Hypersensitivity Effects

It is well established that fungi can cause allergic reactions in humans. The most common symptoms associated with allergic reactions include runny nose, sneezing, post-nasal drip with sore throat, eye irritation, cough, wheeze, and other symptoms associated with the aggravation of asthma.[2,13,18-23] Immunological responses to mold include allergic rhinitis, hypersensitivity pneumonitis, and asthma exacerbations. These conditions require prior exposure for sensitization. These symptoms may persist for some time after removal from the source.

Allergic rhinitis is a group of symptoms that mostly affects the mucous membranes of nasal passages and may result from an allergic reaction to fungi. Symptoms often associated with "hay fever" such as congestion, runny nose, and sneezing may occur.[5,24]

Hypersensitivity pneumonitis (HP) is a rare lung disease with delayed onset (3-8 hours) of fever, shortness of breath, cough, chest tightness, chills, and general malaise. With continued exposure, HP can lead to permanent lung disease. The occurrence of HP, even among those that are highly exposed to fungi, is rare. HP has typically been associated with repeated heavy exposures in forestry and agricultural settings, which raises concerns for workers routinely performing mold remediation, but has also been reported in indoor settings with lower level chronic exposures.[3,11,18,25-27]

Allergic bronchopulmonary aspergillosis (ABPA) and allergic fungal sinusitis (AFS) are examples of rarely occurring allergic reactions to non-invasive fungal growth in the respiratory system. Most symptoms are non-specific resembling asthma or chronic sinusitis. In addition, ABPA and AFS usually occur in those with underlying medical problems. In the case of ABPA, this includes cystic fibrosis, asthma, and other predisposing medical conditions.[28,29]

Recent studies, which have suggested an association between the presence of indoor mold and the development of asthma or allergies, are limited and difficult to interpret. Stark *et al.* found higher concentrations of dust-borne mold in infants' homes were associated with development of allergic rhinitis, which is a known risk factor for childhood asthma.[24] However, other studies have shown higher concentrations of dust-borne fungi and other microorganisms in infants' homes were associated with a *decreased* risk for asthma and wheezing.[30,31] Jaakkola et al. reported an association between a moldy odor in the home and development of asthma, but no association with visible mold or water damage was found. Although the sample size for this subset was small, it suggests that active mold growth might be a stronger risk factor for certain health effects than presence of nonviable or inactive mold alone.[32] This also is supported by recent studies that have shown allergen production is significantly increased during active growth.[33,34]

Though available, allergy testing for molds is limited, subject to high rates of error, and can be difficult to interpret. Preparations for skin testing or the specific antigen in blood tests may be different from the mold to which an individual is sensitive. A positive test indicates an allergic response but does not definitively link a specific mold exposure to an individual's current health condition.[5]

Irritant and Toxic Effects

Irritant Effects

Indoor growth of mold can lead to the production of volatile organic compounds (VOCs), also referred to as microbial VOCs (MVOCs), and the presence of fungal glucans.[13,35-38] Glucans are components of many fungal cell walls. Some studies have reported an association with the inhalation of glucans and airway irritation and inflammation, but results have been mixed and may not be applicable to expected indoor concentrations. Observed effects may also be the result of exposure to or contact with other fungal components, metabolites, or synergistic effects with other microbial agents.[17,36,39] Resolution of irritant symptoms upon removal from the source can help distinguish irritant effects from allergic symptoms.[5]

MVOCs are responsible for the musty odor often associated with mold growth, which may be noticeable at very low concentrations. Many of the MVOCs are common to other sources in the home.[40] The very low levels usually found indoors have not been shown to cause health effects.[35,37]

Toxic Effects

Some symptoms and maladies have been attributed to the toxic effects of fungi in indoor environments. Certain fungi can produce toxins (mycotoxins) at varying levels that are dependent on many complex environmental and biological factors.[41] The reported symptoms from exposure to mycotoxins indoors include headaches, irritation, and nausea/loss of appetite, but are often non-specific (*e.g.* fatigue, inability to concentrate/remember), and may be caused by other environmental and non-environmental agents.[2,42-46] Although health effects from exposures to mycotoxins have been associated with certain occupational exposures or ingestion of mold-contaminated food, scientific support for the reported effects in indoor environments has not been established. This may be due to the lower levels of exposure and different routes of exposure.[2,5,13,21,27,46-49]

Stachybotrys is colloquially referred to as "black mold" or "toxic mold." It has been suggested that toxins produced by this mold are associated with specific health effects. Acute Idiopathic Pulmonary Hemorrhage (AIPH) in infants has been described in several reports suggesting a relationship with *Stachybotrys*. AIPH is an uncommon condition that results in bleeding in the lungs. The IOM reviewed the existing studies and concluded that there was insufficient evidence to determine if mold exposure was associated with AIPH.[2,3] The evidence is also insufficient for an association between inhalation of *Stachybotrys* toxins indoors and neurological damage.[2,26,49] Although severe health effects from the inhalation exposures to *Stachybotrys* toxins indoors is plausible, it is not well-supported, and the issue remains controversial.[2,3,5,27,49,50]

Organic dust toxic syndrome (ODTS) describes the abrupt onset of fever, flu-like symptoms, and respiratory symptoms in the hours following a single, heavy exposure to dust-containing fungi and other microorganisms. Unlike HP, ODTS does not require repeated exposures to bioaerosols and can occur after the first exposure. ODTS has been documented in farm workers handling contaminated material, but may also affect workers performing remediation of building materials with widespread mold growth.[2,11,27] ODTS is a self-limited illness, which usually improves within 24 hours after the discontinuation of exposure. It may be underreported among workers exposed to fungi, but would not be expected in occupants of buildings with mold growth.[11,27]

Infectious Disease

Only a small number of fungi have been associated with infectious disease. Few of these fungi are typically found in the indoor environment.[51,52] Several species of *Aspergillus* are known to cause aspergillosis, most commonly *A. fumigatus*, *A. flavus,* and rarely, other species. Aspergillosis is a disease that generally affects severely immunosuppressed persons. Exposure to these molds, even in high concentrations, is unlikely to cause infection in healthy individuals.[21,53] Heavy exposure to fungi associated with bird and bat droppings (*e.g. Histoplasma capsulatum* and *Cryptococcus neoformans*) can lead to health effects, usually transient flu-like illnesses, in healthy individuals. More severe health effects are primarily encountered in immunocompromised persons.[18,54]

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FACT SHEET

MOLD GROWTH – PREVENTION AND CLEANUP FOR BUILDING OWNERS AND MANAGERS

Mold can grow indoors on many wet or damp building materials. Mold may cause health problems in some people. Mold needs water or moisture to grow. Stop indoor mold growth by fixing leaks, drying wet materials, and cleaning up the mold.

THINGS BUILDINGS OWNERS AND MANAGERS CAN DO TO PREVENT MOLD GROWTH

Fix Water Problems

- Correct water leaks immediately
- Dry any water-damaged items immediately

Control Moisture Sources

- Make sure that bathroom exhaust fans are working, if present
- Make sure that a bathroom window can be opened, if no exhaust vent is present
- Use a dehumidifier to keep humidity levels low in basements

HOW TRAINED BUILDING MAINTENANCE STAFF CAN CLEAN MOLD GROWTH

First, look to see how much damage there is, including any hidden mold growth. If the mold covers a large area (more than 100 square feet), is in the HVAC system, or is difficult to get to, you may need professional help. If the there is less than 100 square feet of mold growth then you should be able to handle the cleanup job yourself:

- Inform affected building occupants about the plan to clean
- Occupants should be removed from the work area before cleaning
- Cover or remove difficult-to-clean surfaces or items (e.g. carpeting, electronics) from the work area before cleaning
- Maintenance staff should use safety goggles, gloves, and a disposable respirator when removing mold growth
- Cleaning should be done using soap or detergent, and water
- Most porous materials (e.g. ceiling tiles, insulation) that are moldy should be removed and thrown away
- If more than a small area (10 square feet) of mold growth is present:
    - ü Cover the floor in the work area with plastic sheeting
    - ü Cover entry and exit pathways with plastic sheeting
    - ü Seal any ventilation ducts with plastic sheeting
    - ü Mop and/or HEPA-vacuum the work area and pathways
- Dispose of any plastic sheeting, moldy materials, and used sponges or rags in sealed heavy-duty plastic bags.
- If the mold returns quickly or spreads, you may have an ongoing water problem. Fix water problems immediately.
- For complete recommendations on the assessment and remediation of mold, visit our web site at nyc.gov/health

SUGGESTED SUPPLIES TO CLEAN MOLD GROWTH

- Soap or detergent
- Disposable rags/sponges and scrub brush
- Buckets
- Heavy-duty plastic garbage bags
- Protective gear (goggles, rubber gloves, N95 respirator)

FOR MORE INFORMATION

Visit our web site at nyc.gov/health for complete recommendations on mold removal or call the New York City Department of Health and Mental Hygiene. In NYC, call 311.

NOTES

APPENDIX B

United States Environmental Protection Agency (EPA)

Mold Remediation in Schools and Commercial Buildings

This EPA document provides guidance on investigating, evaluating, and remediating moisture and mold problems in schools and commercial buildings.

Table 1: Water Damage - Cleanup and Mold Prevention

Table 1 presents strategies to respond to water damage within 24-48 hours. These guidelines are designed to help avoid the need for remediation of mold growth by taking quick action before growth starts. If mold growth is found on the materials listed in Table 1, refer to Table 2 for guidance on remediation. Depending on the size of the area involved and resources available, professional assistance may be needed to dry an area quickly and thoroughly.

Table 1: Water Damage - Cleanup and Mold Prevention	
Guidelines for Response to Clean Water Damage within 24-48 Hours to Prevent Mold Growth*	
Water-Damaged Material†	**Actions**
Books and papers	• For non-valuable items, discard books and papers. • Photocopy valuable/important items, discard originals. • Freeze (in frost-free freezer or meat locker) or freeze-dry.
Carpet and backing - dry within 24-48 hours§	• Remove water with water extraction vacuum. • Reduce ambient humidity levels with dehumidifier. • Accelerate drying process with fans.
Ceiling tiles	• Discard and replace.
Cellulose insulation	• Discard and replace.

Concrete or cinder block surfaces	• Remove water with water extraction vacuum. • Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass insulation	• Discard and replace.
Hard surface, porous flooring§ (Linoleum, ceramic tile, vinyl)	• Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. • Check to make sure underflooring is dry; dry underflooring if necessary.
Non-porous, hard surfaces (Plastics, metals)	• Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	• Remove water with water extraction vacuum. • Accelerate drying process with dehumidifiers, fans, and/or heaters. • May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/ water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	• May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. • Ventilate the wall cavity, if possible.
Window drapes	• Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	• Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) • Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. • Wet paneling should be pried away from wall for drying.

* If mold growth has occurred or materials have been wet for more than 48 hours, consult Table 2 guidelines. Even if materials are dried within 48 hours, mold growth may have occurred. Items may be tested by professionals if there is doubt. Note that mold growth will not always occur after 48 hours; this is only a guideline.

These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then Personal Protective Equipment and containment are required by OSHA. An experienced professional should be consulted if you and/or your remediators do not have expertise remediating in contaminated water situations. Do not use fans before determining that the water is clean or sanitary.

† If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.

§ The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.

Table 2 presents remediation guidelines for building materials that have or are likely to have mold growth. The guidelines in Table 2 are designed to protect the health of occupants and cleanup personnel during remediation. These guidelines are based on the area and type of material affected by water damage and/or mold growth. Please note that these are guidelines; some professionals may prefer other cleaning methods.

If you are considering cleaning your ducts as part of your remediation plan, you should consult EPA's publication entitled, Should You Have the Air Ducts In Your Home Cleaned?(8) (see Resources List). If possible, remediation activities should be scheduled during off-hours when building occupants are less likely to be affected.

Although the level of personal protection suggested in these guidelines is based on the total surface area contaminated and the potential for remediator and/or occupant exposure, professional judgment should always play a part in remediation decisions. These remediation guidelines are based on the size of the affected area to make it easier for remediators to select appropriate techniques, not on the basis of health effects or research showing there is a specific method appropriate at a certain number of square feet. The guidelines have been designed to help construct a remediation plan. The remediation manager will then use professional judgment and experience to adapt the guidelines to particular situations. When in doubt, caution is advised. Consult an experienced mold remediator for more information.

In cases in which a particularly toxic mold species has been identified or is suspected, when extensive hidden mold is expected (such as behind vinyl wallpaper or in the HVAC system), when the chances of the mold becoming airborne are estimated to be high, or sensitive individuals (e.g., those with severe allergies or asthma) are present, a more cautious or

conservative approach to remediation is indicated. Always make sure to protect remediators and building occupants from exposure to mold.

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*

Material or Furnishing Affected	Cleanup Methods†	Personal Protective Equipment	Containment
SMALL - Total Surface Area Affected Less Than 10 square feet (ft2)			
Books and papers	3	Minimum N-95 respirator, gloves, and goggles	None required
Carpet and backing	1,3		
Concrete or cinder block	1,3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3		
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,3		
Wallboard (drywall and gypsum board)	3		
Wood surfaces	1,2,3		
MEDIUM - Total Surface Area Affected Between 10 and 100 (ft2)			
Books and papers	3	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1,3,4		
Concrete or cinder block	1,3		

Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3,4	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,3,4		
Wallboard (drywall and gypsum board)	3,4		
Wood surfaces	1,2,3,4		
LARGE - Total Surface Area Affected Greater Than 100 (ft2) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant			
Books and papers	3	Full Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area	Full Use professional judgment, consider potential for remediator exposure and size of contaminated area
Carpet and backing	1,3,4		
Concrete or cinder block	1,3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3,4		
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,3,4		
Wallboard (drywall and gypsum board)	3,4		
Wood surfaces	1,2,3,4		

*Use professional judgment to determine prudent levels of Personal Protective Equipment and containment for each situation, particularly as the remediation site size increases and the potential for exposure and health effects rises. Assess the need for increased Personal Protective Equipment, if, during the remediation, more extensive contamination is encountered than was expected. Consult Table 1 if materials have been wet for less than 48 hours, and mold growth is not apparent. These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then the Occupational Safety and Health Administration (OSHA) requires PPE and containment. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating contaminated water situations.

†Select method most appropriate to situation. Since molds gradually destroy the things they grow on, if mold growth is not addressed promptly, some items may be damaged such that cleaning will not restore their original appearance. If mold growth is heavy and items are valuable or important, you may wish to consult a restoration/water damage/remediation expert. Please note that these are guidelines; other cleaning methods may be preferred by some professionals.

Cleanup Methods

- **Method 1:** Wet vacuum (in the case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried). Steam cleaning may be an alternative for carpets and some upholstered furniture.

- **Method 2:** Damp-wipe surfaces with plain water or with water and detergent solution (except wood —use wood floor cleaner); scrub as needed.

- **Method 3:** High-efficiency particulate air (HEPA) vacuum after the material has been thoroughly dried. Dispose of the contents of the HEPA vacuum in well-sealed plastic bags.

- **Method 4:** Discard - remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

Personal Protective Equipment (PPE)

- Minimum: Gloves, N-95 respirator, goggles/eye protection

- Limited: Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection

- Full: Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filter

Containment

- Limited: Use polyethylene sheeting ceiling to floor around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA filtered fan unit. Block supply and return air vents within containment area.
- Full: Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA filtered fan exhausted outside of building. Block supply and return air vents within containment area.

Table developed from literature and remediation documents including Bioaerosols: Assessment and Control (American Conference of Governmental Industrial Hygienists, 1999) and IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration, (Institute of Inspection, Cleaning and Restoration, 1999); see Resources List for more information

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7. Please note that Table 1 and Table 2 contain general guidelines. Their purpose is to provide basic information for remediation managers to first assess the extent of the damage and then to determine whether the remediation should be managed by in-house personnel or outside professionals. The remediation manager can then use the guidelines to help design a remediation plan or to assess a plan submitted by outside professionals.

8. Although this document has a residential focus, it is applicable to other building types.

APPENDIX C

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

Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold

Sponsored by:
The National Institute of Environmental Health Sciences WETP
The Society for Occupational and Environmental Health
The Association of Occupational and Environmental Clinics
The Urban Public Health Program of Hunter College, CUNY
The New York City Department of Health and Mental Hygiene
The University of Medicine and Dentistry of New Jersey, School of Public Health

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Edited by:
The National Clearinghouse for Worker Safety and Health Training
Operated by MDB, Inc.
1250 Connecticut Avenue NW, Suite 610, Washington DC, 20036
202-331-0060 Telephone
202-331-0044 Facsimile
http://www.wetp.org

Electron micrograph courtesy Dr. Berlin Nelson, American Phytopathological Society

This document is a summary of NIEHS-sponsored workshops that were held to develop experience-based guidelines for protecting and training mold hazard assessors, mold remdiation workers, and workers exposed to mold in the course of maintaining building systems. The guidance contains recommendations on:

- Conducting a needs assessment of the audience to be trained
- Developing learning objectives and identifying prerequisites for the trainees
- Designing the course
    - Content
    - Delivery method
    - Time allocation
    - Evaluation strategy

APPENDIX D

http://www.cdc.gov/niosh/topics/flood/Cleaning-Flood-HVAC.html

NIOSH Interim Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers

Introduction

During flooding, systems for heating, ventilating, and air conditioning (HVAC) can become submerged in flood waters. As a result, these systems may contain substantial amounts of dirt and debris and may also become contaminated with various types of microorganisms such as bacteria and fungi. The following recommendations will help ensure that HVAC systems contaminated with flood water are properly cleaned and remediated to provide healthy indoor environments. Microorganisms may grow on all surfaces of HVAC system components that were submerged in flood waters. In addition, moisture can collect in HVAC system components that were not submerged (such as air supply ducts above the water line) and can promote the growth of microorganisms. Therefore, all components of the HVAC system that were contaminated with flood water or moisture should be thoroughly inspected, cleaned of dirt and debris, and disinfected by a qualified professional. The following recommendations will help ensure that HVAC systems contaminated with flood water are properly cleaned and remediated to provide healthy indoor environments.

These interim recommendations are based on current knowledge as of September 21, 2005; the recommendations will be updated and revised as appropriate, as additional information becomes available.

Steps Before Cleaning and Remediation

- If the building is to remain partly occupied (for example, on upper floors not affected by flood waters), isolate the construction areas where HVAC systems will be cleaned and remediated by using temporary walls, plastic sheeting, or other vapor-retarding barriers. Maintain the construction areas under negative pressure (relative to adjacent non-construction areas) by using blowers equipped with HEPA filters (high-efficiency particulate air filters) to exhaust the area. To ensure complete isolation from the construction areas, it may be necessary to pressurize the adjacent non-construction areas and temporarily relocate the outdoor-air intake for the HVAC system serving the occupied areas.

- Take precautions to protect the health of workers who are cleaning and remediating the HVAC system. Make sure that workers wear at least an N-95 NIOSH-approved respirator to protect against airborne microorganisms. Increased levels of respiratory protection (for example, powered, air-purifying respirators equipped with HEPA filters) may be appropriate depending on the

level of visible contamination. In addition, when using chlorine bleach or other disinfectants in poorly ventilated environments, it may be necessary to use appropriate chemical cartridges in addition to the particulate filters to protect workers from breathing the chemical vapors. Employers must implement a complete respiratory protection program that meets the requirements of the OSHA respiratory protection standard (29 Code of Federal Regulations 1910.134). The minimum requirements for a respiratory protection program include a written standard operating procedure for the following: selecting and using respirators; the medical evaluation of workers to determine whether they are physically able to wear the respirator selected for use; training and instructions on respirator use; the cleaning, repair, and storage of respirators; the continued surveillance of work area conditions for worker exposure and stress; and a respirator fit-testing program. For tight-fitting respirators, fit-testing is necessary to help ensure that the respirator fits tightly, reducing the potential for leakage of outside air from around the edge of the mask. In addition, employers must provide workers with appropriate skin, eye, and hearing protection for the safe performance of their jobs.

HVAC Cleaning and Remediation

- Remove all flood-contaminated insulation surrounding and within HVAC system components. Discard these contaminated materials appropriately following applicable Federal, State, and local regulations.

- Remove contaminated HVAC filter media and discard appropriately following applicable Federal, State, and local regulations.

- After removing any insulation and filters, clean all flood-contaminated HVAC system component surfaces with a HEPA-filtered vacuum cleaner to remove dirt, debris, and microorganisms. Pay special attention to filter racks, drain pans, bends and horizontal sections of air ducts where debris can collect.

- After removing any insulation or debris, disinfect all HVAC system component surfaces while the HVAC system is not operating. Use a solution of 1 cup of household chlorine bleach in a gallon of water. Do not mix bleach with other cleaning products that contain ammonia.

- Follow the disinfection procedure with a clean water rinse. Depending on the amount of debris present, it may be necessary to mechanically clean the HVAC system component surfaces with a steam or a high-pressure washer before using the disinfectant.

Note: Remove and discard HVAC system components that are contaminated with flood water and cannot be effectively cleaned and disinfected. Replace them with new components.

- After cleaning and disinfecting or replacing the HVAC system components,

replace the insulation – preferably with an external (i.e. not in the air stream) smooth-surfaced insulation to help prevent debris and microorganisms from collecting in the future.

- Make sure that the HVAC system fan has been removed and serviced (cleaned, disinfected, dried thoroughly, and tested) by a qualified professional before it is placed back into the air-handling unit.

- During the cleaning and remediation process, consider upgrading the HVAC system filtration to the highest efficiency filters practical given the static pressure constraints of the HVAC system fan. This step has been shown to be one of the most cost-effective ways to improve the long-term quality of the indoor environment, since it reduces the amount of airborne dusts and microorganisms.

Resuming HVAC Operations

- After cleaning and disinfecting or replacing HVAC system, have a qualified professional thoroughly evaluate its performance and correct it as necessary before the building is occupied again. The HVAC system performance should conform to the recommendations contained in ASHRAE Standard 62-2004, Ventilation for Acceptable Indoor Air Quality.

- Before the building is occupied again, operate the HVAC system continuously in a normal manner at a comfortable temperature for 48 to 72 hours. During this period, it may be beneficial to open the HVAC outdoor air dampers to the maximum setting that still allows you to provide the desired indoor air temperatures. If objectionable flood-related odors persist after this "flush out" period, reassess by looking for flood-contaminated areas that were not identified earlier and continue the flush-out process until odors are no longer apparent. Replace the HVAC filters used during the flush-out prior to building occupancy.

- After a building is occupied again, make frequent (for example, weekly) checks of the HVAC system to ensure that it is operating properly. During these checks, inspect the HVAC system filters and replace them when necessary. Gradually reduce the frequency of the HVAC system checks to monthly or quarterly inspections, depending on the routine operation and maintenance specifications for the HVAC system.

- If no routine operation and maintenance program is in place for the HVAC system, develop and institute such a program. At a minimum, include the following routine procedures: inspection and maintenance of HVAC components, calibration of HVAC system controls, and testing and balancing of the HVAC system.

- After the building is occupied again, maintain the interior temperature and relative humidity to conform with the ranges recommended in ASHRAE Standard 55-

2004, Thermal Environmental Conditions for Human Occupancy.

Additional Resources

Additional information about the cleanup and restoration of water-damaged and mold contaminated HVAC systems is available from the Institute of Inspection, Cleaning and Restoration Certification (IICRC) and the National Air Duct Cleaners Association (NADCA). Their pertinent documents (Standard and Reference Guide for Professional Mold Remediation [IICRC S520] and Assessment, Cleaning and Restoration of HVAC Systems [ACR 2005]) are available for purchase at www.iicrc.org/home and www.nadca.com/_secure/bookstore.asp, respectively. The University of Minnesota also has a document titled, "HVAC System Decontamination" available for free off the internet at www.dehs.umn.edu/iaq/hvacsys.html.

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APPENDIX E

Note: This OSHA document incorporates the 2002 version of the New York City guidelines. Appendix A contains the 2008 revised New York City guidance, which contains the correct size of remediation projects.

http://www.osha.gov/dts/shib/shib101003.html

U.S. Occupational Safety and Health Administration

A Brief Guide to Mold in the Workplace

Safety and Health Information Bulletin (SHIB 03-10-10)

This Safety and Health Information Bulletin is not a standard or regulation, and it creates no new legal obligations. The Bulletin is advisory in nature, informational in content, and is intended to assist building managers, custodians, and others who are responsible for building maintenance. Contractors and other professionals (e.g., environmental consultants and health or safety professionals) who respond to mold and moisture situations in buildings, as well as members of the general public, also may want to refer to these guidelines.

The Occupational Safety and Health Act requires employers to comply with hazard-specific safety and health standards as issued and enforced by either the Federal Occupational Safety and Health Administration (OSHA), or an OSHA-approved State Plan. In addition, Section 5(a)(1), the General Duty Clause, requires employers to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. Employers can be cited for violating the General Duty Clause if there is such a recognized hazard and they do not take reasonable steps to prevent or abate the hazard. However, failure to implement these guidelines is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

Introduction

Concern about indoor exposure to mold has increased along with public awareness that exposure to mold can cause a variety of health effects and symptoms, including allergic reactions. This safety and health information bulletin provides recommendations for the prevention of mold growth and describes measures designed to protect the health of building occupants and workers involved in mold cleanup and prevention. This bulletin is directed primarily at building managers, custodians, and others responsible for building maintenance, but may also be used as a basic reference for those involved in mold remediation. By reading this safety and health information bulletin, individuals with little or no experience with mold remediation may be able to reasonably judge whether mold contamination can be managed in-house or whether outside assistance is required. The advice of a medical professional should always be sought if there are any emerging health issues. This document will help those responsible for building maintenance in the evaluation of remediation plans.

Contractors and other professionals (e.g. industrial hygienists or other environmental health and safety professionals) who respond to mold and moisture situations in buildings, as well as members of the general public, also may find these guidelines helpful. The information in these guidelines is intended only as a summary of basic procedures and is not intended, nor should it be used, as a detailed guide to mold remediation. These guidelines are subject to change as more information regarding mold contamination and remediation becomes available.

Mold Basics

Molds are part of the natural environment. Molds are fungi that can be found anywhere - inside or outside - throughout the year. About 1,000 species of mold can be found in the United States, with more than 100,000 known species worldwide.

Outdoors, molds play an important role in nature by breaking down organic matter such as toppled trees, fallen leaves, and dead animals. We would not have food and medicines, like cheese and penicillin, without mold.

Indoors, mold growth should be avoided. Problems may arise when mold starts eating away at materials, affecting the look, smell, and possibly, with the respect to wood-framed buildings, affecting the structural integrity of the buildings.

Molds can grow on virtually any substance, as long as moisture or water, oxygen, and an organic source are present. Molds reproduce by creating tiny spores (viable seeds) that usually cannot be seen without magnification. Mold spores continually float through the indoor and outdoor air.

Molds are usually not a problem unless mold spores land on a damp spot and begin growing. They digest whatever they land on in order to survive. There are molds that grow on wood, paper, carpet, foods and insulation, while other molds feast on the everyday dust and dirt that gather in the moist regions of a building.

When excessive moisture or water accumulates indoors, mold growth often will occur, particularly if the moisture problem remains uncorrected. While it is impossible to eliminate all molds and mold spores, controlling moisture can control indoor mold growth.

All molds share the characteristic of being able to grow without sunlight; mold needs only a viable seed (spore), a nutrient source, moisture, and the right temperature to proliferate. This explains why mold infestation is often found in damp, dark, hidden spaces; light and air circulation dry areas out, making them less hospitable for mold.

Molds gradually damage building materials and furnishings. If left unchecked, mold can eventually cause structural damage to a wood framed building, weakening floors and walls as it feeds on moist wooden structural members. If you suspect that mold has damaged building integrity, consult a structural engineer or other professional with the appropriate expertise.

Since mold requires water to grow, it is important to prevent excessive moisture in buildings.

Some moisture problems in buildings have been linked to changes in building construction practices since the 1970s, which resulted in tightly sealed buildings with diminished ventilation, contributing to moisture vapor buildup. Other moisture problems may result from roof leaks, landscaping or gutters that direct water into or under a building, or unvented combustion appliance. Delayed or insufficient maintenance may contribute to moisture problems in buildings. Improper maintenance and design of building heating/ventilating/air-conditioning (HVAC) systems, such as insufficient cooling capacity for an air conditioning system, can result in elevated humidity levels in a building.

Health Effects

Currently, there are no federal standards or recommendations, (e.g., OSHA, NIOSH, EPA) for airborne concentrations of mold or mold spores. Scientific research on the relationship between mold exposures and health effects is ongoing. This section provides a brief overview, but does not describe all potential health effects related to mold exposure. For more detailed information, consult a health professional or your state or local health department.

There are many types of mold. Most typical indoor air exposures to mold do not present a risk of adverse health effects. Molds can cause adverse effects by producing allergens (substances that can cause allergic reactions). Potential health concerns are important reasons to prevent mold growth and to remediate existing problem areas.

The onset of allergic reactions to mold can be either immediate or delayed. Allergic responses include hay fever-type symptoms such as runny nose and red eyes.

Molds may cause localized skin or mucosal infections but, in general, do not cause systemic infections in humans, except for persons with impaired immunity, AIDS, uncontrolled diabetes, or those taking immune suppressive drugs. An important reference with guidelines for immuno-compromised individuals can be found at the Centers for Disease Control and Prevention (CDC) website.

Molds can also cause asthma attacks in some individuals who are allergic to mold. In addition, exposure to mold can irritate the eyes, skin, nose and throat in certain individuals. Symptoms other than allergic and irritant types are not commonly reported as a result of inhaling mold in the indoor environment.

Some specific species of mold produce mycotoxins under certain environmental conditions. Potential health effects from mycotoxins are the subject of ongoing scientific research and are beyond the scope of this document.

Eating, drinking, and using tobacco products and cosmetics where mold remediation is taking place should be avoided. This will prevent unnecessary contamination of food, beverage, cosmetics, and tobacco products by mold and other harmful substances within the work area.

Prevention

Moisture control is the key to mold control. When water leaks or spills occur indoors - act promptly. Any initial water infiltration should be stopped and cleaned promptly. A prompt response (within 24-48 hours) and thorough clean- up, drying, and/or removal of water-damaged materials will prevent or limit mold growth.

Mold prevention tips include:

- Repairing plumbing leaks and leaks in the building structure as soon as possible.
- Looking for condensation and wet spots. Fix source(s) of moisture incursion problem(s) as soon as possible.
- Preventing moisture from condensing by increasing surface temperature or reducing the moisture level in the air (humidity). To increase surface temperature, insulate or increase air circulation. To reduce the moisture level in the air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid).
- Keeping HVAC drip pans clean, flowing properly, and unobstructed.
- Performing regularly scheduled building/ HVAC inspections and maintenance, including filter changes.
- Maintaining indoor relative humidity below 70% (25 - 60%, if possible).
- Venting moisture-generating appliances, such as dryers, to the outside where possible.
- Venting kitchens (cooking areas) and bathrooms according to local code requirements.
- Cleaning and drying wet or damp spots as soon as possible, but no more than 48 hours after discovery.
- Providing adequate drainage around buildings and sloping the ground away from building foundations. Follow all local building codes.
- Pinpointing areas where leaks have occurred, identifying the causes, and taking preventive action to ensure that they do not reoccur.

Questions That May Assist in Determining Whether a Mold Problem Currently Exists

- Are building materials or furnishings visibly moisture damaged?
- Have building materials been wet more than 48 hours?

- Are there existing moisture problems in the building?

- Are building occupants reporting musty or moldy odors?
- Are building occupants reporting health problems that they think are related to mold in the indoor environment?

- Has the building been recently remodeled or has the building use changed?

- Has routine maintenance been delayed or the maintenance plan been altered?

Always consider consulting a health professional to address any employee health concerns.

Remediation Plan

Remediation includes both the identification and correction of the conditions that permit mold growth, as well as the steps to safely and effectively remove mold damaged materials.

Before planning the remediation assess the extent of the mold or moisture problem and the type of damaged materials. If you choose to hire outside assistance to do the cleanup, make sure the contractor has experience with mold remediation. Check references and ask the contractor to follow the recommendations in EPA's publication, "Mold Remediation in Schools and Commercial Buildings," or other guidelines developed by professional or governmental organizations.

The remediation plan should include steps to permanently correct the water or moisture problem. The plan should cover the use of appropriate personal protective equipment (PPE). It also should include steps to carefully contain and remove moldy building materials in a manner that will prevent further contamination. Remediation plans may vary greatly depending on the size and complexity of the job, and may require revision if circumstances change or new facts are discovered.

If you suspect that the HVAC system is contaminated with mold, or if mold is present near the intake to the system, contact the National Air Duct Cleaners Association (NADCA), or consult EPA's guide, "Should You Have the Air Ducts in Your Home Cleaned?" before taking further action. Do not run the HVAC system if you know or suspect that it is contaminated with mold, as it could spread contamination throughout the building. If the water or mold damage was caused by sewage or other contaminated water, consult a professional who has experience cleaning and repairing buildings damaged by contaminated water.

The remediation manager's highest priority must be to protect the health and safety of the building occupants and remediators. Remediators should avoid exposing themselves and others to mold-laden dusts as they conduct their cleanup activities. Caution should be used to prevent mold and mold spores from being dispersed throughout the air where they can be inhaled by building occupants. In some cases, especially those involving large areas of contamination, the remediation plan may include temporary relocation of some or all of the building occupants.

When deciding if relocating occupants is necessary, consideration should be given to the size and type of mold growth, the type and extent of health effects reported by the occupants, the potential health risks that could be associated with the remediation activity, and the amount of disruption this activity is likely to cause. In addition, before deciding to relocate occupants, one should also evaluate the remediator's ability to contain/minimize possible aerosolization of mold spores given their expertise and the physical parameters of the workspace. When possible, remediation activities should be scheduled during off hours when building occupants are less likely to be affected.

Remediators, particularly those with health related concerns, may wish to check with their physicians or other health-care professionals before working on mold remediation or investigating potentially moldy areas. If any individual has health concerns, doubts, or questions before beginning a remediation/cleanup project, he or she should consult a health professional.

Mold Remediation/Cleanup Methods

The purpose of mold remediation is to correct the moisture problem and to remove moldy and contaminated materials to prevent human exposure and further damage to building materials and furnishings. Porous materials that are wet and have mold growing on them may have to be discarded because molds can infiltrate porous substances and grow on or fill in empty spaces or crevices. This mold can be difficult or impossible to remove completely.

As a general rule, simply killing the mold, for example, with biocide is not enough. The mold must be removed, since the chemicals and proteins, which can cause a reaction in humans, are present even in dead mold.

A variety of cleanup methods are available for remediating damage to building materials and furnishings caused by moisture control problems and mold growth. The specific method or group of methods used will depend on the type of material affected. Some methods that may be used include the following:

Wet Vacuum

Wet vacuums are vacuum cleaners designed to collect water. They can be used to remove water from floors, carpets, and hard surfaces where water has accumulated. They should not be used to vacuum porous materials, such as gypsum board. Wet vacuums should be used only on wet materials, as spores may be exhausted into the indoor environment if insufficient liquid is present. The tanks, hoses, and attachments of these vacuums should be thoroughly cleaned and dried after use since mold and mold spores may adhere to equipment surfaces.

Damp Wipe

Mold can generally be removed from nonporous surfaces by wiping or scrubbing with water and detergent. It is important to dry these surfaces quickly and thoroughly to discourage further mold growth. Instructions for cleaning surfaces, as listed on product labels, should always be

read and followed.

HEPA Vacuum

HEPA (High-Efficiency Particulate Air) vacuums are recommended for final cleanup of remediation areas after materials have been thoroughly dried and contaminated materials removed. HEPA vacuums also are recommended for cleanup of dust that may have settled on surfaces outside the remediation area. Care must be taken to assure that the filter is properly seated in the vacuum so that all the air passes through the filter. When changing the vacuum filter, remediators should wear respirators, appropriate personal protective clothing, gloves, and eye protection to prevent exposure to any captured mold and other contaminants. The filter and contents of the HEPA vacuum must be disposed of in impermeable bags or containers in such a way as to prevent release of the debris.

Disposal of Damaged Materials

Building materials and furnishings contaminated with mold growth that are not salvageable should be placed in sealed impermeable bags or closed containers while in the remediation area. These materials can usually be discarded as ordinary construction waste. It is important to package mold-contaminated materials in this fashion to minimize the dispersion of mold spores. Large items with heavy mold growth should be covered with polyethylene sheeting and sealed with duct tape before being removed from the remediation area. Some jobs may require the use of dust-tight chutes to move large quantities of debris to a dumpster strategically placed outside a window in the remediation area.

Use of Biocides

The use of a biocide, such as chlorine bleach, is not recommended as a routine practice during mold remediation, although there may be instances where professional judgment may indicate its use (for example, when immuno-compromised individuals are present). In most cases, it is not possible or desirable to sterilize an area, as a background level of mold spores comparable to the level in outside air will persist. However, the spores in the ambient air will not cause further problems if the moisture level in the building has been corrected.

Biocides are toxic to animals and humans, as well as to mold. If you choose to use disinfectants or biocides, always ventilate the area, using outside air if possible, and exhaust the air to the outdoors. When using fans, take care not to extend the zone of contamination by distributing mold spores to a previously unaffected area. **Never mix chlorine bleach solution with other cleaning solutions or detergents that contain ammonia because this may produce highly toxic vapors and create a hazard to workers.**

Some biocides are considered pesticides, and some states require that only registered pesticide applicators apply these products in schools, commercial buildings, and homes. Make sure anyone applying a biocide is properly licensed where required.

Fungicides are commonly applied to outdoor plants, soil, and grains as a powder or spray. Examples of fungicides include hexachlorobenzene, organomercurials, pentachlorophenol,

phthalimides, and dithiocarbamates.
Do not use fungicides developed for outdoor use in any indoor application, as they can be extremely toxic to animals and humans in an enclosed environment.

When you use biocides as a disinfectant or a pesticide, or as a fungicide, you should use appropriate PPE, including respirators. Always, read and follow product label precautions. It is a violation of Federal (EPA) law to use a biocide in any manner inconsistent with its label direction.

Mold Remediation Guidelines

This section presents remediation guidelines for building materials that have or are likely to have mold growth. The guidelines are designed to protect the health of cleanup personnel and other workers during remediation. These guidelines are based on the size of the area impacted by mold contamination. Please note that these are guidelines; some professionals may prefer other remediation methods, and certain circumstances may require different approaches or variations on the approaches described below. If possible, remediation activities should be scheduled during off-hours when building occupants are less likely to be affected.

Although the level of personal protection suggested in these guidelines is based on the total surface area contaminated and the potential for remediator or occupant exposure, professional judgment always should play a part in remediation decisions. These remediation guidelines are based on the size of the affected area to make it easier for remediators to select appropriate techniques, not on the basis of research showing there is a specific method appropriate at a certain number of square feet. The guidelines have been designed to help construct a remediation plan. The remediation manager should rely on professional judgment and experience to adapt the guidelines to particular situations. When in doubt, caution is advised. Consult an experienced mold remediator for more information.

Level I: Small Isolated Areas (10 sq. ft or less) - e.g., ceiling tiles, small areas on walls.

- Remediation can be conducted by the regular building maintenance staff as long as they are trained on proper clean-up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

- Respiratory protection (e.g., N-95 disposable respirator) is recommended. Respirators must be used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134). Gloves and eye protection should be worn.

- The work area should be unoccupied. Removing people from spaces adjacent to the work area is not necessary, but is recommended for infants (less than 12 months old), persons recovering from recent surgery, immune-suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).

- Containment of the work area is not necessary. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.

- Contaminated materials that cannot be cleaned should be removed from the building in a sealed impermeable plastic bag. These materials may be disposed of as ordinary waste.

- The work area and areas used by remediation workers for egress should be cleaned with a damp cloth or mop and a detergent solution.

- All areas should be left dry and visibly free from contamination and debris.

Level II: Mid-Sized Isolated Areas (10-30 sq. ft.) – e.g., individual wallboard panels.

- Remediation can be conducted by the regular building maintenance staff. Such persons should receive training on proper clean-up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

- Respiratory protection (e.g., N-95 disposable respirator) is recommended. Respirators must be used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134). Gloves and eye protection should be worn.

- The work area should be unoccupied. Removing people from spaces adjacent to the work area is not necessary, but is recommended for infants (less than 12 months old), persons recovering from recent surgery, immune-suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).

- Surfaces in the work area that could become contaminated should be covered with a secured plastic sheet(s) before remediation to contain dust/debris and prevent further contamination.

- Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.

- Contaminated materials that cannot be cleaned should be removed from the building in a sealed impermeable plastic bag. These materials may be disposed of as ordinary waste.

- The work area and areas used by remediation workers for egress should be HEPA vacuumed and cleaned with a damp cloth or mop and a detergent solution.

- All areas should be left dry and visibly free from contamination and debris.

Level III: Large Isolated Areas (30 –100 square feet) – e.g., several wallboard panels.

Industrial hygienists or other environmental health and safety professionals with experience performing microbial investigations and/or mold remediation should be consulted prior to remediation activities to provide oversight for the project.

The following procedures may be implemented depending upon the severity of the contamination:

- It is recommended that personnel be trained in the handling of hazardous materials and equipped with respiratory protection (e.g., N-95 disposable respirator). Respirators must be used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134). Gloves and eye protection should be worn.

- Surfaces in the work area and areas directly adjacent that could become decontaminated should be covered with a secured plastic sheet(s) before remediation to contain dust/ debris and prevent further contamination.

- Seal ventilation ducts/grills in the work area and areas directly adjacent with plastic sheeting.

- The work area and areas directly adjacent should be unoccupied. Removing people from spaces near the work area is recommended for infants, persons having undergone recent surgery, immunesuppressed people, or people with chronic inflammatory lung diseases. (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).

- Dust suppression methods, such as misting (not soaking) surfaces prior to mediation, are recommended.

- Contaminated materials that cannot be cleaned should be removed from the building in sealed impermeable plastic bags. These materials may be disposed of as ordinary waste.

- The work area and surrounding areas should be HEPA vacuumed and cleaned with a damp cloth or mop and a detergent solution.

- All areas should be left dry and visibly free from contamination and debris.

Note: If abatement procedures are expected to generate a lot of dust (e.g., abrasive cleaning of contaminated surfaces, demolition of plaster walls) or the visible concentration of the mold is heavy (blanket coverage as opposed to patchy), it is recommended that the remediation procedures for Level IV be followed.

Level IV: Extensive Contamination (greater than 100 contiguous square feet in an area).

Industrial hygienists or other environmental health and safety professionals with experience

performing microbial investigations and/or mold remediation should be consulted prior to remediation activities to provide oversight for the project.

The following procedures may be implemented depending upon the severity of the contamination:

- Personnel trained in the handling of hazardous materials and equipped with:
    - Full face piece respirators with HEPA cartridges;
    - Disposable protective clothing covering entire body including both head and shoes; and
    - Gloves.
- Containment of the affected area:
    - Complete isolation of work area from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts/grills, fixtures, and other openings);
    - The use of an exhaust fan with a HEPA filter to generate negative pressurization; and
    - Airlocks and decontamination room.
- If contaminant practices effectively prevent mold from migrating from affected areas, it may not be necessary to remove people from surrounding work areas. However, removal is still recommended for infants, persons having undergone recent surgery, immune- suppressed people, or people with chronic inflammatory lung diseases. (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).
- Contaminated materials that cannot be cleaned should be removed from the building in sealed impermeable plastic bags. The outside of the bags should be cleaned with a damp cloth and a detergent solution or HEPA vacuumed in the decontamination chamber prior to their transport to uncontaminated areas of the building. These materials may be disposed of as ordinary waste.
- The contained area and decontamination room should be HEPA vacuumed and cleaned with a damp cloth or mopped with a detergent solution and be visibly clean prior to the removal of isolation barriers.

Personal Protective Equipment (PPE)

Any remediation work that disturbs mold and causes mold spores to become airborne increases the degree of respiratory exposure. Actions that tend to disperse mold include:

breaking apart moldy porous materials such as wallboard; destructive invasive procedures to examine or remediate mold growth in a wall cavity; removal of contaminated wallpaper by stripping or peeling; using fans to dry items or ventilate areas.

The primary function of personal protective equipment is to prevent the inhalation and ingestion of mold and mold spores and to avoid mold contact with the skin or eyes. The following sections discuss the various types of PPE that may be used during remediation activities.

Skin and Eye Protection

Gloves protect the skin from contact with mold, as well as from potentially irritating cleaning solutions. Long gloves that extend to the middle of the forearm are recommended. The glove material should be selected based on the type of substance/ chemical being handled. If you are using a biocide such as chlorine bleach, or a strong cleaning solution, you should select gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC. If you are using a mild detergent or plain water, ordinary household rubber gloves may be used.

To protect your eyes, use properly fitted goggles or a full face piece respirator. Goggles must be designed to prevent the entry of dust and small particles. Safety glasses or goggles with open vent holes are not appropriate in mold remediation.

Respiratory Protection

Respirators protect cleanup workers from inhaling airborne mold, contaminated dust, and other particulates that are released during the remediation process. Either a half mask or full face piece air-purifying respirator can be used. A full face piece respirator provides both respiratory and eye protection. Please refer to the discussion of the different levels of remediation to ascertain the type of respiratory protection recommended. Respirators used to provide protection from mold and mold spores must be certified by the National Institute for Occupational Safety and Health (NIOSH). More protective respirators may have to be selected and used if toxic contaminants such as asbestos or lead are encountered during remediation.

As specified by OSHA in 29 CFR 1910.134 individuals who use respirators must be properly trained, have medical clearance, and be properly fit tested before they begin using a respirator. In addition, use of respirators requires the employer to develop and implement a written respiratory protection program, with worksite-specific procedures and elements.

Protective Clothing

While conducting building inspections and remediation work, individuals may encounter hazardous biological agents as well as chemical and physical hazards. Consequently, appropriate personal protective clothing (i.e., reusable or disposable) is recommended to minimize cross-contamination between work areas and clean areas, to prevent the transfer and spread of mold and other contaminants to street clothing, and to eliminate skin contact with mold and potential chemical exposures.

Disposable PPE should be discarded after it is used. They should be placed into impermeable bags, and usually can be discarded as ordinary construction waste. Appropriate precautions and protective equipment for biocide applicators should be selected based on the product manufacturer's warnings and recommendations (e.g., goggles or face shield, aprons or other protective clothing, gloves, and respiratory protection).

Sampling for Mold

Is it necessary to sample for mold? **In most cases, if visible mold growth is present, sampling is unnecessary.** Air sampling for mold may not be part of a routine assessment because decisions about appropriate remediation strategies often can be made on the basis of a visual inspection.

Your first step should be to inspect for any evidence of water damage and visible mold growth. Testing for mold is expensive, and there should be a clear reason for doing so. In many cases, it is not economically practical or useful to test for mold growth on surfaces or for airborne spores in the building. In addition, there are no standards for "acceptable" levels of mold in buildings, and the lack of a definitive correlation between exposure levels and health effects makes interpreting the data difficult, if not impossible.

Testing is usually done to compare the levels and types of mold spores found inside the building with those found outside of the building or for comparison with another location in the building. In addition, air sampling may provide tangible evidence supporting a hypothesis that investigators have formulated. For example, air sampling may show a higher concentration of the same species of mold when the HVAC is operating than when it has been turned off. This finding may convince the investigators that the mold is growing within, and being disseminated by, the HVAC system. Conversely, negative results may persuade investigators to abandon this hypothesis and to consider other sources of mold growth or dissemination. If you know you have a mold problem, it is more important to spend time and resources removing the mold and solving the moisture problem that causes the moldy conditions than to undertake extensive testing for the type and quantity of mold.

If you are in doubt about sampling, consult an industrial hygienist or other environmental health or safety professional with experience in microbial investigations to help you decide if sampling for mold is necessary or useful, and to identify persons who can conduct any necessary sampling. Due to the wide difference in individual susceptibility to mold contamination, sampling results sampling may have limited application. However, sampling results can be used as a guide to determine the extent of an infestation and the effectiveness of the cleanup. Their interpretation is best left to the industrial hygienist or other environmental health or safety professional.

Sampling for mold should be conducted by professionals with specific experience in designing mold-sampling protocols, sampling methods for microbial contaminants, and interpretation of results. For additional information on air sampling, refer to the American Conference of Governmental Industrial Hygienists' document, "Bioaerosols: Assessment and Control." In addition, sampling and analysis should follow any other methods recommended by either

OSHA, NIOSH, EPA, the American Industrial Hygiene Association, or other recognized professional guidelines. Types of samples can include: air samples, surface samples, bulk samples, and water samples from condensate drain pans or cooling towers.

Microscopic identification of the spores/ colonies requires considerable expertise. These services are not routinely available from commercial laboratories. Documented quality control in the laboratories used for analysis of the bulk, surface, and other air samples is necessary. The American Industrial Hygiene Association offers accreditation to microbial laboratories (Environmental Microbiology Laboratory Accreditation Program (EMLAP)). Accredited laboratories must participate in quarterly proficiency testing (Environmental Microbiology Proficiency Analytical Testing Program (EMPAT)).

Remediation Equipment

There are various types of equipment useful in mold assessment and remediation. Some of the more common items include:

Moisture Meters

Moisture meters measure/monitor moisture levels in building materials, and may be helpful for measuring the moisture content in a variety of building materials following water damage. They also can be used to monitor the progress of drying damaged materials. 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, and concrete.

Humidity Gauges or Meters

Humidity meters can be used to monitor indoor humidity. Inexpensive (less than $50) models that monitor both temperature and humidity are available.

Humidistat

A humidistat is a control device that can be connected to an HVAC system and adjusted so that if the humidity level rises above a set point, the HVAC system will automatically turn on and reduce the humidity below the established point.

Boroscope

A boroscope is a hand-held tool that allows users to see potential mold problems inside walls, ceiling plenums, crawl spaces, and other tight areas. It consists of a video camera on the end of a flexible “snake.” No major drilling or cutting of dry wall is required.

HVAC System Filter

High-quality filters must be used in a HVAC system during remediation because conventional

HVAC filters are typically not effective in filtering particles the size of mold spores. Consult an engineer for the appropriate filter efficiency for your specific HVAC system, and consider upgrading your filters if necessary. A filter with a minimum efficiency of 50 to 60% or a rating of MERV 8, as determined by Test Standard 52.2 of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, may be appropriate.

Remember to change filters as appropriate, especially following any remediation activities. Remove filters in a manner that minimizes the reentry of mold and other toxic substances into the workplace. Under certain circumstances, it may be necessary to wear appropriate PPE while performing this task.

How Do You Know When You Have Finished Remediation/Cleanup?

- You must have identified and completely corrected the source of the water or moisture problem.
- Mold removal should be complete. Visible mold, mold-damaged materials, and moldy odors should no longer be present.
- Sampling, if conducted, should show that the level and types of mold and mold spores inside the building are similar to those found outside.
- You should revisit the site(s) after remediation, and it should show no signs of moldy or musty odors, water damage, or mold growth.

Conclusion

After correcting water or moisture infiltration, the prompt removal of contaminated material and structural repair is the primary response to mold contamination in buildings. In all situations, the underlying cause of water accumulation must be rectified or the mold growth will reoccur. Emphasis should be placed on preventing contamination through proper building and HVAC system maintenance and prompt repair of water damaged areas.

Effective communication with building occupants is an essential component of all large-scale remediation efforts. The building owner, management, and/or employer should notify occupants in the affected area(s) of the presence of mold. Notification should include a description of the remedial measures to be taken and a timetable for completion. Group meetings held before and after remediation with full disclosure of plans and results can be an effective communication mechanism. Individuals with persistent health problems that appear to be related to mold exposure should see their physicians for a referral to practitioners who are trained in occupational/environmental medicine or related specialties and are knowledgeable about these types of exposures.

References

American Conference of Governmental Industrial Hygienists 1999. *Bioaerosols Assessment and Control*
http://www.acgih.org

National Apartment Association
http://www.naahq.org

National Institute for Occupational Safety and Health (NIOSH)

National Multi-Housing Council
http://www.nmhc.org

The Building Owners and Managers Association International (BOMA)
http://www.boma.org

New York City Department of Health & Mental Hygiene Bureau of Environmental & Occupational Disease Epidemiology 2002. Guidelines on Assessment and Remediation of Fungi in Indoor Environments

United States Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division 2001. Mold Remediation in Schools and Commercial Buildings.
EPA 402-K-01-001

Mold Resources List

Business owners who are concerned about the cost of professional help can contact the OSHA Consultation Project Office in their state for free consultation service. Priority is given to businesses with fewer than 250 employees at a worksite, with further consideration given to the severity of the worksite problem. The Consultation Program can help the employer evaluate and prevent hazardous conditions in the workplace that can cause injuries and illnesses, including mold problems.

The following list of resources includes information developed and maintained by public and private organizations. However, OSHA does not control this information and cannot guarantee the accuracy, relevance, timeliness, or completeness of this outside information. Further, the inclusion of these resources is not intended to endorse any views expressed, or products or services offered, by the author of the reference or the organization operating the service identified by the reference.

An Office Building Occupant's Guide to IAQ

Biological Contaminants

Building Air Quality Action Plan (For Commercial Buildings)
Floods/Flooding

Indoor Air Quality (IAQ) Home Page

IAQ in Large Buildings/Commercial Buildings

IAQ in Schools

Mold Resources

Mold Remediation in Schools and Commercial Buildings

U.S. EPA IAQ Information Clearinghouse (IAQINFO)
Phone: (800)438-4318 or (703)356-4020
Fax: (703)356-5386
Email: iaqinfo@aol.com
Indoor air related documents, answers to Indoor Air Quality (IAQ) questions, maintains listing of State IAQ contacts, and regional EPA Contacts.

Air Conditioning Contractors of America (ACCA)
(703)575-4477
http://www.acca.org
Information on indoor comfort products and services.

American College of Occupational and Environmental Medicine (ACOEM)
(847)818-1800
http://eserver.acoem.org/physicianlocator/default.cfm
Referrals to physicians who have experience with environmental exposures.

American Conference of Governmental Industrial Hygienists, Inc. (ACGIH)
(513)742-2020
http://www.acgih.org
Occupational and environmental health and safety information.

American Industrial Hygiene Association (AIHA)
(703)849-8888
http://www.aiha.org
Information on industrial hygiene and indoor air quality issues including mold hazards and legal issues.

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
(800)527-4723
http://www.ashrae.org
Information on engineering issues and indoor air quality.

Association of Occupational and Environmental Clinics (AOEC)
(202)347-4976
http://www.aoec.org
Referrals to clinics with physicians, who have experience with environmental exposures, include exposure to mold; maintains a database of occupational and environmental cases.

Association of Specialists in Cleaning and Restoration (ASCR)
(800)272-7012 or (410)729-3603
http://www.ascr.org/institutes
Carpet and Upholstery Cleaning Institute, Mechancial Systems Hygiene Institute, National Institute of Disaster Restoration, National Institute Rug Cleaning, Water Loss Institute referrals to professionals.

American Academy of Allergy, Asthma & Immunology (AAAAI)
(800)822-2762
http://www.aaaai.org
Physician referral directory, information on allergies and asthma.

Asthma and Allergy Foundation of American (AAFA)
(800) 7ASTHMA (800)727-8462)
http://www.aafa.org
Information on allergies and asthma.

American Lung Association (ALA)
(800) LUNGUSA (800)586-4872)
http://www.lungusa.org
Information on allergies and asthma.

Allergy and Asthma Network Mothers of Asthmatics (AANMA)
(800)878-4403 or (703)641-9595)
http://www.aanma.org
Information on allergies and asthma.

National Institute of Allergy and Infectious Diseases (NIAID)
(301)496-5717
Information on allergies and asthma.

National Jewish Medical and Research Center
(800) 222LUNG (800)222-5864)
http://www.njc.org
Information on allergies and asthma.

Carpet and Rug Institute (CRI)
(800) 882-8846
http://www.carpet-rug.com

Carpet maintenance, restoration guidelines for water-damaged carpet, other carpet-related issues.

Centers for Disease Control and Prevention (CDC)
(800)311-3435
Information on health-related topics including asthma molds in the environment, and occupational health. CDC is recognized as the lead federal agency for protecting the health and safety of the American people at home and abroad. Ir serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and education services.

Floods/Flooding
Federal Emergency Management Agency (FEMA)
(800)480-2520
Publications on floods, flood proofing, etc.

University of Minnesota, Department of Environmental Health and Safety
(612)626-5804
http://www.dehs.umn.edu/iaq/flood.html
Managing water infiltration into buildings.

Indoor Environmental Remediation Board (IERB)
(215)387-4097
http://www.ierb.org
Information on best practices in building remediation.

Institute of Inspection, Cleaning and Restoration Certification (IICRC)
(360)693-5675
http://www.iicrc.org
Information on and standards for the inspection, cleaning, and restoration industry.

International Sanitary Supply Association (ISSA)
(800)225-4772
http://www.issa.com
Education and training on cleaning and maintenance.

MidAtlantic Environmental Hygiene Resource Center (MEHRC)
(215)387-4096
http://www.mehrc.org
Indoor environmental quality training center giving courses in building moisture and biocontamination, and managing and operating facilities for good IAQ. Extensive courses given in IAQ.

National Air Duct Cleaners Association (NADCA)
(202)737-2926
http://www.nadca.com
Duct cleaning information.

National Institute of Building Sciences (NIBS)
(202)289-7800
http://www.nibs.org
Information on building regulations, science, and technology.

National Institute for Occupational Safety and Health (NIOSH)
(800) 35NIOSH (800)356-4674)
Health and safety information with a workplace orientation.

National Pesticide Information Center (NPIC)
(800)858-7378
http://npic.orst.edu/
Information on pesticides/antimicrobial chemicals, including safety and disposal information.

New York City Department of Health, Bureau of Environmental and Occupational Disease Epidemiology, Guidelines on Assessment and Remediation of Fungi in Indoor Environments
(212)788-4290

Occupational Safety and Health Administration (OSHA)
(800)321-OSHA (800)321-6742)
Information on worker safety and health, compliance assistance, laws and regulations, cooperative programs, state programs, statistics, and newsroom.

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
(703)803-2980
http://www.smacna.org
Technical information on topics such as air conditioning and air ducts.

Protecting Ourselves From Mold

Awareness Training for Operating Engineers

IUOE National Training Fund
National HAZMAT Program
1293 Airport Road
Beaver, WV 25813
(304) 253-8674