

MOLD REFRESHER TRAINING PROGRAM

NEW YORK STATE DEPARTMENT OF LABOR
ACCREDITED MOLD TRAINING PROGRAM PROVIDER

STUDENT HANDOUTS
MANUAL



ENVIRONMENTAL EDUCATION ASSOCIATES

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NEW YORK STATE DEPARTMENT OF LABOR MOLD TRAINING PROGRAM

MOLD REFRESHER TRAINING STUDENT HANDOUT MANUAL

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PREFACE

This training course manual has been created to provide course attendees with documents, examples and forms that are relevant to mold assessment and remediation in New York State. The procedures and practices detailed in these pages incorporate current procedures at the time of printing. The reader should be advised that as procedures evolve, so do the methods for identifying and remediating mold contamination. Therefore, we emphasize the need for the reader to obtain the most up to date information available.

Standardized procedures, technical expertise and common sense are major components of a successful project. The reader is encouraged to improve further on the techniques provided in this manual as experience is gained through field practice. This will ensure that the mold industry continues to evolve to improve all facets of remediation and worker protection.

ACKNOWLEDGEMENTS & REFERENCES

It would be impossible to acknowledge all the individuals who have contributed to the development of this course manual in some fashion or manner. Environmental Education Associates, Inc. is extremely grateful to those who have generously shared their knowledge, expertise, and experiences throughout the development process. Special thanks to Alisa Raab, Dave Wells and Paul Reid who contributed to the creation of this manual and associated training courses.

DISCLAIMER

This manual was developed using public and proprietary documents. Procedures and practices contained in this manual have not been reviewed or approved by regulatory agencies. It is the responsibility of the user to verify compliance with all applicable Federal, State or local regulatory agencies.

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Section 1

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Supplement to the Mold Refresher Course Curriculum

The Department of Labor (DOL) has developed this supplement to provide direction on the specific topics and issues that must be covered in the *Case Studies & Group Discussion Forum* section of the mold refresher course. DOL has developed this list based on questions received from the regulated community, mold complaints, and enforcement issues encountered in the field. It is anticipated that this list will be updated periodically in response to changing compliance issues and enforcement concerns; as such, it will be maintained as a separate document from the mold refresher curriculum. DOL will notify approved mold training providers if any updates are made to this supplement.

In addition to the general topics of mold remediation considerations, concepts, and lessons learned, training providers must also include all the specific topics listed below in the *Case Studies & Group Discussion Forum* section of the mold refresher course. Training providers have discretion over which topics to present in a case study and which topics to address as discussion points.

1. Proper Mold Assessment and Remediation

- a) Distribute and review any DOL-issued fact sheets. Presently, the **Mold Assessment and Remediation Factsheet** (P227) is posted on DOL's website at this link: <https://labor.ny.gov/formsdocs/wp/P227.pdf>. As noted in the factsheet, in most cases, air sampling and mold testing are not necessary. There are no national or state standards for "safe" levels of mold. Mold assessors who intend to perform sampling or testing on a mold project should explain to the client what type of sampling they wish to perform, why it is necessary, what criteria they are using to compare results, and what it will show that is not already known.
- b) Mold assessors and remediation contractors should reference appropriate guidance and publications from EPA, OSHA, NYCDOH and IICRC in resolving issues pertaining to:
 - i. Proper techniques and standard industry practices for mold removal.
 - ii. Proper use of disinfectant, biocide and anti-microbial coating in accordance with Article 32 Sections 945.3 and 946.5.
- c) Proper mold remediation plan and mold remediation work plan development and content.

2. Moisture Source Identification and Project Clearance

- a) **Mold assessors should emphasize to the client the importance of identifying the source(s) of moisture and elimination of the moisture source(s) to prevent mold recurrence.** As per Article 32 Section 945.1(h) of the NYS Labor Law, when possible, mold assessors should identify the source(s) of the moisture resulting in mold growth in the mold remediation plan and provide a recommendation as to the type of contractor who could remedy the source of the moisture. Ultimately, it is the client's responsibility to decide whether to repair the underlying source of moisture; however, the assessor should clearly identify the moisture source and remedies in the mold remediation plan.
- b) For a remediated project to achieve clearance, a mold assessor shall conduct a post-remediation assessment. Ideally, the same mold assessor that developed the mold remediation plan for a project will perform the post-remediation assessment, but this is not required. If the client declines to have the post-remediation assessment performed, the mold assessor and remediation contractor should obtain documentation of the client's refusal to have a post-remediation assessment performed before leaving the site.

3. Prohibited Work Practices

- a) Unlicensed mold assessors, mold remediation contractors, and mold abatement workers/supervisors cannot perform work on a mold project per Article 32 Section 931 of the NYS Labor Law.
- b) It is unlawful for a licensed contractor to perform both mold assessment and mold remediation on the same property per Article 32 Section 936.2 of the NYS Labor Law.
- c) Licensed mold remediation contractors cannot proceed with mold remediation on a mold project until they have provided the client with a mold remediation work plan based upon the mold remediation plan completed by the licensed mold assessor. See Article 32 Section 946 of the NYS Labor Law.

4. Standard Procedures for a Mold Project

The following steps should be followed for the execution of a typical mold project:

- a) The mold assessor provides the mold remediation plan, including the clearance criteria, for the project to the client. See Article 32 Sections 935.1 and 945 of the NYS Labor Law.
- b) The client provides the mold remediation plan to the mold remediation contractor.
- c) The mold remediation contractor utilizes the mold remediation plan to prepare the mold remediation work plan (i.e., standard operating procedures) that is specific to the project and provides it to the client prior to remediating the mold. See Article 32 Sections 935.2 and 946 of the NYS Labor Law.
- d) The mold remediation contractor must be aware of the clearance criteria set forth in the mold remediation plan by the mold assessor.
- e) The post-remediation clearance assessment shall be performed by a licensed mold assessor who shall issue a passed clearance report to the client if the clearance criteria are met, or a final status report with recommendations for completing the remediation.
- f) Upon receipt of a passed clearance report from an assessor, the remediation contractor may complete the project.

5. DOL Mold Program Website and Resources

- a) Review the contents of DOL's Mold Program website and subpages:
<https://labor.ny.gov/workerprotection/safetyhealth/mold/mold-program.shtm>
- b) Review DOL's Mold Program Frequently Asked Questions:
<https://labor.ny.gov/workerprotection/safetyhealth/mold/frequently-asked-questions.shtm>
- c) Observations of prohibited work practices and other potential violations of Article 32 of the NYS Labor Law should be reported to DOL via the Mold Contractor Complaint Form, located at this link:
<https://labor.ny.gov/formsdocs/wp/SH140.pdf>

Mold Assessment and Remediation in New York State

What is Mold?

Mold is a multi-cellular fungus, similar to mushrooms and yeast. Mold can be different colors, and look fuzzy, slimy, or powdery. It often has a musty odor when present in large amounts.

Mold requires three things to grow:

- water/moisture,
- organic food source (paper, fabric, sheetrock, etc.), and
- proper temperature.

The presence of mold means there is too much moisture. Moisture problems can be caused by:

- plumbing leaks
- leaking roofs or windows
- high humidity
- flooding
- condensation due to poor ventilation or insulation

It is impossible to ‘mold proof’ your house. However, you can manage mold growth by controlling indoor humidity levels and fixing water leakage problems. To prevent mold from coming back in the future, you must fix the underlying source of moisture.

If I want to clean up mold, do I need to hire a mold professional?

No. Mold issues can often be fixed by the property owner. However, if you are sensitive to mold, not interested in cleaning up the mold or are not capable of cleaning the mold, you can hire mold professionals.

Does New York require a property owner to clean up mold when it is found?

No, there is no cleanup requirement for property owners. However, if a property owner chooses to hire a mold professional, those professionals must follow the requirements of the law.

Note: Rental property owners must still provide clean and sanitary living conditions to their tenants.

How does the Department of Labor help with mold issues?

The Department of Labor makes sure that professionals who do mold assessments and remediation work have proper training, licenses and minimum work standards.

Every mold cleanup project performed by professionals must follow these steps: assessment, remediation (clean up), clearance. The law protects consumers by barring licensed mold companies and their employees from doing both the assessment and remediation on the same property. One mold company and their employees may do the initial and post-cleanup clearance assessments, but a different company and their employees must do the actual cleanup work.

Assessments

What is an assessment?

An assessment, or a mold remediation plan, is a document prepared by a mold professional. It identifies mold and serves as a guide for the cleanup project. It says what must be done, how it is to be done, and how you will be able to tell if all the mold has been removed. The specific requirements are listed in Section 945 of the Labor Law.

Am I entitled to a copy of the assessment?

Yes. If you hire a mold professional to do an assessment, you must be given a copy. The professional you hire to do the remediation work must also get a copy.

Does a mold assessor need to perform sampling as part of an assessment?

No. In most cases, air sampling and mold testing are not necessary. There are no national or state standards for “safe” levels of mold. Mold spores are a natural part of the environment and are always in the air and on surfaces. A thorough visual inspection is the most important step to identify mold problems and determine cleanup strategies. Before contractors perform any sampling or testing, ask what type of sampling or testing they wish to perform, why it is necessary, and what it will show that is not already known.

How much should an assessment cost?

The law does not say how much an assessment should cost. We recommend that you get estimates from different companies. If a contractor recommends testing as part of an assessment, you should have a clear understanding of the costs for that testing and exactly what the testing will show.

Remediation

What does the Mold Remediation Contractor do?

The remediation contractor does the actual cleanup work. They must give you a mold remediation work plan. The work plan must fulfill all the requirements of the mold remediation plan developed through the assessment.

Hiring a Mold Professional

What should I know before hiring a mold professional?

As is true with all construction projects, the most important step is choosing your contractor. Contact more than one contractor for all work to be performed.

- For Mold Assessment: Make sure each contractor comes to the job site and bids on the same work. Before any work starts, you should have a clear understanding of the scope of work and the services the contractor will provide. You should understand and agree with the mold assessor’s remediation plan for

acceptable work scope and job clearance. This may include sampling, recommended use of biocides or other chemicals, replacement of materials, and criteria to demonstrate clearance after the cleanup.

- For Mold Remediation: The work plan must fulfill all the requirements of the mold remediation plan developed through the assessment. The work plan should also have specific instructions and/or standard operating procedures for how the contractor will perform the cleanup work.

Ask about the contractor’s experience and references from previous clients. If you are not sure that the proposed work complies with local building code rules, contact the local building code office before allowing the contractor to start work.

How can I verify that a Mold Assessor or Mold Remediation Contractor is licensed by NYSDOL?

Visit the Department of Labor’s website and use the “Licensed Mold Contractors Search Tool” at: <https://www.labor.ny.gov/workerprotection/safetyhealth/mold/licensing.shtm>

How can I file a complaint if I do not believe the mold professionals followed this guidance?

Submit the “Mold Contractor Complaint Form” at: <https://www.labor.ny.gov/workerprotection/safetyhealth/mold/compliance.shtm>

Where do I go for more information?

New York State Department of Labor:
<http://labor.ny.gov/mold>

New York City Department of Health and Mental Hygiene: <http://www1.nyc.gov/site/doh/health/health-topics/mold.page>

U.S. Environmental Protection Agency:
<https://www.epa.gov/mold>

What to Expect When You Hire a Mold Assessor and Mold Remediation Contractor

When does a property owner have to hire a Mold Assessor or Mold Remediation Contractor?

The New York State Department of Labor does not require you to clean up mold on your property. However, if you decide to have someone assess and remediate an area of mold that is larger than 10 square feet of mold, you must use a licensed mold professional to do the work. You must first have a Mold Assessor do an inspection and complete a Mold Remediation Plan. You will then hire a Mold Remediation Contractor to do the work outlined in the plan.

When you hire a mold professional for a mold project, the mold professional must perform their duties in accordance with the New York State Mold Law, Article 32, "Licensing of Mold Inspection, Assessment and Remediation Specialists and Minimum Work Standards." This fact sheet provides guidance so you know what to expect.

What are the main responsibilities of a Mold Assessor?

- Have a valid Mold Assessor License from the New York State Department of Labor for the company and employees.
- Perform the **initial** visual inspection and assessment of the property for mold growth. This may include the use of a moisture meter and, in rare cases, mold sampling.
- Identify the underlying source of moisture causing the mold growth (when possible).
- Educate the property owner on the Mold Law and mold in general.
- Develop a Mold Remediation Plan. This plan will identify:
 - The source of the moisture causing mold growth,
 - How to remedy the moisture issue,

- The mold remediation methods to be used for cleanup, and
- The criteria that must be met to consider the cleanup complete.
- Perform a post-remediation assessment to confirm the remediation was successful.
- Develop a written passed clearance report or final status report.

Why is mold sampling rarely recommended?

- Mold is a natural part of the environment. There is always some mold in the air and on surfaces.
- Sampling will almost always reveal the presence of mold or mold spores.
- There are no national or state standards for comparing or analyzing mold samples.
- There are no national or state standards to compare the sample results against.
- Unless people are allergic to mold or mold spores, the presence of mold does not usually produce any symptoms.
- Unless you know the specific type (genus and species) of mold to which someone is allergic, this information is not typically useful.

What should the Mold Assessor put in the *Mold Remediation Plan*?

The *Mold Remediation Plan* is specific to each project. The purpose of this plan is to provide methods to eliminate the moisture source(s) and visible mold growth. The plan should include:

- A description of the rooms or areas where the remediation will be performed,
- An estimate of the quantity of material to be cleaned or removed,
- A description of the abatement methods to be used for each type of remediation in each area,
- A proposal for containment, when needed, to prevent the spread of mold,

- A list of recommended personal protective equipment for abatement workers (to be provided by the Remediation Contractor),
 - A list of clearance procedures and criteria for each type of remediation in each area,
 - For an occupied property, recommendations for notice to occupants and posting requirements that are appropriate for the project,
 - An estimate of cost and time for completion of the project,
 - Information on the use of any United States Environmental Protection Agency (USEPA) registered disinfectant, biocide, or antimicrobial coating being considered, taking into account the potential for occupant sensitivities to such products, and
 - Identification of the underlying source(s) of moisture, when possible, that may be causing mold growth and recommendations for the type of contractor who would be able to fix the issue.
- Ensure workers on projects have Mold Abatement Worker licenses from the Department of Labor.
 - Prepare a *Mold Remediation Work Plan*. This plan gives instructions and standard operating procedures for how they will do the cleanup work described in the *Mold Remediation Plan*. This plan may also include containment construction and other equipment necessary to prevent the spread of mold spores during the abatement.
 - The Mold Remediation Work Plan must be given to you **before** cleanup work starts.
 - Perform the physical removal, cleaning, sanitizing, surface disinfection or other work that is needed to clean up the mold, in accordance with general industry-accepted standards.

Note: Mold remediation contractors are not required to remedy the source of the moisture that caused the mold if they do not have the required expertise to do so.

Note: It is always recommended to correct the underlying source of water/moisture before cleaning up mold growth or the mold will likely grow back.

How is the *Mold Remediation Plan* used?

The Mold Assessor must give you, the client, the *Mold Remediation Plan* before the cleanup project begins. You should understand and agree with the plan.

You will then give the *Mold Remediation Plan* to Mold Remediation Contractors you may want to hire to do the work. This will give them the information they need to give you a cost estimate for the work.

What are the main responsibilities of a Mold Remediation Contractor?

- Have a valid Mold Remediation Contractor License from the Department of Labor for the company.

What precautions must be taken when disinfectants, biocides and antimicrobial coatings are used during mold remediation?

Disinfectants, biocides and antimicrobial coatings registered with the USEPA may only be used if they are specified in the Mold Remediation Plan. These chemicals must be used only for their intended purpose. They should also only be applied according to the manufacturer's labeling instructions. The Mold Assessor and the Mold Remediation Contractor must consider the potential for people who occupy the property to be sensitive or have a negative reaction to the chemicals.

When is a mold remediation project complete?

Once your Mold Remediation Contractor has done the work, the Mold Assessor must do a post-remediation assessment. The project is complete when the Mold Assessor issues a written passed clearance report that states:

- the work area is free from all visible mold,
- all work has been done according to the *Mold Remediation Plan* and *Mold Remediation Work Plan*, and
- the clearance criteria listed in the *Mold Remediation Plan* was met.

If the cleanup work was not successful, the Mold Assessor will write a final status report listing what needs to be done to receive a passed clearance report. The final status report will be given to you and the Mold Remediation Contractor.

You should use the same Mold Assessor who wrote the *Mold Remediation Plan* to do the post-remediation assessment, but this is not required.

The Mold Remediation Contractor may not remove materials or dismantle containment structures until you get a passed clearance report.

Note: If you decide not to have a post-remediation assessment, the Mold Assessor and Mold Remediation Contractor should get documentation that you accept the work as is before they leave the property.

Where can I find more information on general industry accepted practices for mold remediation?

- New York City Department of Health and Mental Hygiene: <http://www1.nyc.gov/site/doh/health/health-topics/mold.page>
- New York State Department of Health: <https://www.health.ny.gov/publications/7287/>
- U.S. Environmental Protection Agency: <https://www.epa.gov/mold>
- Institute of Inspection, Cleaning and Restoration Certification: <http://www.iicrc.org/standards/iicrc-s520/>

How can I verify that a Mold Assessor or Mold Remediation Contractor is licensed by the Department of Labor?

Visit the Department of Labor’s website and use the “Licensed Mold Contractors Search Tool” at: <https://www.labor.ny.gov/workerprotection/safetyhealth/mold/licensed-mold-contractors-search-tool.shtm>

How can I file a complaint if I do not believe the mold professionals followed this guidance?

Submit the “Mold Contractor Complaint Form” at: <https://www.labor.ny.gov/workerprotection/safetyhealth/mold/compliance.shtm>



**Department
of Labor**

Licensing of Mold Inspection, Assessment and Remediation Specialists and Minimum Work Standards

Article 32
New York State Labor Law
Effective July 28, 2015

SH 120 (12/16)

ARTICLE 32
LICENSING OF MOLD INSPECTION, ASSESSMENT AND REMEDIATION SPECIALISTS
AND MINIMUM WORK STANDARDS

Title 1. Licensing of mold inspection, assessment and remediation specialists and minimum work standards (Sections 930-940.)

Section

- 930. Definitions.
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§ 930. Definitions. As used in this article:

1. "Department" means the department of labor.
2. "Mold" means any indoor multi-cellular fungi growth capable of creating toxins that can cause pulmonary, respiratory, neurological or other major illnesses after minimal exposure, as such exposure is defined by the environmental protection agency, centers for disease control and prevention, national institute of health, or other federal, state, or local agency organized to study and/or protect human health.
3. "Mold remediation" means conducting the business of removal, cleaning, sanitizing, or surface disinfection of mold, mold containment, and waste handling of mold and materials used to remove mold from surfaces by a business enterprise, including but not limited to, sole proprietorships. Mold remediation for the purposes of this article shall not include remediation of the underlying sources of moisture that may be the cause of mold that requires expertise not specific to acts authorized under this article.
4. "Mold assessment" means an inspection or assessment of real property that is designed to discover mold, conditions that facilitate mold, indicia of conditions that are likely to facilitate mold, or any combination thereof.
5. "Mold abatement" means the act of removal, cleaning, sanitizing, or surface disinfection of mold, mold containment, and waste handling of mold and materials used to remove mold from surfaces by an individual.
6. "Project" means mold remediation, mold assessment, or mold abatement, of areas greater than ten square feet, but does not include (a) routine cleaning or (b) construction, maintenance, repair or demolition of buildings, structures or fixtures undertaken for purposes other than mold remediation or abatement.
7. "Commissioner" means the commissioner of the department of labor.

§ 931. Licensing requirements.

1. It shall be unlawful for any contractor to engage in mold assessment on a project, or to advertise or hold themselves out as a mold assessment contractor unless such contractor has a valid mold assessment license issued by the commissioner.
2. It shall be unlawful for any contractor to engage in mold remediation on a project, or to advertise or hold themselves out as a mold remediation contractor unless such contractor has a valid mold remediation license issued by the commissioner.
3. It shall be unlawful for any individual to engage in mold abatement on a project or to advertise or hold themselves out as a mold abatement worker unless such individual has a valid mold abater's license issued by the commissioner.
4. A copy of a valid mold assessment or mold remediation license must be conspicuously displayed at the work site on a mold project.
5.
 - (a) Nothing in this article shall prohibit any design professional licensed pursuant to title eight of the education law from performing mold inspection, assessment, remediation and/or abatement tasks or functions if the person is acting within the scope of his or her practice, or require the design professional to obtain a license under this article for such mold inspection, assessment remediation and/or abatement tasks or functions.
 - (b) Nothing in this article shall mean that any individual not licensed pursuant to title eight of the education law may perform tasks or functions limited to the scope of practice of a design professional under such title.

§932. License; procedure.

1. The commissioner shall establish minimum qualifications for licensing.
2. Applications for licenses and renewal licenses shall be submitted to the commissioner in writing on forms furnished by the commissioner and shall contain the information set forth in this section as well as any additional information that the commissioner may require.
3. An applicant for a license to perform mold assessment shall meet the following minimum requirements:
 - (a) be eighteen years of age or older;
 - (b) have satisfactorily completed commissioner approved course work, including training on the appropriate use and care of personal protection equipment;
 - (c) paid the appropriate fees as provided in subdivision six of this section; and
 - (d) submitted insurance certificates evidencing workers' compensation coverage, if required, and liability insurance of at least fifty thousand dollars providing coverage for claims arising from the licensed activities and operations performed pursuant to this article.
4. An applicant for a license to perform mold remediation shall meet the following minimum requirements:
 - (a) be eighteen years of age or older;
 - (b) have satisfactorily completed commissioner approved course work, including training on the appropriate use and care of personal protection equipment;
 - (c) paid the appropriate fees as provided in subdivision six of this section; and
 - (d) submitted insurance certificates evidencing workers' compensation coverage, if required, and liability insurance of at least fifty thousand dollars providing coverage for claims arising from the licensed activities and operations performed pursuant to this article.

5. An applicant for a license to perform mold abatement shall meet the following minimum requirements:
 - (a) be eighteen years of age or older;
 - (b) have satisfactorily completed commissioner approved course work, including training on the appropriate use and care of personal protection equipment; and
 - (c) paid the appropriate fees as provided in subdivision six of this section.
6. The commissioner shall charge and collect the following non-refundable fees which shall accompany each application:
 - (a) a fee for an initial application for a license as determined by the commissioner, of not less than five hundred dollars nor more than one thousand dollars for a mold remediation license, not less than one hundred fifty dollars nor more than three hundred dollars for a mold assessment license and not less than fifty dollars nor more than one hundred dollars for an individual mold abatement license;
 - (b) a fee for renewal of a license equal to the application fee; and
 - (c) a fee to be charged to a course provider for review of each course submitted for approval, as determined by the commissioner, of not less than five hundred dollars and not more than one thousand dollars, and an additional fee to be charged to a course provider of not less than one hundred dollars nor more than two hundred dollars for review of changes of technical content.

§ 933. Exemptions. The following persons shall not be required to obtain a license as provided in this title in order to perform mold assessment, remediation, or abatement:

1. a residential property owner who performs mold inspection, assessment, remediation, or abatement on his or her own property;
2. a non-residential property owner, or the employee of such owner, who performs mold assessment, remediation, or abatement on an apartment building owned by that person that has not more than four dwelling units;
3. an owner or a managing agent or a full-time employee of an owner or managing agent who performs mold assessment, remediation, or abatement on commercial property or a residential apartment building of more than four dwelling units owned by the owner provided, however, that this subdivision shall not apply if the managing agent or employee engages in the business of performing mold assessment, remediation, or abatement for the public; and
4. a federal, state or local governmental unit or public authority and employees thereof that perform mold assessment, remediation, or abatement on any property owned, managed or remediated by such governmental unit or authority.

§ 934. License issuance and renewal.

1. Licenses issued pursuant to the provisions of this title shall be valid for a period of two years from the date of issuance and may be renewed in accordance with the conditions set forth in this article and established by the commissioner.
2. Within thirty days of the receipt of the application and fee for any license issued under this section, the commissioner shall either issue the license or issue a notification of denial pursuant to subdivision one of section nine hundred thirty-eight of this title.
3. Licenses shall be in a form prescribed by the commissioner.
4. The renewal of all licenses granted under the provisions of this article shall be conditioned upon the submission of a certificate of completion of a commissioner-approved course

designed to ensure the continuing education of licensees on new and existing mold assessment and mold remediation standards.

§ 935. Practice by license holder.

1. A mold assessment license holder who intends to perform mold assessment on a mold remediation project shall prepare a work analysis for the project. The mold assessment license holder shall provide the analysis to the client before the mold remediation begins and such plan must include the analysis as defined in section nine hundred forty-five of this article.
2. A mold remediation license holder who intends to perform mold remediation shall prepare a work plan providing instructions for the remediation efforts to be performed for the mold remediation project. The mold remediation license holder shall provide the work plan to the client before the mold remediation begins. The mold remediation license holder shall maintain a copy of the work plan at the job site where the remediation is being performed.

§ 936. Licensee duties; prohibited activities.

1. A mold assessment licensee who performs mold assessment services shall provide a written report to each person for whom such licensee performs mold assessment services for compensation.
2. No licensee shall perform both mold assessment and mold remediation on the same property.
3. No person shall own an interest in both the licensee who performs mold assessment services and the licensee who performs mold remediation services on the same property.

§ 937. Civil penalties and revocation.

1. The commissioner may, after a notice and hearing, suspend or revoke any license, or censure, fine, or impose probationary or other restrictions on any licensee for good cause shown which shall include, but not be limited to the following:
 - (a) conviction of a felony relating to the performance of a mold assessment or mold remediation;
 - (b) deceit or misrepresentation in obtaining a license authorized under this article;
 - (c) providing false testimony or documents to the commissioner in relation to a license authorized by this article or any other license issued by the commissioner;
 - (d) deceiving or defrauding the public in relation to services provided for a fee that require a license; or
 - (e) incompetence or gross negligence in relation to mold assessment or mold remediation.
2. Violators of any of the provisions of this article may be fined by the commissioner in an amount not to exceed two thousand dollars for the initial violation and up to ten thousand dollars for each subsequent violation.

§938. Denial of license; complaints; notice of hearing.

1. The commissioner shall, before making a determination to deny an application for a license, notify the applicant in writing of the reasons for such proposed denial and afford the applicant an opportunity to be heard in person or by counsel prior to denial of the application. Such notice shall notify the applicant that a request for a hearing must be

- made within thirty days after issuance of such notification. If a hearing is requested, such hearing shall be held at such time and place as the commissioner shall prescribe.
2. If the applicant fails to make a written request for a hearing within thirty days after issuance of such notification, then the notification of denial shall become the final determination of the commissioner. The commissioner shall have subpoena powers regulated by the civil practice law and rules. If, after such hearing, the application is denied, written notice of such denial shall be served upon the applicant.
 3. The commissioner shall, before revoking or suspending any license or imposing any fine as authorized by this article or reprimand on the holder thereof and at least ten days prior to the date set for the hearing, notify in writing the holder of such license, of any charges made and shall afford such person an opportunity to be heard in person or by counsel in reference thereto. No prior notice and hearing is required before the commissioner issues an order directing the cessation of unlicensed activities.
 4. Written notice must be served to the licensee or person charged.
 5. The hearing on such charges shall be at such time and place as the commissioner shall prescribe.

§ 939. Judicial review. The action of the commissioner in suspending, revoking or refusing to issue or renew a license, or issuing an order directing the cessation of unlicensed activity or imposing a fine or reprimand may be appealed by a proceeding brought under and pursuant to article seventy-eight of the civil practice law and rules.

§ 940. Rulemaking authority. The commissioner may adopt rules and regulations to oversee the practice of mold assessment, remediation and abatement and to ensure the health, safety and welfare of the public.

Title 2. Minimum work standards for the conduct of mold assessments and remediation by licensed persons (Sections 945-948.)

Section

945. Minimum work standards for the conduct of mold assessments by licensed persons.
946. Minimum work standards for the conduct of mold remediation by licensed persons.
947. Post-remediation assessment and clearance.
948. Investigations and complaints.

§ 945. Minimum work standards for the conduct of mold assessments by licensed persons.

1. A mold assessment licensee shall prepare a mold remediation plan that is specific to each remediation project and provide the plan to the client before the remediation begins. The mold remediation plan must specify:
 - (a) the rooms or areas where the work will be performed;
 - (b) the estimated quantities of materials to be cleaned or removed;
 - (c) the methods to be used for each type of remediation in each type of area;
 - (d) the personal protection equipment (PPE) to be supplied by licensed remediators for use by licensed abaters;
 - (e) the proposed clearance procedures and criteria for each type of remediation in each type of area;

- (f) when the project is a building that is currently occupied, how to properly notify such occupants of such projects taking into consideration proper health concerns; the plan must also provide recommendations for notice and posting requirements that are appropriate for the project size, duration and points of entry;
 - (g) an estimate of cost and an estimated time frame for completion; and
 - (h) when possible, the underlying sources of moisture that may be causing the mold and a recommendation as to the type of contractor who would remedy the source of such moisture.
2. The remediation plan may require containment, as appropriate, to prevent the spread of mold to areas of the building outside the containment under normal conditions of use.
 3. A mold assessment licensee who indicates in a remediation plan that a disinfectant, biocide, or antimicrobial coating will be used on a mold remediation project shall indicate a specific product or brand only if it is registered by the United States Environmental Protection Agency for the intended use and if the use is consistent with the manufacturer's labeling instructions. A decision by a mold assessment licensee to use such products must take into account the potential for occupant sensitivities.

§ 946. Minimum work standards for the conduct of mold remediation by licensed persons.

1. A mold remediation licensee shall prepare a mold remediation work plan that is specific to each project, fulfills all the requirements of the mold remediation plan developed by the mold assessment licensee as provided to the client and provides specific instructions and/or standard operating procedures for how a mold remediation project will be performed. The mold remediation licensee shall provide the mold remediation work plan to the client before site preparation work begins.
2. If a mold assessment licensee specifies in the mold remediation plan that personal protection equipment (PPE) is required for the project, the mold remediation licensee shall provide the specified PPE to all employees who engage in remediation activities and who will, or are anticipated to, disturb or remove mold contamination. The containment, when constructed as described in the remediation work plan and under normal conditions of use, must prevent the spread of mold to areas outside the containment.
3. Signs advising that a mold remediation project is in progress shall be displayed at all accessible entrances to remediation areas.
4. No person shall remove or dismantle any containment structures or materials from a project site prior to receipt by the mold remediation licensee overseeing the project of a notice from a mold assessment licensee that the project has achieved clearance as described in section nine hundred forty-seven of this title.
5. Disinfectants, biocides and antimicrobial coatings may be used only if their use is specified in a mold remediation plan, if they are registered by the United States Environmental Protection Agency for the intended use and if the use is consistent with the manufacturer's labeling instructions. If a plan specifies the use of such a product but does not specify the brand or type of product, a mold remediation licensee may select the brand or type of product to be used. A decision by a mold assessment or remediation licensee to use such a product must take into account the potential for occupant sensitivities and possible adverse reactions to chemicals that have the potential to be off-gassed from surfaces coated with the product.

§ 947. Post-remediation assessment and clearance.

1. For a remediated project to achieve clearance, a mold assessment licensee shall conduct a post-remediation assessment. The post-remediation assessment shall determine whether:

- (a) the work area is free from all visible mold; and
 - (b) all work has been completed in compliance with the remediation plan and remediation work plan and meets clearance criteria specified in the plan.
2. Post-remediation assessment shall, to the extent feasible, determine that the underlying cause of the mold has been remediated so that it is reasonably certain that the mold will not return from that remediated area. If it has been determined that the underlying cause of the mold has not been remediated, the mold assessment licensee shall make a recommendation to the client as to the type of contractor who could remedy the source of the mold or the moisture causing the mold.
 3. A mold assessment licensee who determines that remediation has been successful shall issue a written passed clearance report to the client at the conclusion of each mold remediation project.
 4. If the mold assessment licensee determines that remediation has not been successful, the licensee shall issue a written final status report to the client and to the remediation licensee and recommend to the client that either a new assessment be conducted, that the remediation plan as originally developed be completed, or the underlying causes of mold be addressed, as appropriate.

§ 948. Investigations and complaints. The commissioner shall have the authority to inspect ongoing or completed mold assessment and mold remediation projects and to conduct an investigation upon his or her own initiation or upon receipt of a complaint by any person or entity.



Department of Labor

Division of Safety and Health
Harriman State Office Campus
Building 12, Room 167
Albany, NY 12240
(518) 457-1255
www.labor.ny.gov

For DOL Use Only: MC - ____ - _____

Mold Contractor Complaint Form

Purpose: The information you report on this form will be used to investigate violations of Article 32 of the New York State Labor Law.

Please Note:

- A. If the mold-affected area is less than 10 square feet, be advised that the Mold Law does not apply.
- B. Please send the completed form and any attachment(s) to the address of your local district office, which may be found at the end of this form, or electronically in a PDF format to moldcomplaints@labor.ny.gov.

Instructions: Please type or write legibly. Please provide as much information as possible using this form and include all relevant documents. A representative from the Department may contact you if additional information is needed.

1. Complainant Information

Name: _____
First Last

Address: _____

City: _____ State: _____ Zip Code: _____

Phone: () _____ - _____ Email: _____

2. Information on Mold-Affected Property

What is the relationship between the complainant and the mold-affected property?
 Owner Occupant Landlord Tenant Other: _____

Is the affected property's address the same as the home address above? Yes No

If it is not the same, provide the mold-affected property address below:
 Affected Property's Address: _____
 City: _____ State: _____ Zip Code: _____

Property Type: Single Family Apartment Commercial
 Industrial Multi Family: Number of Units: _____ Other: _____

3. Business or Individual Complaint is Against

Which group(s) of mold professionals do you have a complaint against?
 Mold Assessor Mold Remediation Contractor Mold Abatement Worker

Please provide the following information for the Mold Professional you have a complaint against:
 Mold Professional's Name: _____
First Last

Mold Professional's License No. (if known): _____
 Mold Professional's Contractor License No. (if known): _____

Type of Business (if known): Sole Proprietor Company

Business Name: _____ Business Website: _____

Business Address: _____
 City: _____ State: _____ Zip Code: _____

How did you hear about the Mold Professional? TV Print Website Radio Other: _____

Have you complained to the business? Yes No

If the answer is yes, how did you communicate your complaint?

E-mail Phone In Person Letter Other: _____

Did you sign a contract/proposal with the Mold Professional to perform the work?

Yes – **Please provide a copy of the contract/proposal.** No

Was any plan or work plan provided to you by the mold professional?

Yes – **Please attach a copy of the plan/work plan.** No

What is the nature of your complaint(s)? Please check the appropriate box(s). If you did not see the category of your complaint(s), please check 'Other' and provide a brief description. You may provide a more detailed description in the next section.

- Unlicensed or expired license for company and/or worker.
 - Contractor performed mold assessment and mold remediation on the same property.
 - Inadequate mold assessment.
 - Inadequate mold remediation.
 - Abatement workers not following the Mold Remediation Work Plan.
 - No or failed post-remediation clearance inspection.
 - Other (Please Specify Briefly): _____
-

4. Detailed Complaint Write-up

Please describe your complaint in detail (attach extra sheets if necessary). Include the names of individuals you have dealt with, dates and outcome(s) of your dealings, and enclose copies of all contracts, receipts, correspondence, and other documents you have related to this complaint.

Date(s)	Description

Do not mark in this box. For DOL internal use only.			
VC: ___ Y ___ N	Assigned to: _____	Region: _____	Date Processed: _____

Where to send your complaint form and attachments:

Albany District

Counties: Albany, Clinton, Columbia, Dutchess, Essex, Fulton, Green, Montgomery, Orange, Putnam, Rockland, Rensselaer, Saratoga, Schenectady, Schoharie, Sullivan, Ulster, Warren, Washington

State Office Campus, Room 166, Albany, NY 12240

Phone: (518) 457-2072

Fax: (518) 485-8054

Buffalo District

Counties: Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Monroe, Niagara, Ontario, Orleans, Wayne, Wyoming, Yates

65 Court Street, Room 405, Buffalo, NY 14202

Phone: (716) 847-7126

Fax: (716) 847-7138

New York City District

Counties: Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

One Hudson Square, 75 Varick Street (7th Floor), New York, NY 10013

Phone: (212) 775-3532

Fax: (212) 775-3535

Syracuse District

Counties: Broome, Cayuga, Chemung, Chenengo, Cortland, Delaware, Franklin, Hamilton, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Otsego, St. Lawrence, Schuyler, Seneca, Steuben, Tioga, Tompkins

450 S. Salina Street, Syracuse, NY 13202

Phone: (315) 479-3303

Fax: (315) 479-3333

Section 2

Guidelines
on
Assessment and Remediation of Fungi in Indoor Environments

New York City Department of Health and Mental Hygiene

November 2008

1



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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.

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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

A visual inspection is the most important initial step in identifying a possible mold problem and in determining remedial strategies. The extent of any water damage and mold growth should be visually assessed and the affected building materials identified. A visual inspection should also include observations of hidden areas where damages may be present, such as crawl spaces, attics, and behind wallboard. Carpet backing and padding, wallpaper, moldings (*e.g.* baseboards), insulation and other materials that are suspected of hiding mold growth should also be assessed.

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 exposure⁸ 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 (less than 10 square feet) – *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

References

1. US Department of Health and Human Services, Centers for Disease Control and Prevention (CDC), Guidelines for Environmental Infection Control in Health-Care Facilities, Atlanta, GA, 2003, www.cdc.gov/ncidod/dhqp/pdf/guidelines/Enviro_guide_03.pdf
2. Health Canada, Fungal Contamination in Public Buildings: Health Effects and Investigation Methods, 2004
3. Institute of Medicine. Damp indoor spaces and health. Washington, DC: National Academies Press, 2004.
4. Mazur L, Kim J. Spectrum of noninfectious health effects from molds. Committee on Environmental Health, American Academy of Pediatrics. *Pediatrics*, 2006; **118**(6): e1909-26.
5. Seltzer JM, Fedoruk MJ. Health effects of mold in children. *Pediatr Clin N Am*, 2007; **54**: 309-333.
6. Storey E, Dangman KH, Schenck P, et al. Guidance for clinicians on the recognition and management of health effects related to mold exposure and moisture indoors. Farmington, CT: University of Connecticut Health Center, Division of Occupational and Environmental Medicine, Center for Indoor Environments and Health, 2004. <http://oehc.uhc.edu/clinser/MOLD%20GUIDE.pdf>
7. Kerckmar C, Dearborn D, et al. Reduction in Asthma Morbidity in Children as a Result of Home Remediation Aimed at Moisture Sources. *Env Health Perspectives* 2006; **114**(8): 1574-1580.
8. Haas D, Habib J, et al. Assessment of indoor air in Austrian apartments with and without visible mold growth. *Atmospheric Env* 2007; **41**: 5192-5201.
9. US Environmental Protection Agency. Mold Remediation in Schools and Office Buildings. Washington DC, 2001. www.epa.gov/mold/table1.html
10. American Industrial Hygiene Association. Assessment, Remediation, and Post-Remediation Verification of Mold in Buildings. AIHA guideline #3. Fairfax, VA. 2004.
11. American Industrial Hygiene Association. "Total Fungi and Other Assessment Methods," Field Guide for the Determination of Biological Contaminants in Environmental Samples. Hung L, Miller JD, Dillon HK, ed. Fairfax, VA; AIHA 2005.
12. Morey P. "Microbiological sampling strategies in indoor environments," Sampling and analysis of indoor microorganisms. Yang CS, ed. Hoboken, NJ: John Wiley & Sons, Inc., 2007.
13. Park J, Schleiff P, et al. Building-related respiratory symptoms can be predicted with semi-quantitative indices of exposure to dampness and mold. *Indoor Air* 2004; **14**: 425-433.
14. Meklin T, Reponen T, et al. Comparison of mold concentrations quantified by MSQPRC in indoor and outdoor air sampled simultaneously. *Science of the Total Environment* 2007; **382**: 130-134.

15. Wieslander G, Norbäck D, Venge P. Changes of symptoms, tear film stability and eosinophilic cationic protein in nasal lavage fluid after re-exposure to a damp office building with a history of flooding. *Indoor Air* 2007; **17**: 19-27.
16. Hicks J, Lu E, et al. Fungal Types and Concentrations from Settled Dust in Normal Residences. *J Occ Env Hygiene* 2005; **2**: 481-492.
17. Hung L, Lindsey S, Kroehle K. A Fungal Abatement Project in an Office Located in Arid Southwestern Region of the United States. *Proceedings: Indoor Air 2002*: 733-738.
18. Burge H, Otten J. "Fungi," Bioaerosols Assessment and Control. J Macher, ed. Cincinnati, OH: American Conference of Industrial Hygienists, 1999.
19. American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. Ventilation for acceptable indoor air quality – ASHRAE Standard (ANSI/ASHRAE 62.1-2007). Atlanta, GA, 2007.
20. American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. 2007 ASHRAE Handbook – Heating Ventilating and Air-Conditioning Applications, Chapter 21, Inch-Pound Edition, Atlanta, GA, 2007
21. Cummings K, Sickel D, et al. Knowledge, Attitudes, and Practices Related to Mold Exposure Among Residents and Remediation Workers in Posthurricane New Orleans. *Arch Env Occ Health* 2006; **61**(3): 101-108.
22. Cummings K, Cox-Ganser J, et al. Respirator Donning in Post-Hurricane New Orleans. *Emerging Infectious Disease* 2007 **13**(5): 700-707.
23. National Clearinghouse for Worker Safety and Health Training. *Guidelines for the protection and training of workers engaged in maintenance and remediation work associated with mold*; May 20, 2005. <http://tools.niehs.nih.gov/wetp/index.cfm?id=327>
24. Krause M, Geer W, et al. Controlled Study of Mold Growth and Cleaning Procedure on Treated and Untreated Wet Gypsum Wallboard in an Indoor Environment. *J Occ Env Hyg* 2006; **3**: 435-441.
25. American Industrial Hygiene Association. "Advanced Perspectives in Mold Assessment and Control: Approaches to Varying Occupancies/Building Types," Recognition, Evaluation, and Control of Indoor Mold. Prezant B, Weekes D, Miller JD ed. Fairfax, VA; AIHA 2008.
26. American Industrial Hygiene Association. "Remediation: Scope, Roles, and Risk Communication," Recognition, Evaluation, and Control of Indoor Mold. Prezant B, Weekes D, Miller JD ed. Fairfax, VA; AIHA 2008.

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}

Appendix A References

1. Health Canada, Fungal Contamination in Public Buildings: Health Effects and Investigation Methods, 2004
2. Institute of Medicine. Damp indoor spaces and health. Washington, DC: National Academies Press, 2004.
3. Mazur L, Kim J. Spectrum of noninfectious health effects from molds. Committee on Environmental Health, American Academy of Pediatrics. *Pediatrics*, 2006; **118**(6): e1909-26.
4. Seltzer JM, Fedoruk MJ. Health effects of mold in children. *Pediatr Clin N Am*, 2007; **54**: 309-333.
5. Storey E, Dangman KH, Schenck P, et al. Guidance for clinicians on the recognition and management of health effects related to mold exposure and moisture indoors. Farmington, CT: University of Connecticut Health Center, Division of Occupational and Environmental Medicine, Center for Indoor Environments and Health, 2004.
<http://oehc.uchc.edu/clinser/MOLD%20GUIDE.pdf>
6. do Pico G, Hazardous Exposure and Lung Disease Among Farm Workers. *Clinics in Chest Medicine* 1992; **13**(2): 311-28.

7. Cookingham C, Solomon W. "Bioaerosol-Induced Hypersensitivity Diseases," Bioaerosols. H Burge, ed. Boca Raton, FL: CRC Press, 1995.
8. Lee S, Adhikari A, Grinshpun S, et al. Personal Exposure to Airborne Dust and Microorganisms in Agricultural Environments. *Journal Of Occupational and Environmental Hygiene* 2006; **3**: 118-130.
9. Moore J, Convery R, Millar BC. Hypersensitivity Pneumonitis Associated with Mushroom Worker's Lung: An Update on the Clinical Significance of the Importation of Exotic Mushroom Varieties. *Int. Arch Allergy and Immunology*, 2005; **136**: 98-102.
10. Rose C. "Hypersensitivity Pneumonitis," Preventing Occupational Disease and Injury. Levy B., et al. ed. American Public Health Association, Washington DC, 2005
11. Seifert SA, Von Essen S, Jacobitz K, et al. Organic dust toxic syndrome: a review. *J Toxicol Clin Toxicol*, 2003; **41**(2): 185-193.
12. Weltermann BM, Hodgson M, Storey E, et al. Hypersensitivity pneumonitis: a sentinel event investigation in a wet building. *Am J Ind Med*, 1998; **34**(5): 499-505.
13. Bush RK, Portnoy JM, Saxon A, et al. The medical effects of mold exposure. *J Allergy Clin Immunol*, 2006; **117**(2): 326-333.
14. Hodgson MJ, Morey PR, Attfield M, et al. Pulmonary disease associated with cafeteria flooding. *Arch Environ Health*, 1985; **40**(2): 96-101.
15. Rautiala S, Reponen T, Nevalainen A, et al. Control of exposure to airborne viable microorganisms during remediation of moldy buildings; report of three case studies. *Am Ind Hyg Assoc J*, 1998; **59**(7): 455-60.
16. Morey P, Hunt S. Mold contamination in an earthquake damaged building, in *Proceedings of Healthy Buildings*, 1995; **95**:1377-80 in *Guidelines for the protection and training of workers engaged in maintenance and remediation work associated with mold, May 20, 2005*: National Clearinghouse for Worker Safety and Health Training.
17. Douwes J, Thorne P, Pearce N, Heederik D. Review – Bioaerosol Health Effects and Exposure Assessment: Progress and Prospects. *Annals of Occupational Hygiene*, 2003; **47**(3): 187-200.
18. Burge H, Otten J. "Fungi," Bioaerosols Assessment and Control. J Macher, ed. Cincinnati, OH: American Conference of Industrial Hygienists, 1999.
19. Committee on Environmental Health, American Academy of Pediatrics. Spectrum of noninfectious health effects from molds. *Pediatrics*, 2006; **118**(6): 2582-6.
20. Dales RE, Zwanenburg H, Burnett R, et al. Respiratory health effects of home dampness and molds among Canadian children. *Am J Epidemiol*, 1991; **134**(2): 196-203.
21. Levetin E. "Fungi," Bioaerosols. H Burge, ed. Boca Raton, FL: CRC Press, 1995.
22. Bush RK, Portnoy JM. The role and abatement of fungal allergens in allergic diseases. *J Allergy Clin Immunol* 2001; **107**(3 Suppl): S430-40.

23. Villette M, Cornier Y, et al. Hypersensitivity Pneumonitis in a Hardwood Processing Plant Related to Heavy Mold Exposure. *Journal Of Occupational and Environmental Hygiene* 2006; **3**: 301-307.
24. Stark P, Celedón J, et al. Fungal levels in the Home and Allergic Rhinitis by 5 Years of Age. *Environmental Health Perspectives* 2005; **113** (10): 1405-1409.
25. Cox-Ganser J, White S, et al. Respiratory Morbidity in Office Workers in a Water-Damaged Building. *Environmental Health Perspectives* 2005; **113**(4): 485-490.
26. Jarvis J, Morey P. Allergic Respiratory Disease and Fungal Remediation in a Building in a Subtropical Climate. *Applied Occupational and Environmental Hygiene* 2001; **16**(3): 380-388.
27. Kuhn D, Ghannoum M. Indoor Mold, Toxigenic Fungi, and *Stachybotrys chartarum*: Infectious Disease Perspective. *Clinical Microbiology Reviews* 2003; **16**(1): 144-172.
28. Ritz N, Ammann R, et al. Risk factors for allergic bronchopulmonary aspergillosis and sensitization to *Aspergillus fumigatus* in patients with cystic fibrosis. *European Journal of Pediatrics* 2005; **164**(9): 577-582.
29. Simon-Nobbe B, Denk U, et al. The Spectrum of Fungal Allergy. *Int. Ach Allergy Immunol* 2008; **145**:58-68.
30. Iossifova Y, Reponen T, et al. House dust (1-3)- β -D-glucan and wheezing in infants. *Allergy* 2007; **62**:504-513.
31. Douwes J, van Strien R, et al. Does early indoor microbial exposure reduce the risk of asthma? The Prevention and Incidence of Asthma and Mite Allergy birth cohort study. *J Allergy Clin Immunol.* 2006 **117**(5): 1067-1073.
32. Jaakkola J, Hwang B, Jaakkola N. Home Dampness and Molds, Parental Atopy, and Asthma in Childhood: A Six-Year Population-Based Cohort Study. *Environmental Health Perspectives* 2005; **113**(3): 357-361.
33. Mitakakis T, Barnes C, et al. Spore germination increases allergen release from *Alternaria*. *J Allergy Clin Immunol.* 2001 **107**(2): 388-390.
34. Green B, Mitakakis T, Tovey E. Allergen detection from 11 fungal species before and after germination. *J Allergy Clin Immunol.* 2003 **111**(2): 285-289.
35. Schleibinger H, Laubmann D. Emission patterns and emission rates of MVOC and the possibility for predicting hidden mold damage? *Indoor Air* 2005; **15**(suppl 9): 98-104.
36. Rylander R, Lin R. (1-3)- β -D-glucan – relationship to indoor air-related symptoms, allergy and asthma. *Toxicology* 2000; **152**: 47-52.
37. Horner W, Miller JD. Microbial volatile organic compounds with emphasis on those arising from filamentous fungal contaminants of buildings. ASHRAE Transactions: Research 4621 (RP-1072) 2003.
38. American Industrial Hygiene Association. “Total Fungi and Other Assessment Methods,” Field Guide for the Determination of Biological Contaminants in Environmental Samples. Hung

L, Miller JD, Dillon HK, ed. Fairfax, VA; AIHA 2005.

39. Douwes J. (1-3)- β -D-glucans and respiratory health: a review of the scientific evidence. *Indoor Air* 2005; **15**: 160-169.
40. Wessen B., Strom G., et al. "Analysis of Microbial Volatile Organic Compounds," *Microorganisms in Home and Indoor Work Environments*. Flannigan B., Samson R., Miller J., ed. New York NY: Taylor and Francis, 2001.
41. Bennett J, Klich M. Mycotoxins. *Clin Microbiol Rev*; 2003; **16**(3): 497-516.
42. Hodgson MJ, Morey P, Leung WY, et al. Building-associated pulmonary disease from exposure to *Stachybotrys chartarum* and *Aspergillus versicolor*. *J Occup Environ Med*, 1998; **40**(3): 241-249.
43. Croft WA, Jarvis BB, Yatawara CS. Airborne Outbreak of Trichothecene Toxicosis. *Atmospheric Environment*, 1986; **20**(3): 549-552.
44. DeKoster J, Thorne P. Bioaerosol concentrations in noncompliant, complaint, and intervention homes in the Midwest. *Am Ind Hyg Assoc J*, 1995; **56**(6): 573-580.
45. Johanning E, Biagini R, Hull D, et al. Health and immunological study following exposure to toxigenic fungi (*Stachybotrys chartarum*) in a water-damaged office environment. *Int Arch Occup Environ Health*, 1996; **68**: 207-218.
46. Kelman BJ, Robbins CA, Swenson LJ, et al. Risk from inhaled mycotoxins in indoor office and residential environments. *Int J Toxicol*, 2004; **23**(1): 3-10.
47. Fischer G, Wolfgang D. Relevance of airborne fungi and their secondary metabolites for environmental, occupational and indoor hygiene. *Arch Microbiology* 2003; **179**: 75-82
48. Fung F, Hughson W. Health Effects of Indoor Fungal Bioaerosol Exposure. *Applied Occ and Env Hygiene* 2003; **18**: 535-544.
49. Miller J D, Rand T, Jarvis B. *Stachybotrys chartarum*: cause of human disease or media darling? *Medical Mycology* 2003; **41**: 271-291.
50. Etzel R. Mycotoxins. *JAMA* 2002; **287**(4): 425-27.
51. Horner W, Worthan P, Morey P. Air- and dust-borne mycoflora in houses free of water damage and fungal growth. *Appl Environ Microbiol* 2004; **70**(11): 6394-6400.
52. MacIntosh D, Brightman H, et al. Airborne Fungal Spores in a Cross-Sectional Study of Office Buildings. *J Occ Env Hyg* 2006; **3**: 379-389.
53. US Centers for Disease Control and Prevention. Division of Bacterial and Mycotic Diseases, US Department of Health and Human Services. Aspergillosis. http://www.cdc.gov/ncidod/dbmd/diseaseinfo/aspergillosis_t.htm, 6 October 2005.
54. Lenhart S, Schafer M, et al. Histoplasmosis – Protecting Workers at Risk. Occupational Respiratory Diseases. Cincinnati, OH: US Department of Health and Human Services, 2004.

Preventing and Cleaning Mold Growth Fact Sheet for Building Owners and Managers

Mold (mildew) is a fungus that can grow inside building on wet or damp surfaces. Mold can cause allergic reactions, trigger asthma attacks, or cause other health problems in some people.

Mold needs water or moisture to grow. Stop indoor mold growth by fixing leaks, drying damp or wet areas and controlling humidity. Before a clean-up, refer to the complete “Mold Guidelines” at nyc.gov/health.

PREVENT MOLD GROWTH

Fix Water Problems Immediately

- Correct water leaks.
- Dry any and all water-damaged items or areas.

Control Moisture Sources

- In bathrooms without windows, check that bathroom fans or exhaust vents are working.
- In bathrooms with windows, check that the window can be opened.
- Use a dehumidifier to lower humidity levels in basements.

CHECK THE SIZE OF THE AREA WITH MOLD GROWTH AND WATER DAMAGE

- Look for hidden mold and water damage
- If the amount of mold observed 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 there is less than 100 square feet of mold growth, trained building staff should be able to do the cleanup job.

FOLLOW THE PROPER STEPS TO CLEAN MOLD GROWTH

- Tell people living or working in the building about the plan to clean the mold growth.
- Tenants and others should leave the work area before cleaning begins.
- Cover or remove difficult-to-clean surfaces or items (e.g. carpeting, electronics) from the work area before cleaning begins.
- Use safety goggles, gloves, and a disposable respirator when removing mold growth.
- Clean mold growth with soap or a detergent, and water.
- Remove and throw away porous materials (e.g. ceiling tiles, insulation) with mold growth on them.
- Dispose of any plastic sheeting, moldy materials, and used sponges or rags in sealed heavy-duty plastic bags.
- Always fix water problems immediately. If the mold returns quickly or spreads, you may have an ongoing water problem.

If more than 10 square feet of mold growth is present also:

- Cover the floor in the work area with plastic sheeting.
- Cover entry and exit pathways with plastic sheeting.
- Seal any ventilation ducts with plastic sheeting.
- Mop and/or HEPA-vacuum the work area and pathways.

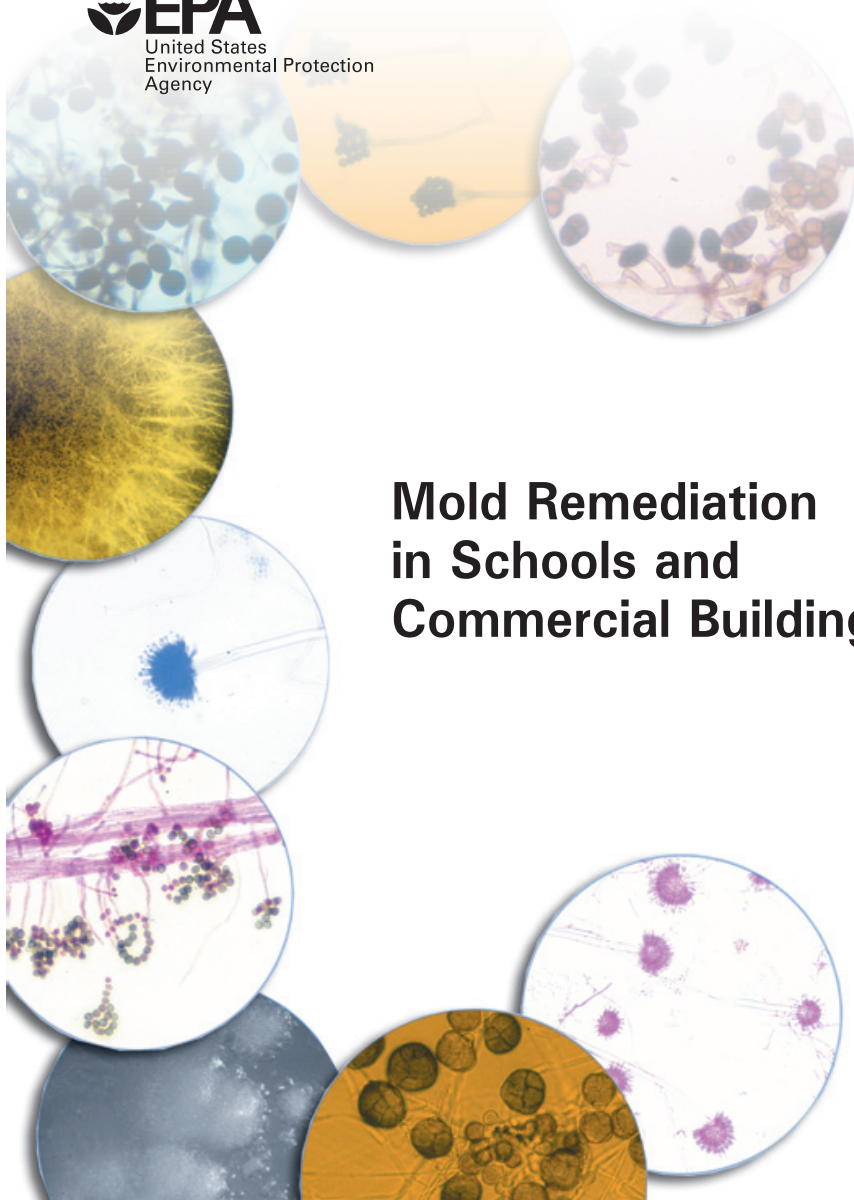
CLEAN MOLD GROWTH WITH PROPER SUPPLIES

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

FOR MORE INFORMATION

Visit our web site at nyc.gov/health for the complete “Mold Guidelines”

Section 3



Mold Remediation in Schools and Commercial Buildings

Indoor Air Quality (IAQ)

Acknowledgements

This document was prepared by the Indoor Environments Division (IED) of the U.S. Environmental Protection Agency. IED would like to thank the reviewers of this document who provided many valuable and insightful comments, and the contractors who provided support during the development of this document.

EPA would also like to thank those who provided photos: Terry Brennan (Photo #2, Photo #3A, Photo #4A, Photo #6, Photo #8, Photo #9); Paul Ellringer (Photo #4C); Stephen Vesper, Ph.D. (Photo #3B); and Chin Yang, Ph.D. (cover photos, Photo #4B, Photo #5, Photo #7).

Please note that this document presents *recommendations* on mold remediation. EPA does not regulate mold or mold spores in indoor air.

Cover Photos: Magnified photos of different species of mold

Mold Remediation in Schools and Commercial Buildings

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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 document presents guidelines for the remediation/cleanup of mold and moisture problems in schools and commercial buildings; these guidelines include measures designed to protect the health of building occupants and remediators. It has been designed primarily for building managers, custodians, and others who are responsible for commercial building and school maintenance. It should serve as a reference for potential mold and moisture remediators. Using this document, individuals with little or no experience with mold remediation should be able to make a reasonable judgment as to whether the situation can be handled in-house. It will help those in charge of maintenance to evaluate an in-house remediation plan or a remediation plan submitted by an outside contractor.¹ Contractors and other professionals who respond to mold and moisture situations in commercial buildings and schools may also want to refer to these guidelines.

Molds gradually destroy the things they grow on. Prevent damage to building materials and furnishings, save money, and avoid potential health risks by controlling moisture and eliminating mold growth.



Photo 2: Extensive mold contamination of ceiling and walls

¹ If you choose to use outside contractors or professionals, make sure they have experience cleaning up mold, check their references, and have them follow the recommendations presented in this document, the guidelines of the American Conference of Government Industrial Hygienists (ACGIH) (see Resources List), and/or guidelines from other professional organizations.

Molds can be found almost anywhere; they can grow on virtually any organic substance, as long as moisture and oxygen are present. There are molds that can grow on wood, paper, carpet, foods, and insulation. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. It is impossible to eliminate all mold and mold spores in the indoor environment. However, mold growth can be controlled indoors by controlling moisture indoors.

Molds reproduce by making spores that usually cannot be seen without magnification. Mold spores waft through the indoor and outdoor air continually. When mold spores land on a damp spot indoors, they may begin growing and digesting whatever they are growing on in order to survive. Molds gradually destroy the things they grow on.

Many types of molds exist. All molds have the potential to cause health effects. Molds can produce allergens that can trigger allergic reactions or even asthma attacks in people allergic to mold. Others are known to produce potent toxins and/or irritants. Potential health concerns are an important reason to prevent mold growth and to remediate/clean up any existing indoor mold growth.

Since mold requires water to grow, it is important to prevent moisture problems in buildings. Moisture problems can have many causes, including uncontrolled humidity. Some moisture problems in buildings have been linked to changes in building construction practices during the 1970s, '80s, and '90s. Some of these changes have resulted in buildings that are tightly sealed, but may lack adequate ventilation, potentially leading to moisture buildup. Building materials, such as drywall, may not allow moisture to escape easily. Moisture problems may include roof leaks, landscaping or gutters that direct water into or under the building, and unvented combustion appliances. Delayed maintenance or insufficient maintenance are also associated with moisture problems in schools and large buildings. Moisture problems in portable classrooms and other temporary structures have frequently been associated with mold problems.

2 Mold Remediation in Schools and Commercial Buildings

When mold growth occurs in buildings, adverse health problems may be reported by some building occupants, particularly those with allergies or respiratory problems. 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.

Prevention

The key to mold control is moisture control. Solve moisture problems before they become mold problems!

Mold Prevention Tips

- Fix leaky plumbing and leaks in the building envelope as soon as possible.
- Watch for condensation and wet spots. Fix source(s) of moisture problem(s) 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, 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% relative humidity (RH), ideally 30 – 50%, if possible.
- Perform regular building/HVAC inspections and maintenance as scheduled.
- Clean and dry wet or damp spots within 48 hours.
- Don't let foundations stay wet. Provide drainage and slope the ground away from the foundation.

Investigating, Evaluating, and Remediating Moisture and Mold Problems

Safety Tips While Investigating and Evaluating Mold and Moisture Problems

- Do not touch mold or moldy items with bare hands.
- Do not get mold or mold spores in your eyes.
- Do not breathe in mold or mold spores.
- Consult Table 2 and text for Personal Protective Equipment (PPE) and containment guidelines.
- Consider using PPE when disturbing mold. The minimum PPE is an N-95 respirator, gloves, and eye protection.

Moldy Areas Encountered During an Investigation

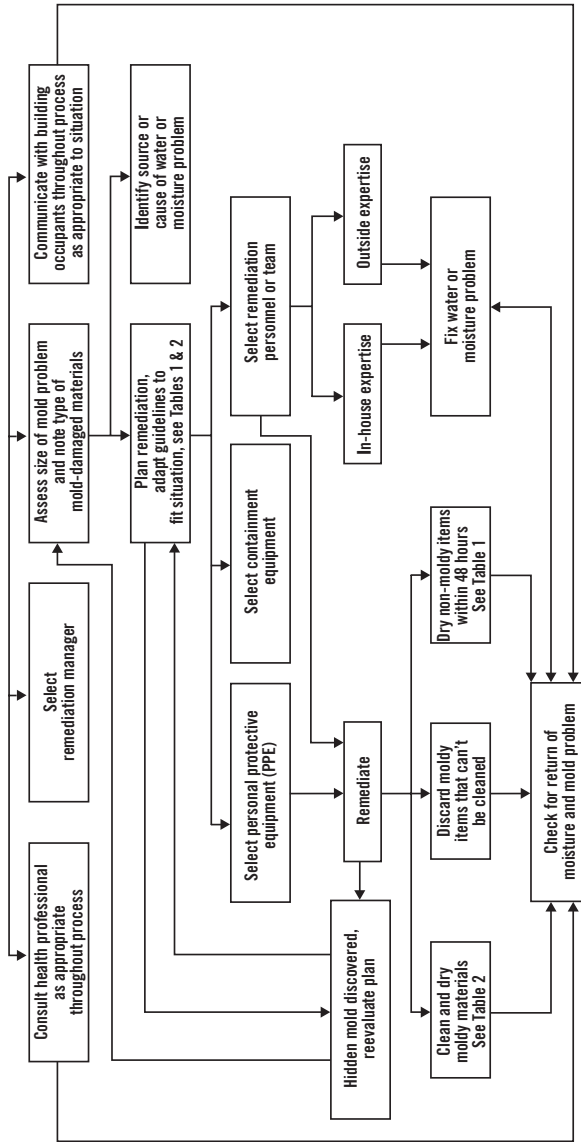


Photo 3A: Mold growing in closet as a result of condensation from room air



Photo 3B: Front side of wallboard looks fine, but the back side is covered with mold

Mold Remediation – Key Steps



Plan the Remediation Before Starting Work

Questions to Consider Before Remediating

- Are there existing moisture problems in the building?
- Have building materials been wet more than 48 hours? (See Table 2 and text)
- Are there hidden sources of water or is the humidity too high (high enough to cause condensation)?
- Are building occupants reporting musty or moldy odors?
- Are building occupants reporting health problems?
- Are building materials or furnishings visibly damaged?
- Has maintenance been delayed or the maintenance plan been altered?
- Has the building been recently remodeled or has building use changed?
- Is consultation with medical or health professionals indicated?

Remediation Plan

Assess the size of the mold and/or moisture problem and the type of damaged materials before planning the remediation work. Select a remediation manager for medium or large jobs (or small jobs requiring more than one person). The remediation plan should include steps to fix the water or moisture problem, or the problem may reoccur. The plan should cover the use of appropriate Personal Protective Equipment (PPE) and include steps to carefully contain and remove moldy building materials to avoid spreading the mold.² A remediation plan may vary greatly depending on the size and complexity of the job, and may require revision if circumstances change or new facts are discovered.

The remediation manager's highest priority must be to protect the health and safety of the building occupants and remediators. It is also important to communicate with building occupants when mold problems are identified.³ In some cases,

²Molds are known allergens and may be toxic. You may wish to use Personal Protective Equipment (PPE) while investigating a mold problem, as well as during remediation/cleanup situations. The minimum PPE includes an N-95 respirator, gloves, and eye protection.

³See Appendix C.

especially those involving large areas of contamination, the remediation plan may include temporary relocation of some or all of the building occupants. The decision to relocate occupants should consider the size and type of the area affected by mold growth, the type and extent of health effects reported by the occupants, the potential health risks that could be associated with debris, and the amount of disruption likely to be caused by remediation activities. If possible, remediation activities should be scheduled for off-hours when building occupants are less likely to be affected.

Remediators, particularly those with health-related concerns, may wish to check with their doctors or health care professionals before working on mold remediation or investigating potentially moldy areas. If you have any doubts or questions, you should consult a health professional before beginning a remediation project.

HVAC System

Do not run the HVAC system if you know or suspect that it is contaminated with mold. If you suspect that it may be contaminated (it is part of an identified moisture problem, for instance, or there is mold growth near the intake to the system), consult EPA's guide *Should You Have the Air Ducts in Your Home Cleaned?*⁴ before taking further action (see Resources List).

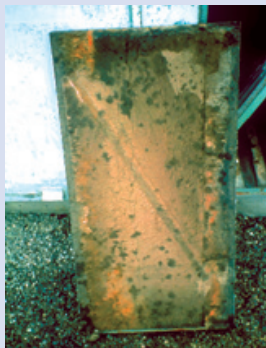


Photo 4A: Contaminated fibrous insulation inside air handler cover

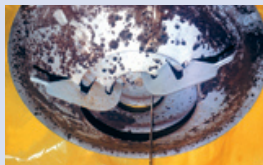


Photo 4B: Mold growth on air diffuser in ceiling



Photo 4C: Moldy air duct

⁴Although this document has a residential focus, it is applicable to other building types.

Hidden Mold

In some cases, indoor mold growth may not be obvious. It is possible that mold may be growing on hidden surfaces, such as the back side of drywall, wallpaper, or paneling, the top of ceiling tiles, the underside of carpets and pads, etc. Possible locations of hidden mold can include pipe chases and utility tunnels (with leaking or condensing pipes), walls behind furniture (where condensation forms), condensate drain pans inside air handling units, porous thermal or acoustic liners inside ductwork, or roof materials above ceiling tiles (due to roof leaks or insufficient insulation). Some building materials, such as drywall with vinyl wallpaper over it or wood paneling, may act as vapor barriers,⁵ trapping moisture underneath their surfaces and thereby providing a moist environment where mold can grow. You may suspect hidden mold if a building smells moldy, but you cannot see the source, or if you know there has been water damage and building occupants are reporting health problems. Investigating hidden mold

Hidden Mold Growth

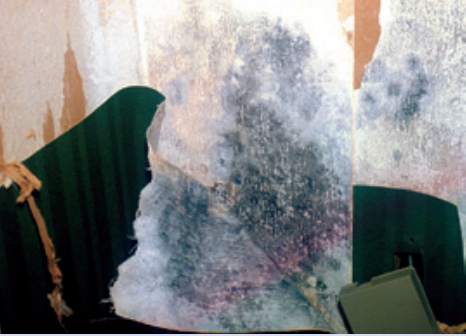


Photo 5: Mold growth behind wallpaper

problems may be difficult and will require caution when the investigation involves disturbing potential sites of mold growth—make sure to use PPE. For example, removal of wallpaper can lead to a massive release of spores from mold growing on the underside of the paper. If you believe that you may have a hidden mold problem, you may want to consider hiring an experienced professional. If you discover hidden mold, you should revise your remediation plan to account for the total area affected by mold growth.

⁵For more information on vapor barriers and building construction, see Resources List. It is important that building materials be able to dry; moisture should not be trapped between two vapor barriers or mold may result.

Remediation

1. Fix the water or humidity problem. Complete and carry out repair plan if appropriate. Revise and/or carry out maintenance plan if necessary. Revise remediation plan, as necessary, if more damage is discovered during remediation. See Mold Remediation – Key Steps (page 5) and Resources List (page 29) for additional information.
2. Continue to communicate with building occupants, as appropriate to the situation. Be sure to address all concerns.
3. Completely clean up mold and dry water-damaged areas. Select appropriate cleaning and drying methods for damaged/contaminated materials. Carefully contain and remove moldy building materials. Use appropriate Personal Protective Equipment (PPE). Arrange for outside professional support if necessary.

The Key to Mold Control is Moisture Control!

- When addressing mold problems, don't forget to address the source of the moisture problem, or the mold problem may simply reappear!
- Remember to check for high humidity and condensation problems as well as actual water leaks, maintenance issues, and HVAC system problems.
- Protect the health and safety of the building occupants and remediators. Consult a health professional as needed. Use PPE and containment as appropriate when working with mold.

Table 1: Water Damage Cleanup and Mold Prevention⁶

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.

⁶Please note that Tables 1 and 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.

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	<ul style="list-style-type: none"> * 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 [§]	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Reduce ambient humidity levels with dehumidifier. * Accelerate drying process with fans.
Ceiling tiles	<ul style="list-style-type: none"> * Discard and replace.
Cellulose insulation	<ul style="list-style-type: none"> * Discard and replace.
Concrete or cinder block surfaces	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass insulation	<ul style="list-style-type: none"> * Discard and replace.
Hard surface, porous flooring [§] (Linoleum, ceramic tile, vinyl)	<ul style="list-style-type: none"> * 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)	<ul style="list-style-type: none"> * Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	<ul style="list-style-type: none"> * 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)	<ul style="list-style-type: none"> * 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	<ul style="list-style-type: none"> * Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	<ul style="list-style-type: none"> * 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.
<p>*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.</p> <p>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 the Occupational Safety and Health Administration (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.</p> <p>[†] If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.</p> <p>[§] 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.</p>	

Table 2: Mold Remediation Guidelines⁷

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.

Mold and Indoor Air Regulations and Standards

Standards or Threshold Limit Values (TLVs) for airborne concentrations of mold, or mold spores, have not been set. As of December 2000, there are no EPA regulations or standards for airborne mold contaminants.

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 for 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.

⁷ Please note that Tables 1 and 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.

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.

Health Concerns

If building occupants are reporting serious health concerns, you should consult a health professional.

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		
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		
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 exposure and size of contaminated area	Full 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		
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		

Table 2 continued

*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.

Cleanup Methods

A variety of mold 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, as presented in Table 2. Please note that professional remediators may use some methods not covered in these guidelines; absence of a method in the guidelines does not necessarily mean that it is not useful.⁹

Method 1: 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,



Photo 6: Heavy mold growth on underside of spruce floorboards

Molds Can Damage Building Materials and Furnishings

Mold growth can eventually cause structural damage to a school or large building, if a mold/moisture problem remains unaddressed for a long time. In the case of a long-term roof leak, for example, molds can weaken floors and walls as the molds feed on wet wood. If you suspect that mold has damaged building integrity, you should consult a structural engineer or other professional with expertise in this area.

⁹If you are unsure what to do, or if the item is expensive or of sentimental value, you may wish to consult a specialist. Specialists in furniture repair/restoration, painting, art restoration and conservation, carpet and rug cleaning, water damage, and fire/water restoration are commonly listed in phone books. Be sure to ask for and check references; look for affiliation with professional organizations. See Resources List.

such as gypsum board. They should be used only when materials are still wet—wet vacuums may spread spores if sufficient liquid is not present. The tanks, hoses, and attachments of these vacuums should be thoroughly cleaned and dried after use since mold and mold spores may stick to the surfaces.

Method 2: Damp Wipe

Whether dead or alive, mold is allergenic, and some molds may be toxic. Mold can generally be removed from non-porous (hard) surfaces by wiping or scrubbing with water, or 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. Porous materials that are wet and have mold growing on them may have to be discarded. Since molds will infiltrate porous substances and grow on or fill in empty spaces or crevices, the mold can be difficult or impossible to remove completely.

Mold and Paint

Don't paint or caulk moldy surfaces; clean and dry surfaces before painting. Paint applied over moldy surfaces is likely to peel.

Method 3: 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 are also recommended for cleanup of dust that may have settled on surfaces outside the remediation area. Care must be taken to ensure that the filter is properly seated in the vacuum so that all the air must pass through the filter. When changing the vacuum filter, remediators should wear PPE to prevent exposure to the mold that has been captured. The filter and contents of the HEPA vacuum must be disposed of in well-sealed plastic bags.

Mold Remediation/Cleanup and Biocides

The purpose of mold remediation is to remove the mold to prevent human exposure and damage to building materials and furnishings. It is necessary to clean up mold contamination, not just to kill the mold. Dead mold is still allergenic, and some dead molds are potentially toxic. 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 immune-compromised individuals are present). In most cases, it is not possible or desirable to sterilize an area; a background level of mold spores will remain in the air (roughly equivalent to or lower than the level in outside air). These spores will not grow if the moisture problem in the building has been resolved.

If you choose to use disinfectants or biocides, always ventilate the area. Outdoor air may need to be brought in with fans. When using fans, take care not to distribute mold spores throughout an unaffected area. Biocides are toxic to humans, as well as to mold. You should also use appropriate PPE and read and follow label precautions. Never mix chlorine bleach solution with cleaning solutions or detergents that contain ammonia; toxic fumes could be produced.

Some biocides are considered pesticides, and some States require that only registered pesticide applicators apply these products in schools. Make sure anyone applying a biocide is properly licensed, if necessary. Fungicides are commonly applied to outdoor plants, soil, and grains as a dust or spray—examples include hexachlorobenzene, organomercurials, pentachlorophenol, phthalimides, and dithiocarbamates. Do not use fungicides developed for use outdoors for mold remediation or for any other indoor situation.

Method 4: Discard – Remove Damaged Materials and Seal in Plastic Bags

Building materials and furnishings that are contaminated with mold growth and are not salvageable should be double-bagged using 6-mil polyethylene sheeting. These materials can then usually be discarded as ordinary construction waste. It is important to package mold-contaminated materials in sealed bags before removal from the containment area to minimize the dispersion of mold spores throughout the building. Large items that have heavy mold growth

should be covered with polyethylene sheeting and sealed with duct tape before they are removed from the containment area.

Personal Protective Equipment (PPE)

If the remediation job disturbs mold and mold spores become airborne, then the risk of respiratory exposure goes up. Actions that are likely to stir up mold include: breakup of moldy porous materials such as wallboard; invasive procedures used to examine or remediate mold growth in a wall cavity; actively stripping or peeling wallpaper to remove it; and using fans to dry items.

Always use gloves and eye protection when cleaning up mold!

The primary function of Personal Protective Equipment (PPE) is to avoid inhaling mold and mold spores and to avoid mold contact with the skin or eyes. The following sections discuss the different types of PPE that can be used during remediation activities. Please note that all individuals using certain PPE equipment, such as half-face or full-face respirators, must be trained, must have medical clearance, and must be fit-tested by a trained professional. In addition, the use of respirators must follow a complete respiratory protection program as specified by the Occupational Safety and Health Administration (OSHA) (see Resources List for more information).

Skin and Eye Protection

Gloves are required to protect the skin from contact with mold allergens (and in some cases mold toxins) and from potentially irritating cleaning solutions. Long gloves that extend to the middle of the forearm are recommended. The glove material should

Personal Protective Equipment



Photo 7: Remediation worker with limited PPE

be selected based on the type of materials 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 respirator with HEPA filter. Goggles must be designed to prevent the entry of dust and small particles. Safety glasses or goggles with open vent holes are not acceptable.

Respiratory Protection

Respirators protect cleanup workers from inhaling airborne mold, mold spores, and dust.

Minimum: When cleaning up a small area affected by mold, you should use an N-95 respirator. This device covers the nose and mouth, will filter out 95% of the particulates in the air, and is available in most hardware stores.

Limited: Limited PPE includes use of a half-face or full-face air purifying respirator (APR) equipped with a HEPA filter cartridge. These respirators contain both inhalation and exhalation valves that filter the air and ensure that it is free of mold particles. Note that half-face APRs do not provide eye protection. In addition, the HEPA filters do not remove vapors or gases. You should always use respirators approved by the National Institute for Occupational Safety and Health (see Resources List).

Full: In situations in which high levels of airborne dust or mold spores are likely or when intense or long-term exposures are expected (e.g., the cleanup of large areas of contamination), a full-face, powered air purifying respirator (PAPR) is recommended. Full-face PAPRs use a blower to force air through a HEPA filter. The HEPA-filtered air is supplied to a mask that covers the entire face or a hood that covers the entire head. The positive pressure within the hood prevents unfiltered air from entering through penetrations or gaps. Individuals must be trained to use their respirators before they begin remediation. The use of these respirators must be in compliance with OSHA regulations (see Resources List).

Disposable Protective Clothing

Disposable clothing is recommended during a medium or large remediation project to prevent the transfer and spread of mold to clothing and to eliminate skin contact with mold.

Limited: Disposable paper overalls can be used.

Full: Mold-impervious disposable head and foot coverings, and a body suit made of a breathable material, such as TYVEK®, should be used. All gaps, such as those around ankles and wrists, should be sealed (many remediators use duct tape to seal clothing).

Containment

The purpose of containment during remediation activities is to limit release of mold into the air and surroundings, in order to minimize the exposure of remediators and building occupants to mold. Mold and moldy debris should not be allowed to spread to areas in the building beyond the contaminated site.

The two types of containment recommended in Table 2 are limited and full. The larger the area of moldy material, the greater the possibility of human exposure and the greater the need for containment. In general, the size of the area helps determine the level of containment. However, a heavy growth of mold in a relatively small area could release more spores than a lighter growth of mold in a relatively large area. Choice of containment should be based on professional judgment.¹⁰ The primary object of containment should be to prevent occupant and remediator exposure to mold.

Containment Tips

- Always maintain the containment area under negative pressure.
- Exhaust fans to outdoors and ensure that adequate makeup air is provided.
- If the containment is working, the polyethylene sheeting should billow inwards on all surfaces. If it flutters or billows outward, containment has been lost, and you should find and correct the problem before continuing your remediation activities.

¹⁰For example, a remediator may decide that a small area that is extensively contaminated and has the potential to distribute mold to occupied areas during cleanup should have full containment, whereas a large wall surface that is lightly contaminated and easily cleaned would require only limited containment.

Limited Containment

Limited containment is generally recommended for areas involving between 10 and 100 square feet (ft²) of mold contamination. The enclosure around the moldy area should consist of a single layer of 6-mil, fire-retardant polyethylene sheeting. The containment should have a slit entry and covering flap on the outside of the containment area. For small areas, the polyethylene sheeting can be affixed to floors and ceilings with duct tape.

For larger areas, a steel or wooden stud frame can be erected and polyethylene sheeting attached to it. All supply and air vents, doors, chases, and risers within the containment area must be sealed with polyethylene sheeting to minimize the migration of contaminants to other parts of the building. Heavy mold growth on ceiling tiles may impact HVAC systems if the space above the ceiling is used as a return air plenum. In this case, containment should be installed from the floor to the ceiling deck, and the filters in the air handling units serving the affected area may have to be replaced once remediation is finished.

The containment area must be maintained under negative pressure relative to surrounding areas. This will ensure that contaminated air does not flow into adjacent areas. This can be done with a HEPA-filtered fan unit exhausted outside of the building. For small, easily contained areas, an exhaust fan ducted to the outdoors

can also be used. The surfaces of all objects removed from the containment area should be remediated/cleaned prior to removal. The remediation guidelines outlined in Table 2 can be implemented when the containment is completely sealed and is under negative pressure relative to the surrounding area.

Containment Area



Photo 8: Full containment on large job

Full Containment

Full containment is recommended for the cleanup of mold-contaminated surface areas greater than 100 ft² or in any situation in which it appears likely that the occupant space would be further contaminated without full containment. Double layers of polyethylene should be used to create a barrier between the moldy area and other parts of the building. A decontamination chamber or airlock should be constructed for entry into and exit from the remediation area. The entryways to the airlock from the outside and from the airlock to the main containment area should consist of a slit entry with covering flaps on the outside surface of each slit entry. The chamber should be large enough to hold a waste container and allow a person to put on and remove PPE. All contaminated PPE, except respirators, should be placed in a sealed bag while in this chamber. Respirators should be worn until remediators are outside the decontamination chamber. PPE must be worn throughout the final stages of HEPA vacuuming and damp-wiping of the contained area. PPE must also be worn during HEPA vacuum filter changes or cleanup of the HEPA vacuum.

Equipment

Moisture Meters: Measure/Monitor Moisture Levels in Building Materials

Moisture meters may be helpful for measuring the moisture content in a variety of building materials following water damage. They can also be used to monitor the process of drying damaged materials. These direct reading devices have a thin probe which can be inserted into the material to be tested or can be pressed directly against the surface of the material. Moisture meters can be used on materials such as carpet, wallboard, wood, brick, and concrete.

Moisture Meter



Photo 9: Moisture meter measuring moisture content of plywood subfloor

Humidity Gauges or Meters: Monitor Moisture Levels in the Air

Humidity meters can be used to monitor humidity indoors. Inexpensive (<\$50) models are available that monitor both temperature and humidity.

Humidistat: Turns on HVAC System at Specific Relative Humidity (RH)

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

HVAC System Filter: Filters Outdoor Air

Use high-quality filters in your HVAC system during remediation. Consult an engineer for the appropriate efficiency for your specific HVAC system and consider upgrading your filters if appropriate. Conventional HVAC filters are typically not effective in filtering particles the size of mold spores. Consider upgrading to 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. Remember to change filters regularly and change them following any remediation activities.

Sampling

Is sampling for mold needed? In most cases, if visible mold growth is present, sampling is unnecessary. In specific instances, such as cases where litigation is involved, the source(s) of the mold contamination is unclear, or health concerns are a problem, you may consider sampling as part of your site evaluation. Surface sampling may also be useful in order to determine if an area has been adequately cleaned or remediated. Sampling should be done only after developing a sampling plan that includes a confirmable theory regarding suspected mold sources and routes of exposure. Figure out what you think is happening and how to prove or disprove it before you sample!

If you do not have extensive experience and/or are in doubt about sampling, consult an experienced professional. This individual can help you decide if sampling for mold is useful and/or needed, and will be able to carry out any necessary sampling. It is important to remember that the results of sampling may have limited use or application. Sampling may help locate the source of mold contamination, identify some of the mold species present, and differentiate between mold and soot or dirt. Pre- and post-remediation sampling may also be useful in determining whether remediation efforts have been effective. After remediation, the types and concentrations of mold in indoor air samples should be similar to what is found in the local outdoor air. Since no EPA or other Federal threshold limits have been set for mold or mold spores, sampling cannot be used to check a building's compliance with Federal mold standards.

Sampling for mold should be conducted by professionals with specific experience in designing mold sampling protocols, sampling methods, and interpretation of results. Sample analysis should follow analytical methods recommended by the American Industrial Hygiene Association (AIHA), the American Conference of Governmental Industrial Hygienists (ACGIH), or other professional guidelines (see Resources List). Types of samples include air samples, surface samples, bulk samples (chunks of carpet, insulation, wallboard, etc.), and water samples from condensate drain pans or cooling towers.

A number of pitfalls may be encountered when inexperienced personnel conduct sampling. They may take an inadequate number of samples, there may be inconsistency in sampling protocols, the samples may become contaminated, outdoor control samples may be omitted, and you may incur costs for unneeded or inappropriate samples. Budget constraints will often be a consideration when sampling; professional advice may be necessary to determine if it is possible to take sufficient samples to characterize a problem on a given budget. If it is not possible to sample properly, with a sufficient number of samples to answer the question(s) posed, it would be preferable not to sample. Inadequate sample plans may generate misleading, confusing, and useless results.

Keep in mind that air sampling for mold provides information only for the moment in time in which the sampling occurred, much like a snapshot. Air sampling will reveal, when properly done, what was in the air at the moment when the sample was taken. For someone without experience, sampling results will be difficult to interpret. Experience in interpretation of results is essential.

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

1. You must have completely fixed the water or moisture problem.
2. You should complete mold removal. Use professional judgment to determine if the cleanup is sufficient. Visible mold, mold-damaged materials, and moldy odors should not be present.
3. If you have sampled, the kinds and concentrations of mold and mold spores in the building should be similar to those found outside, once cleanup activities have been completed.
4. You should revisit the site(s) shortly after remediation, and it should show no signs of water damage or mold growth.
5. People should be able to occupy or re-occupy the space without health complaints or physical symptoms.
6. Ultimately, this is a judgment call; there is no easy answer.

Checklist for Mold Remediation*

Investigate and evaluate moisture and mold problems

- Assess size of moldy area (square feet)
- Consider the possibility of hidden mold
- Clean up small mold problems and fix moisture problems before they become large problems
- Select remediation manager for medium or large size mold problem
- Investigate areas associated with occupant complaints
- Identify source(s) or cause of water or moisture problem(s)
- Note type of water-damaged materials (wallboard, carpet, etc.)
- Check inside air ducts and air handling unit
- Throughout process, consult qualified professional if necessary or desired

Communicate with building occupants at all stages of process, as appropriate

- Designate contact person for questions and comments about medium or large scale remediation as needed

Plan remediation

- Adapt or modify remediation guidelines to fit your situation; use professional judgment
- Plan to dry wet, non-moldy materials within 48 hours to prevent mold growth (see Table 1 and text)
- Select cleanup methods for moldy items (see Table 2 and text)
- Select Personal Protection Equipment – protect remediators (see Table 2 and text)
- Select containment equipment – protect building occupants (see Table 2 and text)
- Select remediation personnel who have the experience and training needed to implement the remediation plan and use Personal Protection Equipment and containment as appropriate

Remediate moisture and mold problems

- Fix moisture problem, implement repair plan and/or maintenance plan
- Dry wet, non-moldy materials within 48 hours to prevent mold growth
- Clean and dry moldy materials (see Table 2 and text)
- Discard moldy porous items that can't be cleaned (see Table 2 and text)

*For details, see main text of this publication. Please note that this checklist was designed to highlight key parts of a school or commercial building remediation and does not list all potential steps or problems.

28 Mold Remediation in Schools and Commercial Buildings

Resources List – EPA

U.S. Environmental Protection Agency (EPA), Indoor Environments Division (IED)

[An Office Building Occupant's Guide to IAQ](#)

www.epa.gov/iaq/pubs/occupgd.html

[Biological Contaminants](#)

www.epa.gov/iaq/biologic.html

[Building Air Quality Action Plan \(for Commercial Buildings\)](#)

www.epa.gov/iaq/largebdgs/pdf_files/baactionplan.pdf

[Floods / Flooding](#)

www.epa.gov/iaq/flood

[Indoor Air Quality \(IAQ\) Home Page](#)

www.epa.gov/iaq/index.html

[IAQ in Large Buildings / Commercial Buildings](#)

www.epa.gov/iaq/largebdgs

[IAQ in Schools](#)

www.epa.gov/iaq/schools

[Mold Remediation in Schools and Commercial Buildings](#)

www.epa.gov/mold/mold_remediation.html

[Mold Resources](#)

www.epa.gov/mold/moldresources.html

Resources List – OTHER

The following list of resources includes information created and maintained by other public and private organizations. The U.S. EPA does not control or guarantee the accuracy, relevance, timeliness, or completeness of this outside information. Further, the inclusion of such 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 on which the reference is maintained.

American College of Occupational and Environmental Medicine (ACOEM)

(847) 818-1800

www.acoem.org/

Referrals to physicians who have experience with environmental exposures

American Conference of Governmental Industrial Hygienists, Inc. (ACGIH)

(513) 742-2020

www.acgih.org

Occupational and environmental health and safety information

American Industrial Hygiene Association (AIHA)

(703) 849-8888

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

www.ashrae.org

Information on engineering issues and indoor air quality

Association of Occupational and Environmental Clinics (AOEC)

(888) 347-AOEC (2632)

www.aoec.org

Referrals to clinics with physicians who have experience with environmental exposures, including exposures to mold; maintains a database of occupational and environmental cases

Asthma and Allergic Diseases:

American Academy of Allergy, Asthma & Immunology (AAAAI)

(414) 272-6071

www.aaaai.org

Physician referral directory, information on allergies and asthma

Asthma and Allergy Foundation of America (AAFA)

(800) 7-ASTHMA (800-727-8462)

www.aafa.org

Information on allergies and asthma

American Lung Association (ALA)

(800) LUNGUSA (800-586-4872)

www.lungusa.org

Information on allergies and asthma

Asthma and Allergy Network/Mothers of Asthmatics, Inc. (AAN-MA)

(800) 878-4403 or (703) 641-9595

www.aanma.org

Information on allergies and asthma

National Institute of Allergy and Infectious Diseases (NIAID)

(301) 496-5717

www.niaid.nih.gov/

Information on allergies and asthma

National Jewish Medical and Research Center

(800) 222-LUNG (800-222-5864)

www.nationaljewish.org/

Information on allergies and asthma

Canada Mortgage and Housing Corporation (CMHC)

(613) 748-2000 [International]

www.cmhc-schl.gc.ca/

Several documents on mold-related topics available

Carpet and Rug Institute (CRI)

(706) 278-3176

www.carpet-rug.org/

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

Centers for Disease Control and Prevention (CDC)

(800) CDC-INFO (232-4636)

www.cdc.gov

Information on health-related topics including asthma, molds in the environment, and occupational health

CDC's National Center for Environmental Health (NCEH)

(800) CDC-INFO (232-4636)

www.cdc.gov/mold/stachy.htm

Questions and answers on *Stachybotrys chartarum* and other molds

Energy and Environmental Building Association

(952) 881-1098

www.eeba.org

Information on energy-efficient and environmentally responsible buildings, humidity/moisture control/vapor barriers

Floods/ Flooding:

Federal Emergency Management Agency (FEMA)

(800) 621-FEMA (3362)

www.fema.gov/hazard/flood/index.shtm

Publications on floods, flood proofing, etc.

University of Minnesota, Department of Environmental Health & Safety

(612) 626-6002

www.dehs.umn.edu/

Managing water infiltration into buildings

University of Wisconsin-Extension, The Disaster Handbook

(608) 262-3980

www.uwex.edu/ces/news/handbook.html

Information on floods and other natural disasters

Health Canada, Health Protection Branch, Laboratory Centre for Disease Control, Office of Biosafety

(613) 957-1779

www.phac-aspc.gc.ca/msds-ftss

Material Safety Data Sheets with health and safety information on infectious microorganisms, including *Aspergillus* and other molds and airborne biologicals

Indoor Environmental Remediation Board (IERB)

(916) 736-1100

www.ierb.org

Information on best practices in building remediation

Institute of Inspection, Cleaning and Restoration Certification (IICRC)

(360) 693-5675

www.iicrc.org

Information on and standards for the inspection, cleaning, and restoration industry

International Society of Cleaning Technicians (ISCT)

(800) WHY-ISCT (800-949-4728)

Information on cleaning such as stain removal guide for carpets

ISSA—The Worldwide Cleaning Industry Association

(800) 225-4772

www.issa.com

Education and training on cleaning and maintenance

National Air Duct Cleaners Association (NADCA)

(202) 737-2926

www.nadca.com

Duct cleaning information

National Association of the Remodeling Industry (NARI)

(847) 298-9200

www.nari.org

Consumer information on remodeling, including help finding a professional remodeling contractor

National Institute of Building Sciences (NIBS)

(202) 289-7800

<http://nibs.org>

Information on building regulations, science, and technology

National Institute for Occupational Safety and Health (NIOSH)

(800) CDC-INFO (232-4636)

www.cdc.gov/niosh

Health and safety information with a workplace orientation

National Pesticide Information Center (NPIC)

(800) 858-7378

<http://npic.orst.edu/>

Regulatory information, safety information, and product information on antimicrobials

New York City Department of Health and Mental Hygiene

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

“Guidelines on Assessment and Remediation of Fungi in Indoor Environments”

Occupational Safety & Health Administration (OSHA)

(800) 321-OSHA (800-321-6742)

www.osha.gov

Information on worker safety, includes topics such as respirator use and safety in the workplace

Restoration Industry Association

(800) 272-7012

www.ascr.org/

Disaster recovery, water and fire damage, emergency tips, referrals to professionals

Sheet Metal & Air Conditioning Contractors' National Association (SMACNA)

(703) 803-2980

www.smacna.org

Technical information on topics such as air conditioning and air ducts

Smithsonian Museum Conservation Institute

(301) 238-1240

www.si.edu/mci

Guidelines for caring for and preserving furniture and wooden objects, paper-based materials; preservation studies

University of Michigan Herbarium

(734) 615-6200

www.herbarium.lsa.umich.edu

Specimen-based information on fungi; information on fungal ecology

University of Tulsa Indoor Air Program

(918) 631-5246

www.utulsa.edu/iaqprogram

Courses, classes, and continuing education on indoor air quality

References

- American Academy of Pediatrics, Committee on Environmental Health. "Toxic Effects of Indoor Air Molds." *Pediatrics*. Volume 101, pp. 712-714. 1996.
- American Conference of Governmental Industrial Hygienists. *Bioaerosols: Assessment and Control*. Macher, J., editor. ACGIH. Cincinnati, OH. ISBN 1-882417-29-1. 1999.
- American Conference of Governmental Industrial Hygienists. *Guidelines for the Assessment of Bioaerosols in the Indoor Environment*. ISBN 0-936712-83-X. 1989.
- American Industrial Hygiene Association. *Field Guide for the Determination of Biological Contaminants in Environmental Samples*. Dillon, H. K., Heinsohn, P. A., and Miller, J. D., editors. Fairfax, VA. 1996.
- American Society of Heating, Refrigerating, and Air Conditioning Engineers. *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*. ASHRAE Standard 52.2. 2000.
- American Society for Microbiology. *Manual of Environmental Microbiology*. Hurst, C., Editor in Chief. ASM Press. Washington, DC. 1997.
- Canada Mortgage and Housing Corporation. *Clean-up Procedures for Mold in Houses*. ISBN 0-662-21133-2. 1993.
- Eastern New York Occupational and Environmental Health Center. *Proceedings of the International Conference, Saratoga Springs, NY. October 6-7, 1994. Fungi and Bacteria in Indoor Air Environments - Health Effects, Detection, and Remediation*. Johanning, E., and Yang, C., editors. Eastern New York Occupational Health Program. Latham, NY. 1995.
- Eastern New York Occupational and Environmental Health Center. *Bioaerosols, Fungi and Mycotoxins: Health Effects, Assessment, Prevention and Control*. Johanning, E., editor. Albany, NY. 1999. (Proceedings of the Third International Conference on Fungi, Mycotoxins and Bioaerosols: Health Effects, Assessment, Prevention and Control. September 23-25, 1998.)

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- Gravesen, S., Frisvad, J., and Samson, R. *Microfungi*. Munksgaard. Copenhagen, Denmark. 1994.
- “Indoor Mold and Children’s Health.” *Environmental Health Perspectives*, Vol. 107, Suppl. 3, June 1999.
- Institute of Inspection, Cleaning and Restoration Certification, *IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration*, 2nd Edition. 1999.
- Lstiburek, J. *Building Science Corporation Builder’s Guide, Mixed-Humid Climates*. Building Science Corporation and the Energy Efficient Building Association. 1999.
- National Academy of Sciences, Committee on the Assessment of Asthma and Indoor Air. *Clearing the Air: Asthma and Indoor Air Exposures*. National Academy Press. 2000.
- National Academy of Sciences. *Indoor Allergens: Assessing and Controlling Adverse Health Effects*. National Academy Press. 1993.
- National Institute for Occupational Safety and Health. *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84*. DHHS (NIOSH) Publication No. 96-101. January 1996.
- New York City Department of Health, Bureau of Environmental & Occupational Disease Epidemiology. *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*. 2000.
- Occupational Safety & Health Administration. *Respiratory Protection Standard, 29 CFR 1910.134*. 63 FR 1152. January 8, 1998.
- U.S. Environmental Protection Agency. *Should You Have the Air Ducts In Your Home Cleaned?* EPA-402-K-97-002. October 1997.
- U.S. Environmental Protection Agency. *IAQ Tools for Schools*. EPA-402-K-95-001. May 1995.

Appendix A – Glossary

Allergen.....	Substance (such as mold) that can cause an allergic reaction.
APR.....	Air purifying respirator
Biocide	Substance or chemical that kills organisms such as molds.
EPA	Environmental Protection Agency
Fungi	Fungi are neither animals nor plants and are classified in a kingdom of their own. Fungi include molds, yeasts, mushrooms, and puffballs. In this document, the terms fungi and mold are used interchangeably. Molds reproduce by making spores. Mold spores waft through the indoor and outdoor air continually. When mold spores land on a damp spot indoors, they may begin growing and digesting whatever they are growing on. Molds can grow on virtually any organic substance, providing moisture and oxygen are present. It is estimated that more than 1.5 million species of fungi exist.
Fungicide.....	Substance or chemical that kills fungi.
HEPA	High-Efficiency Particulate Air
Hypersensitivity	Great or excessive sensitivity
IAQ	Indoor Air Quality
Mold.....	Molds are a group of organisms that belong to the kingdom Fungi. In this document, the terms fungi and mold are used interchangeably. There are over 20,000 species of mold.

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- mVOC.....Microbial volatile organic compound, a chemical made by a mold which may have a moldy or musty odor.

 - OSHA.....Occupational Safety and Health Administration

 - PAPR.....Powered air purifying respirator

 - PPE.....Personal Protective Equipment

 - RemediateFix

 - Sensitization.....Repeated or single exposure to an allergen that results in the exposed individual becoming hypersensitive to the allergen.

 - SporeMolds reproduce by means of spores. Spores are microscopic; they vary in shape and size (2 – 100 micrometers). Spores may travel in several ways—they may be passively moved (by a breeze or waterdrop), mechanically disturbed (by a person or animal passing by), or actively discharged by the mold (usually under moist conditions or high humidity).

Appendix B – Introduction to Molds

Molds in the Environment

Molds live in the soil, on plants, and on dead or decaying matter. Outdoors, molds play a key role in the breakdown of leaves, wood, and other plant debris. Molds belong to the kingdom Fungi, and unlike plants, they lack chlorophyll and must survive by digesting plant materials, using plant and other organic materials for food. Without molds, our environment would be overwhelmed with large amounts of dead plant matter.

Molds produce tiny spores to reproduce, just as some plants produce seeds. These mold spores can be found in both indoor and outdoor air, and settled on indoor and outdoor surfaces. When mold spores land on a damp spot, they may begin growing and digesting whatever they are growing on in order to survive. Since molds gradually destroy the things they grow on, you can prevent damage to building materials and furnishings and save money by eliminating mold growth.

Moisture control is the key to mold control. Molds need both food and water to survive; since molds can digest most things, water is the factor that limits mold growth. Molds will often grow in damp or wet areas indoors. Common sites for indoor mold growth include bathroom tile, basement walls, areas around windows where moisture condenses, and near leaky water fountains or sinks. Common sources or causes of water or moisture problems include roof leaks, deferred maintenance, condensation associated with high humidity or cold spots in the building, localized flooding due to plumbing failures or heavy rains, slow leaks in plumbing fixtures, and malfunction or poor design of humidification systems. Uncontrolled humidity can also be a source of moisture leading to mold growth, particularly in hot, humid climates.

Health Effects and Symptoms Associated with Mold Exposure

When moisture problems occur and mold growth results, building occupants may begin to report odors and a variety of health problems, such as headaches, breathing difficulties, skin irritation, allergic reactions, and aggravation of asthma symptoms; all of these symptoms could potentially be associated with mold exposure.

All molds have the potential to cause health effects. Molds produce allergens, irritants, and in some cases, toxins that may cause reactions in humans. The types and severity of symptoms depend, in part, on the types of mold present, the extent of an individual's exposure, the ages of the individuals, and their existing sensitivities or allergies. Specific reactions to mold growth can include the following:

Allergic Reactions: Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Allergic reactions to mold are common—these reactions can be immediate or delayed. Allergic responses include hay fever-type symptoms, such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Mold spores and fragments can produce allergic reactions in sensitive individuals regardless of whether the mold is dead or alive. Repeated or single exposure to mold or mold spores may cause previously non-sensitive individuals to become sensitive. Repeated exposure has the potential to increase sensitivity.

Asthma: Molds can trigger asthma attacks in persons who are allergic (sensitized) to molds. The irritants produced by molds may also worsen asthma in non-allergic (non-sensitized) people.

Hypersensitivity Pneumonitis: Hypersensitivity pneumonitis may develop following either short-term (acute) or long-term (chronic) exposure to molds. The disease resembles bacterial pneumonia and is uncommon.

Potential Health Effects Associated with Inhalation Exposure to Molds and Mycotoxins

- Allergic Reactions (e.g., rhinitis and dermatitis or skin rash)
- Asthma
- Hypersensitivity Pneumonitis
- Other Immunologic Effects
Research on mold and health effects is ongoing. This list is not intended to be all-inclusive.

The health effects listed above are well documented in humans. Evidence for other health effects in humans is less substantial and is primarily based on case reports or occupational studies.

Irritant Effects: Mold exposure can cause irritation of the eyes, skin, nose, throat, and lungs, and sometimes can create a burning sensation in these areas.

Opportunistic Infections: People with weakened immune systems (i.e., immune-compromised or immune-suppressed individuals) may be more vulnerable to infections by molds (as well as more vulnerable than healthy persons to mold toxins). *Aspergillus fumigatus*, for example, has been known to infect the lungs of immune-compromised individuals. These individuals inhale the mold spores which then start growing in their lungs. *Trichoderma* has also been known to infect immune-compromised children.

Healthy individuals are usually not vulnerable to opportunistic infections from airborne mold exposure. However, molds can cause common skin diseases, such as athlete's foot, as well as other infections such as yeast infections.

Mold Toxins (Mycotoxins)

Molds can produce toxic substances called mycotoxins. Some mycotoxins cling to the surface of mold spores; others may be found within spores. More than 200 mycotoxins have been identified from common molds, and many more remain to be identified. Some of the molds that are known to produce mycotoxins are commonly found in moisture-damaged buildings. Exposure pathways for mycotoxins can include inhalation, ingestion, or skin contact. Although some mycotoxins are well known to affect humans and have been shown to be responsible for human health effects, for many mycotoxins, little information is available.

Aflatoxin B₁ is perhaps the most well known and studied mycotoxin. It can be produced by the molds *Aspergillus flavus* and *Aspergillus parasiticus* and is one of the most potent carcinogens known. Ingestion of aflatoxin B₁ can cause liver cancer. There is also some evidence that inhalation of aflatoxin B₁ can cause lung cancer. Aflatoxin B₁ has been found on contaminated grains, peanuts, and other human and animal foodstuffs. However, *Aspergillus flavus* and *Aspergillus parasiticus* are *not* commonly found on building materials or in indoor environments.

Much of the information on the human health effects of inhalation exposure to mycotoxins comes from studies done in the workplace and some case studies or case reports.* Many symptoms and human health effects attributed to inhalation of mycotoxins have been reported including: mucous membrane irritation, skin rash, nausea, immune system suppression, acute or chronic liver damage, acute or chronic central nervous system damage, endocrine effects, and cancer. More studies are needed to get a clear picture of the health effects related to most mycotoxins. However, it is clearly prudent to avoid exposure to molds and mycotoxins.

Some molds can produce several toxins, and some molds produce mycotoxins only under certain environmental conditions. The presence of mold in a building does not necessarily mean that mycotoxins are present or that they are present in large quantities.

Toxic Molds

Some molds, such as *Aspergillus versicolor* and *Stachybotrys atra* (*chartarum*), are known to produce potent toxins under certain circumstances. Although some mycotoxins are well known to affect humans and have been shown to be responsible for human health effects, for many mycotoxins, little information is available, and in some cases research is ongoing. For example, some strains of *Stachybotrys atra* can produce one or more potent toxins. In addition, preliminary reports from an investigation of an outbreak of pulmonary hemorrhage in infants suggested an association between pulmonary hemorrhage and exposure to *Stachybotrys chartarum*. Review of the evidence of this association at the Centers for Disease Control and Prevention (CDC) resulted in a published clarification stating that such an association was not established. Research on the possible causes of pulmonary hemorrhage in infants continues. Consult CDC for more information on pulmonary hemorrhage in infants (see Resources List, page 31, for CDC contact and other information).

* Information on ingestion exposure, for both humans and animals, is more abundant—a wide range of health effects has been reported following ingestion of moldy foods including liver damage, nervous system damage and immunological effects.

Microbial Volatile Organic Compounds (mVOCs)

Some compounds produced by molds are volatile and are released directly into the air. These are known as microbial volatile organic compounds (mVOCs). Because these compounds often have strong and/or unpleasant odors, they can be the source of odors associated with molds. Exposure to mVOCs from molds has been linked to symptoms such as headaches, nasal irritation, dizziness, fatigue, and nausea. Research on mVOCs is still in the early phase.

Glucans or Fungal Cell Wall Components (also known as β -(1,3)-D-Glucans)

Glucans are small pieces of the cell walls of molds which may cause inflammatory lung and airway reactions. These glucans can affect the immune system when inhaled. Exposure to very high levels of glucans or dust mixtures including glucans may cause a flu-like illness known as Organic Dust Toxic Syndrome (ODTS). This illness has been primarily noted in agricultural and manufacturing settings.

Spores

Mold spores are microscopic (2 – 10 μm) and are naturally present in both indoor and outdoor air. Molds reproduce by means of spores. Some molds have spores that are easily disturbed and waft into the air and settle repeatedly with each disturbance. Other molds have sticky spores that will cling to surfaces and are dislodged by brushing against them or by other direct contact. Spores may remain able to grow for years after they are produced. In addition, whether or not the spores are alive, the allergens in and on them may remain allergenic for years.

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Appendix C – Communication With Building Occupants

Communication with building occupants is essential for successful mold remediation. Some occupants will naturally be concerned about mold growth in their building and the potential health impacts. Occupants' perceptions of the health risk may rise if they perceive that information is being withheld from them. The status of the building investigation and remediation should be openly communicated including information on any known or suspected health risks.

Small remediation efforts will usually not require a formal communication process, but do be sure to take individual concerns seriously and use common sense when deciding whether formal communications are required. Individuals managing medium or large remediation efforts should make sure they understand and address the concerns of building occupants and communicate clearly what has to be done as well as possible health concerns.

Communication approaches include regular memos and/or meetings with occupants (with time allotted for questions and answers), depending on the scope of the remediation and the level of occupant interest. Tell the occupants about the size of the project, planned activities, and remediation timetable. Send or post regular updates on the remediation progress, and send or post a final memo when the project is completed or hold a final meeting. Try and resolve

Mold in Schools

Special communication strategies may be desirable if you are treating a mold problem in a school. Teachers, parents, and other locally affected groups should be notified of significant issues as soon as they are identified. Consider holding a special meeting to provide parents with an opportunity to learn about the problem and ask questions of school authorities, particularly if it is necessary/advisable to ensure that the school is vacated during remediation. For more information on investigating and remediating molds in schools, refer to the U.S. EPA's *IAQ Tools for Schools* kit and the asthma companion piece for the *IAQ Tools for Schools* kit, entitled *Managing Asthma in the School Environment*.

Communicate, When You Remediate

- Establish that the health and safety of building occupants are top priorities.
- Demonstrate that the occupants' concerns are understood and taken seriously.
- Present clearly the current status of the investigation or remediation efforts.
- Identify a person whom building occupants can contact directly to discuss questions and comments about the remediation activities.

issues and occupant concerns as they come up. When building-wide communications are frequent and open, those managing the remediation can direct more time toward resolving the problem and less time to responding to occupant concerns.

If possible, remediation activities should be scheduled during off-hours when building occupants are less likely to be affected. Communication is important if occupants are relocated during remediation. The decision to relocate occupants should consider the size of the area affected, the extent and types of health effects exhibited by the occupants, and the potential health risks associated with debris and activities during the remediation project. When considering the issue of relocation, be sure to inquire about, accommodate, and plan for

individuals with asthma, allergies, compromised immune systems, and other health-related concerns. Smooth the relocation process and give occupants an opportunity to participate in resolution of the problem by clearly explaining the disruption of the workplace and work schedules. Notify individuals of relocation efforts in advance, if possible.

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NOTES

This is a reprint of EPA document 402-K-01-001, March 2001. The guidance has not changed. The Resources List has been updated.

Indoor Air Quality (IAQ)

Section 4



- U.S. Department of Labor
- Occupational Safety and Health Administration
- Directorate of Technical Support and Emergency Management
- (formerly Directorate of Science, Technology and Medicine)
- Office of Science and Technology Assessment

A Brief Guide to Mold in the Workplace

Safety and Health Information Bulletin

SHIB 03-10-10; updated 11-08-13

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 employers in providing a safe and healthful workplace. Pursuant to the *Occupational Safety and Health Act*, employers must comply with hazard-specific safety and health standards and regulations promulgated by OSHA or by a state with an OSHA-approved state plan. In addition, pursuant to Section 5(a)(1), the General Duty Clause of the Act, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm.

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 immunocompromised individuals can be found at the [Centers for Disease Control and Prevention \(CDC\) website](http://www.cdc.gov).

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 contaminated 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, immunosuppressed 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 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*

National Apartment Association

[National Institute for Occupational Safety and Health \(NIOSH\)](#)

[National Multi-Housing Council](#)

The Building Owners and Managers Association International (BOMA)

[New York City Department of Health & Mental Hygiene Bureau of Environmental & Occupational Disease Epidemiology](#) (PDF) 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 Occupants Guide to Indoor Air Quality [Page title updated in 2012]

Biological Pollutants [Page title updated in 2012]

Building Air Quality (BAQ) [Page title updated in 2012]

[Flood Cleanup to Protect Indoor Air Quality](#) [Page title and link updated in 2015]

[Indoor Air Quality \(IAQ\) Home Page](#)

[Indoor Air Quality in Offices and Other Large Buildings](#) [Page title and link updated in 2015]

[Creating Healthy Indoor Air Quality in Schools](#) [Page title updated in 2015]

[Resources for Flood Cleanup and Mold](#)

[Mold Remediation in Schools and Commercial Buildings Guide](#) [Link updated in 2015]

- 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
- Referrals to physicians who have experience with environmental exposures.
- [American Conference of Governmental Industrial Hygienists, Inc. \(ACGIH\)](#)
- (513) 742-2020
- Occupational and environmental health and safety information.
- [American Industrial Hygiene Association \(AIHA\)](#)
- (703) 849-8888
- 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
- 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
- www.ascr.org/institutes [<http://www.restorationindustry.org>]
- Carpet and Upholstery Cleaning Institute, Mechanical 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)

- Information on allergies and asthma.
- [American Lung Association \(ALA\)](#)
- (800) LUNGUSA ((800) 586-4872)
- Information on allergies and asthma.
- *Allergy and Asthma Network Mothers of Asthmatics (AANMA)*
- (800) 878-4403 or (703) 641-9595)
- Information on allergies and asthma.
- [National Institute of Allergy and Infectious Diseases \(NIAID\)](#)
- (301) 496-5717
- Information on allergies and asthma.
- [National Jewish Health Medical and Research Center](#)
- (800) 222LUNG ((800) 222-5864)
- Information on allergies and asthma.
- [Carpet and Rug Institute \(CRI\)](#)
- (800) 882-8846
- 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. It serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and education activities.
- [Flood Cleanup to Protect Indoor Air Quality](#) [Page title and link updated in 2015]
- 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
- [Managing water infiltration into buildings](#)
- *IERB*. Indoor Environmental Remediation Board
- (215) 387-4097
- Information on best practices in building remediation.
- [Institute of Inspection, Cleaning and Restoration Certification \(IICRC\)](#)
- (360) 693-5675

- Information on and standards for the inspection, cleaning, and restoration industry.
- [International Sanitary Supply Association \(ISSA\)](#)
- (800) 225-4772
- Education and training on cleaning and maintenance.
- *MidAtlantic Environmental Hygiene Resource Center (MEHRC)*
- (215) 387-4096
- 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
- Duct cleaning information.
- [National Institute of Building Sciences \(NIBS\)](#)
- (202) 289-7800
- 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
- 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
- Technical information on topics such as air conditioning and air ducts.

Section 5

Mold Cleaners and Disinfectants Reference Table

	Sodium Hypochlorite >5.25%	Hydrogen Peroxide (<8%)	Hydrogen Peroxide (18-20%)	Powdered Percarbonate	Enzymes
Mold Cleaners					
Packaging	Plastic Ready to Use - Liquid	Plastic vented Ready to Use - Liquid	Plastic vented Ready to Use - Liquid	Plastic vented Concentrate – Powder	Plastic Concentrate – Liquid
Shelf Life	3-4 months in an airtight container away from light.	2 years in an airtight container away from light.	2 years in an airtight container away from light.	1 year in container. Reduce heat / moisture exposure	2 years in an airtight container away from light.
Shipping	As RTU PG III – Class 5.2 Max packaging qty 8 gal Best Shipping:LTL	<8% – Not regulated Best Shipping: FedEx / UPS or LTL	>8% to <20% - PG III Oxidizer – Max packaging qty 4 gal Best Shipping:LTL	<60% Percarbonate – Not regulated Best Shipping: FedEx/UPS >60% PG III Oxidizer Best Shipping:LTL	Not regulated Best Shipping: FedEx/UPS
Products	Fast MMR Packaed in 1 gal & 2.5 gal Coverage: 200 sf / gallon	Anabec Advanced Cleaning Soln Packed in 5 gal pail Coverage: 800-1000 sf / gallon Fiberlock Advanced Perox Cleaner Packed in 5 gal pail Coverage: 200 sf / gallon	Serum 1000 Packed in 5 gal pail Coverage: unclear	Concrobium Paked in 2-1qt Coverage 65 sf/gal	Sporicidin Package Various Coverage: 1000 sf/gal
Pre-cleaning required?	Yes – when significant organic debris present.	No – This is the first step in their mold cleaning process.	No – This is the first step in their mold cleaning process.	No – this is the first step in their mold cleaning process.	No – this is the first step in their mold cleaning process.
Post-cleaning required?	Yes – HEPA vac / Surface rinse to reduce chlorine on some surfaces	Yes – HEPA Vac	Yes – HEPA Vac	Yes – HEPA Vac	Yes – HEPA Vac
Stain Removal	Very effective	Effective	Effective	Effective	Varied results based on stain chemistry
Timing	Almost immediate	1 day to see final results	1 day to see final results	30 m - 1 hour to activate 2 hour lifespan of mixed product 1 day to see final results	Up to 3 days to see final results
Disinfection Properties	Yes – High	Yes – High	Yes – High	Yes – High	No
PPE / Environmental Controls	Personal protective equipment (w / full dermal protection), respirator and increased ventilation.	Personal protective equipment (w / full dermal protection) respirator and increased ventilation.	Personal protective equipment (w / full dermal protection) respirator and increased ventilation.	Personal protective equipment (w / full dermal protection) respirator and increased ventilation.	Personal protective equipment (w /dermal protection) respirator and increased ventilation.
Health risks	Extreme irritant to mucous membranes, eyes and skin, to the point where chemical burns can occur. If mixed with ammonia or acidic products can create poisonous chlorine gas.	Irritant to mucous membranes, eyes and skin at use concentration.	Irritant to mucous membranes, eyes and skin at use concentration. Can bleach skin and hair	Irritant to mucous membranes, eyes and skin at use concentration.	Irritant to mucous membranes, eyes, and skin at use concentration.
Environmental Issues/ Disposal	Highly Toxic to aquatic organisms. Environmental release to be avoided. Any amount flushed down a sink should be accompanied with a large quantity of water.	Small amounts can be flushed down a sink with a large quantity of water. Larger amounts should be treated before disposal.	Small amounts can be flushed down a sink with a large quantity of water. Larger amounts should be treated before disposal.	Small amounts can be flushed down a sink with a large quantity of water. Larger amounts should be treated before disposal.	Small amounts can be flushed down a sink with a large quantity of water. Large quantities can impact septic tank / drain biological activity.

Mold Cleaners and Disinfectants Reference Table

Mold Cleaners	Sodium Hypochlorite >5.25%	Hydrogen Peroxide (<8%)	Hydrogen Peroxide (18-20%)	Powdered Percarbonate	Enzymes
Advantages	Can kill spores at high concentrations. Broad spectrum of antimicrobial activity. Does not leave toxic residues, unaffected by water hardness, inexpensive and fast acting.	Can remove biofilms and kill spores at use concentration. Broad spectrum of antimicrobial activity. Does not leave residues. Biodegradable	Can remove biofilms and kill spores at use concentration. Broad spectrum of antimicrobial activity. Does not leave residues. Biodegradable	Can remove biofilms and kill spores at use concentration. Broad spectrum of antimicrobial activity. Does not leave toxic residues. Biodegradable	Digest stains with bacillus based enzymes. Retains similar bactericidal activity in the presence of organic matter. Biodegradable. Safe for surfaces.
Disadvantages	Will cause damage / bleaching to floor finishes, metals, carpets, clothing and other fibers at use concentrations. Wipe down metals after exposure required. Rinsing required in applications where direct skin or oral contact occurs. Must be stored separately from ammonia and flammable products. Inactivated by heavy biofilms, organic debris, light and some metals. Not effective at cleaning mold from porous surfaces	At use concentration cause discoloration of anodized metal finishes and bleaching of some fabric. Cosmetic and functional material compatibility concerns with brass, zinc, copper, and nickel/silver plating.	At use concentration cause discoloration of anodized metal finishes and bleaching of some fabric. Cosmetic and functional material compatibility concerns with brass, zinc, copper, and nickel/silver plating.	Can cause discoloration of black anodized metal finishes and bleaching of non-colorfast fabric. Cosmetic and functional material compatibility concerns with brass, zinc, copper, and nickel/silver plating.	Slow working. Not compatible with disinfectants.

Mold Cleaners and Disinfectants Reference Table

Disinfectants	Sodium Hypochlorite <5%	Quaternary Ammonium Compounds	Hydrogen Peroxide <8%	Thymol	Phenols
Disinfection Level	Low / Intermediate	Int / High (~40-130 org)	High	Low ~15 orgs	Low
Stain Removal	Fast and effective at removing stains	Lightens staining by killing organisms	Effective at lightening staining at <8% with addition of surfactant	Ineffective at stain removal	Ineffective at stain removal
Health risks	Irritant to mucous membranes, eyes and skin. If mixed with ammonia or acidic products can create poisonous gas.	Can cause dermatitis. Irritant to mucous membranes. Can trigger asthmatic symptoms.	Irritating to eyes, skin at mucous membranes at >6% concentration.	Irritating to eyes, skin at mucous membranes	Irritant to mucous membranes, eyes and skin.
Controls	Personal protective equipment (w / full dermal protection) and increased ventilation.	Personal protective equipment and increased ventilation.	Personal protective equipment (w/ dermal protection) including goggles and increased ventilation.	Personal protective equipment (w/ dermal protection) including goggles and increased ventilation.	Personal protective equipment and increased ventilation.
Competitive Products	Bleach	Anabec Anashpere, Fiberlock Shockwave, Foster 4080	Fiberlock Advanced Peroxide Cleaner	Concrobium Disinfectant, Botaniclean Benefect	Sporicidin
Environmental Issues/ Disposal	Toxic to aquatic organisms.	Toxic to aquatic organisms.	Small amounts can be flushed down a sink with a large quantity of water. Larger amounts should be treated before disposal.	Toxic to aquatic organisms.	Toxic to all animals including aquatic organisms. Remains persistent in the environment. Subject to disposal restrictions.
Shelf Life	3 months. Keep in an airtight container away from light.	2 years in an airtight container if undiluted. Reality is much longer.	2 years in an airtight container away from light.	Stable	1 year in a sealed container.
Packaging	Plastic	Plastic	Plastic vented	Plastic	Plastic
Shipping	As RTU PG III – Class 5.2 Max packaging qty 8 gal	As Concentrate PG III, Small quantity exemption As RTU – not regulated	>8% to <20% - PG III Oxidizer - Max packaging qty 4 gal <8% – Not regulated	As RTU PG III – Class 5.2 Max packaging qty 8 gal	2% (typical use range) - Not regulated
Disadvantages	<ul style="list-style-type: none"> Can cause damage to floor finishes, metals, carpets, clothing and other fibers at use concentrations. Must be stored separately from most chemicals. Rinsing required in applications where direct skin or oral contact occurs. Inactivated in the presence of organic matter, biofilm and by light and some metals. No residual activity. Not recommended for porous materials 	<ul style="list-style-type: none"> Can easily become contaminated. Leaves residue, rinsing required. QUATs are generally inactivated by organic matter, some soaps and hard water with the exception of newer fourth generation QUATs. 	<ul style="list-style-type: none"> >7.5% hydrogen peroxide can cause discoloration of black anodized metal finishes and bleaching of fabric. Cosmetic and functional material compatibility concerns with brass, zinc, copper, and nickel/silver plating. Inactivated by organic matter. 	<ul style="list-style-type: none"> Can cause damage to floor finishes, metals, carpets, clothing and other fibers at higher concentrations. Must be stored separately from ammonia and flammable products. Rinsing required in applications where direct skin or oral contact occurs. Inactivated in the presence of organic matter and by light and some metals. 	<ul style="list-style-type: none"> Not for use on food preparation surfaces or food utensils and in nurseries or schools. May damage floor finishes and other surfaces. Leaves residue, rinsing required. Not effective against non-enveloped viruses such as norovirus and spores and some gram-negative bacteria.
Advantages	Can kill spores at high concentrations. Broad spectrum of antimicrobial activity. Does not leave toxic residues, unaffected by water hardness, and fast acting.	Does not cause damage to surfaces.	Non-corrosive when diluted, no disposal issues, odor or irritation issues. Leave no residue. Biodegradable	Can remove biofilms and kill spores at high concentrations. Broad spectrum of antimicrobial activity. Does not leave toxic residues, unaffected by water hardness, inexpensive and fast acting.	Maintains some activity in hard water and in the presence of organic matter and has some residual activity after drying.

