

The National Institutes of Health
Moisture and Mold Remediation
Standard Operating Procedures

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Technical Assistance Branch
Division of Occupational Health and Safety, ORS



I. Overview

- Introduction
- Policy

A. Introduction

The presence of excessive moisture in buildings has been linked with occupant illnesses and deterioration of building material. When mold spores land on wet or damp areas they may begin to grow. Excess moisture on almost all indoor materials leads to growth of microbes, such as mold, fungi and bacteria. Generally, mold will grow on materials where excessive moisture accumulates and remain undiscovered and/or uncorrected. As the mold grows, it digests the substrate and gradually destroys it. Even if mold cannot be seen, its presence may be noticed as a moldy or earthy smell. Controlling the moisture in the building can help minimize mold growth.

Currently, there are no federal standards (e.g., OSHA, NIOSH, EPA) for airborne concentrations of mold spores. However, epidemiological studies suggests that the occupants of damp or moldy buildings are at increased risk of respiratory symptoms, respiratory infections and exacerbation of asthma. Strategies for mold prevention and remediation are based on best practices as determined in the field. These strategies are utilized at the NIH and apply to health care and non-health care facilities.

This document outlines and describes the best and most current guidance for response to water intrusion and mold contamination.

B. Standard Operating Procedure (SOP)

This SOP outlines methods to prevent mold growth, the conditions under which mold and moisture remediation must be performed and the responsibilities of the affected parties. The goal is to reduce or eliminate excess moisture in less than 48 hours as a means to prevent mold growth.

This SOP applies to the ICs, Clinical Center, and to all ORS and ORF staff participating in moisture remediation.

II. General

- Responsibilities
 1. Division of Occupational Health and Safety (DOHS) upon request will:
 - Conduct a walk-through of the areas impacted by water intrusion and collect qualitative and quantitative data.
 - Provide technical assistance and recommendations to facility managers

- and project officers for drying and moisture remediation.
 - Evaluate areas suspected to be contaminated by mold growth and provide recommendations to facility managers and project officers for remediation.
 - Assist in identifying the underlying causes of water intrusion and mold growth and develop the appropriate response(s) to prevent recurrence.
 - Assess conditions for occupancy after water restoration or mold remediation activities.
2. The Office of Research Facilities Development and Operations (ORF):
- Shall identify and fix the source(s) of water leak(s) or intrusion.
 - Shall perform or arrange for contract services for water removal and restorative drying of affected structure.
 - Shall notify DOHS of water intrusion when: total surface area affected is greater than 10 ft²; the water source originates from other than a sanitary source (e.g., rain or sewage); or is suspected to be contaminated.
 - Shall notify DOHS immediately when an area of suspected mold growth is discovered.
3. Contractor:
- Shall evaluate and document the extent of damage (e.g. water or mold) in the structure, systems and building contents using appropriate monitoring and detection equipment.
 - Shall designate a Project Leader, representing the Contractor, to work with ORF, ORS and facility personnel during the entire project.
 - Shall provide ORF and ORS representative a written action plan. Depending on the response activity, the action plan will include a timeline and goals for drying and the implementation of mold remediation techniques.
 - Shall record and document all activities and services performed in response to the problem. For water restoration records would include complete moisture readings. Records and documents will be provided to ORF and ORS representatives.
 - Shall complete the project in a manner which complies with all government regulations and NIH policies and procedures.
4. Building Occupants:
- Shall notify the Central Call Desk at 301-435-8000 or online at <http://orf.od.nih.gov/58000> to report water infiltration.
 - Building occupants should report any health concerns due to the environmental conditions in a facility to the Occupational Medical Service (OMS) in Building 10, Room 6C306, for evaluation by a health practitioner.

III. Guidance for Moisture Infiltration

- Initial Response
- First 48 hours
- After 48 Hours

A. Initial Response

Building occupants should follow the following steps if water infiltration is discovered in an NIH facility:

- Notify the Central Call Desk at 301-435-8000 or online at <http://orf.od.nih.gov/58000> to report water infiltration.
- Notify the Facility Manager (<http://orf.od.nih.gov/AboutORF/Buildings/>).
- Contact the DOHS at 301-496-3353 to request an evaluation of the affected area. The building occupant is responsible for implementing the DOHS recommendations. Depending on the recommendations, other services may be required.

B. Guidance for Remediating Moisture in the First 48 hours

In the event of water infiltration into building areas, remediation within 24 to 48 hours is critical in prevention of mold growth.

1. Identify the source of the moisture: Following the discovery of water infiltration into building spaces, the first step is to identify whether the moisture source is clean or polluted water.
 - If the water infiltrating the building originates from a sanitary water source (no chemical or biological pollutants or sewage), the sooner repair, clean up and drying are accomplished, the likelihood of preventing mold growth is increased.
 - If mold growth is found or if the water is polluted, contact the DOHS at 301-496-3353 and review the information in Moisture Infiltration after 48 Hours.

Note: Potable, de-ionized, reverse osmosis, and distilled water are considered unpolluted, unless they have come in contact with a pollution source. All others are considered polluted. However, clean water may not remain clean as it contacts other surfaces or materials.

2. Halt further moisture infiltration: The next step is to halt further moisture intrusion by repairing the water leak. Conduct an inventory of the water damaged areas, building materials, and furnishings, paying special attention to identifying wet carpet under cabinets, furniture, and

furnishings. If you can't determine the start time of the water infiltration, it should be handled as if it has existed for more than 48 hours (see section titled "Guidance on Moisture Infiltration after 48 hours").

3. Determine whether materials are "dry": Using the appropriate detection equipment to evaluate materials in the impacted area for excess moisture (see section titled "Response Equipment").
4. Specific instructions: Following are guidelines for preventing mold growth on specific water-damage materials.
 - **Ceiling tiles**: Discard and replace (**Note**: If the tiles are glued onto the ceiling or wall, call DOHS (301-496-3353) to determine whether the material(s) contain asbestos).
 - **Carpet and Backing**: Remove all furniture/cabinets sitting on wet carpet. Remove water with an extraction vacuum; reduce ambient humidity levels with de-humidifiers; and accelerate drying by using fans. Exercise caution when removing carpet laid over floor tile as it may contain asbestos. Contact DOHS (301-496-3353) to collect samples.
 - **Cellulose Insulation**: Discard and replace.
 - **Fiberglass Insulation**: Discard and replace.
 - **Electrical**: Consider all wet wiring, light fixtures, and electrical outlets to be shock hazards. Turn power off in the affected area until these hazards have been checked by a building inspector or electrician. All wet electrical circuit breakers, GFI's, and fuses need to be replaced. All wet electric motors, light fixtures, and so on must be opened, cleaned, and air-dried by a qualified person and visually inspected for moisture before they are placed back into service.
 - **Books and Papers**: Non-valuable materials should be discarded. Photocopy valuable/important items and discard originals. For items with high monetary or sentimental value, consult with a restoration/water damage specialist.
 - **Concrete or Cinder Block Surfaces**: Remove water with a water extraction vacuum and accelerate drying with de-humidifiers, fans, and/or heaters.
 - **Flooring (Linoleum, Ceramic Tile, and Vinyl)**: Vacuum or damp wipe with water and mild detergent and allow them to dry. Check under flooring to make sure it is dry (**Note**: Call DOHS (301-496-3353) to determine whether the flooring material(s) contain asbestos.)
 - **Non-Porous, Hard Surfaces (Plastics, Metals)**: Vacuum or damp wipe with water and mild detergent.
 - **Upholstered Furniture**: Remove water with an extraction vacuum. Accelerate drying with de-humidifiers, fans, and/or heaters. Drying furniture may be difficult to complete within 48 hours. If the furniture is valuable, consult a restoration/water damage specialist.

- **Wallboard (Drywall and Gypsum Board):** May be dried in place if there is no water stain and/or obvious swelling and the seams are intact. Remove base molding to inspect the wallboard.
- **Wood Surfaces:** Remove moisture immediately and use de-humidifiers, 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 the wall for drying.

C. Guidance on Moisture Infiltration After 48 hours

When water infiltration has remained uncorrected or building materials are not “dry” after 48 hours, mold growth may have begun. There may be visible evidence of growth or a moldy, damp smell. In these cases, the situation is now one of potential mold remediation. The guidance provided here is for information purposes only and is not a substitute for DOHS expertise.

Remediation efforts are more intensive than prevention, and they must be designed to protect the health of building occupants and remediation personnel. Recommendations for cleanup or remediation by DOHS will depend on the extent of the damage, the types of materials affected, and the presence/type of mold growth. DOHS will make recommendations on whether current occupants should be relocated; on the containment/cleanup methods to be used (including whether remediation can be done by in-house personnel or if professional contractors are required); and on the types of personal protective equipment required by NIH personnel.

Air handling units (AHUs) servicing the affected area(s) should not be shut down unless gross, visible mold growth has been identified and a containment area cannot be established. Having the AHU running helps the drying process and control humidity in the area.

If water infiltration necessitates the replacement of any portion of a gypsum shaft or partition assembly, or any interior wall, ceiling or floor finishes, the facility manager will coordinate the repairs/replacement through the Division of the Fire Marshal, ORS. Use of specific materials and construction methods may be necessary to maintain required fire protection ratings of partition and shaft assemblies. U.L. classified wall, ceiling, and floor finish materials may be required in accordance with the International Building Code, the National Fire Protection Association 101 “Life Safety Code,” or the NIH Design Requirements Manual.

- **Carpet:** The impacted carpet should be discarded and replaced.
- **Ceiling tiles:** Discard and replace (**Note:** If the tiles are glued onto the ceiling or wall, call DOHS (301-496-3353) to determine whether the material(s) contain asbestos).

- **Porous/absorbent items:** Regardless of the original source of water damage (e.g., flooding versus water leaks from point-of-use fixtures or roofs), remove wet, absorbent items and replace with new materials as soon as the underlying structure is declared by the facility engineer to be thoroughly dry.
- **Wallboard:** If the wallboard cannot be dried within 48 hours, measure twelve (12) inches above the water mark/damage and remove and discard wallboard below that point. Remove and discard damp insulation, and ventilate the wall cavity. In some cases it may be difficult to tell if the wallboard has been sufficiently dried. A moisture meter can be used to check for moisture. To use a moisture meter, check the affected area and compare the reading to a control reading in a non-affected area (see section titled “Response Equipment”).

Mechanical Rooms: Mechanical room leaks, standing water, consistent relative humidity levels above 60%, and condensation problems should be fixed as they are detected. If standing water is found in areas that have concrete or tile floors and there is no apparent visible mold, the DOHS does not need to be contacted.

Contaminated Water: Contact the DOHS immediately if the water infiltrating a building area is polluted. Following repairs to prevent any further infiltration, any contaminated ceiling tiles, carpet, upholstered furniture, paper products, or similar materials must be disposed of in sealed containers by personnel wearing appropriate personal protective equipment (protective clothing, gloves, boots, and, at a minimum, a N-95 type respirator). The entire area must be disinfected.

Note: Potable, de-ionized, reverse osmosis, and distilled water are considered unpolluted unless they have come in contact with a pollution source. All others are considered polluted. However, clean water may not remain clean once it contacts other surfaces or materials.

IV. Response Equipment

- Moisture Monitoring and Evaluation Equipment
- Restorative Drying Equipment

A. Moisture Monitoring and Evaluation Equipment

The following is a list of equipment that can be employed to evaluate high moisture levels and facilitate drying of affected areas.

1. **Moisture Meters:** A moisture meter may be useful in the following situations:
 - When a stain has been found on wallboard and a decision is needed as to whether the stain can be cleaned or further action is required.

- Sometimes it is difficult to determine when wallboard has been completely dried. In these cases, use a moisture meter to check drywall in the affected area and compare the reading to a non-affected area. Readings should be the same.
- Table 1 references acceptable moisture levels for select building materials provided by William Yobe & Associates & U.S. Forest Products (USDA).

Table 1 - Acceptable moisture levels for select building materials

Material/Component	Moisture %
Baseboard	7 to 10
Gypsum Wallboard	7 to 10
Hardwood Flooring	7 to 10
Framing Lumber	15 to 19
Wood Furnishings (interior)	7 to 12

Source: William Yobe & Associates & U.S. Forest Products (USDA)

2. **Infrared Camera:** A thermal camera may be useful in the following situation:
 - Infrared cameras are used to detect surface temperature. An infrared camera produces a thermal image of a material that can provide rapid identification of potentially moist areas by indicating temperature differences at the surface of materials. In these cases, use a thermal camera to check drywall in an affected area and compare the reading to the surroundings to detect thermal disparities attributed to moisture. This method may be used in conjunction with a moisture meter.
3. **Borescope:** A borescope may be useful in the following situations:
 - To inspect behind walls for pockets of water or mold.
 - To inspect inside ducts, behind motors and compressors of HVAC systems.

B. Restorative Equipment

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, 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.
2. **Dehumidifiers:** Dehumidifiers are devices designed to remove water vapor from the air. They can be used to lower humidity levels in affected areas to

aid in drying. The number of dehumidifiers is dependent on the type of dehumidifier being used, the size of the affected area, and the type of building material affected.

3. **Airmovers:** Airmovers are designed at a low center of gravity to force air along floor and wall surfaces, while axial fans are designed to force a large volume of air across a large area. Residential box fans, circular fans, etc. should not be used for structural drying in affected areas due to possible electrical shock hazards.
4. **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 assure 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.

V. Mold Remediation

- Microbial “Mold Remediation” Policy
- Containments
- Prevention Strategy

A. Microbial “Mold Remediation” Policy

The NIH follows the 2008 Institute of Inspection Cleaning and Restoration Certification S520 standard and Reference Guide for Professional Mold Remediation. Prior to and during activities that disturb mold, engineering controls and work practices shall be implemented to prevent mold contamination from spreading to other clean areas. Remediation efforts should be coordinated with the DOHS at 301-496-3353.

1. Determine the size of the impacted area: Assess the size of the moisture problem before planning the remediation work (see Table 2). Remediation should not proceed until the source of the water intrusion has been fixed, or the problem may reoccur. Remediation techniques may vary greatly depending on the size and complexity of the job, and may require revision if circumstances change or new facts are discovered.
2. Biocides: The goal of mold remediation is to remove the mold and prevent human exposure and damage to building materials. Physically removing mold

contamination is the primary means of remediation. Even after mold is rendered non-viable, the remaining mold fragments are still allergenic, and some are potentially harmful. The use of biocides is not routinely recommended during remediation. However, there may be some instances when the use of a biocide may be justified, such as when immune compromised individuals are present. Biocides are toxic to humans as well as molds. If biocides are used, occupants must first be evacuated from the area and applied with adequate ventilation. Remediation personnel must wear appropriate personal protective equipment. Since some biocides are registered pesticides with the EPA. As such these may only be applied by licensed applicators.

3. Mold Sampling: In most cases, sampling for mold is unnecessary even if there are visible signs of mold or moldy, musty odors. In some specific instances such as where litigation is involved or the source of the mold is unclear then sampling may be part of the site evaluation. Air sampling may be necessary if an individual(s) has been diagnosed with a disease that is or may be associated with mold exposure (e.g., aspergillosis) and the occupational health physician/medical practitioner desires to confirm the causative agent. Sampling for mold should only be done after a sampling strategy has been developed. Since no OSHA or other occupational exposure levels have been set for mold, sampling cannot be used to check a building's compliance with existing standards.
4. Post Remediation Verification: Remediated structures, systems, and contents can be considered clean (by post remediation evaluation) when contamination or unrestorable contaminated materials and debris have been removed, and surfaces are visibly free of dust. Also, remediated areas should be free of odors.

Table 2 – Containment – Size of impacted area

Extent of Contamination	Containment
Used for relatively small or limited areas of mold growth	Source
Used when moderate levels of fungal growth are visible or suspected. HEPA-filtered air filtration devices are used to create negative pressure differentials.	Local
Used when significant or extensive mold growth is present or suspected, and where source and local containments cannot effectively control or eliminate cross-contamination.	Full-scale

Note 1: Containment type is dictated during the remediation. If more extensive contamination is encountered than was expected then the containment type should be upgraded.

Note 2: Regardless of the size of the affected area, DOHS should be contacted whenever suspected mold is discovered.

B. Containment

The purpose of establishing containment is to prevent the release and dispersion of mold spores to areas outside of the affected building space. Mold contamination should be controlled as close to the source as possible. When mold spores are aerosolized, they are much more difficult to capture and control. Controlling containments can be accomplished by using source, local or full containment (**Note:** Call DOHS (301-496-3353) whenever mold growth is discovered to determine appropriate containment and remediation methods).

1. Source Containment

Source containment may be used to address relatively small areas of mold growth, or in combination with other engineering controls to reduce the amount of spores released and dust generated. Source containment may be used alone when fungal growth is limited to small, visible, controllable areas where no hidden mold growth is anticipated. In areas where there is limited visible mold, and hidden mold growth is anticipated, a more extensive containment is recommended. Source containment methods may also be used within areas of more extensive mold growth in conjunction with other forms of containment.

Examples of source containment methods include:

- Taping polyethylene sheeting or using self-adhering plastic on the moldy surface or material before removing; and
- Wrapping, bagging, and securely enclosing moldy contents or materials in 6-mil poly or comparable packaging.

It is recommended that workers avoid crushing materials or other actions that would generate dust and disperse fungal spores and fragments. It is recommended that techniques that limit dust aerosolization such as wetting the materials or using damp clothes be used to control and remove dust immediately. Remediators must wear appropriate PPE.

2. Local Containment

Local containments may be used when “moderate levels” of fungal growth are visible or suspected. A structural enclosure can be built to contain the work area and separate it from the unaffected section of a or structure. PVC pipe, wood framing, or spring-loaded expansion poles can be used to build an enclosure, which then is covered with an appropriate poly material. Constructing structural support is not always necessary if the isolation barrier can be securely attached to wall and ceiling surfaces.

One or two layers of 6-mil polyethylene sheeting may be used to cover the

enclosure or to erect isolation barriers. HEPA-filtered air filtration devices are installed to create a negative pressure differential in relation to surrounding areas. In very small local containments, a HEPA vacuum cleaner can be substituted, if it is able to create the necessary pressure differential. However, this works only if the vacuum canister is adequately sized and located outside the containment area.

3. Full Containment

Full-scale containments normally are used when significant and/or extensive mold growth is present or suspected and cannot be effectively controlled and remediated with source or local containment methods.

In a full-scale containment, the entire room or building section is designated as the work/containment area. Critical barriers are established to separate unaffected areas from affected areas. Walls, ceilings, floors, cabinets, fixtures or other surfaces that cannot be cleaned effectively must be sealed off with poly barriers.

C. Prevention Strategies

- Fix leaks immediately;
- Clean and dry wet or damp spots immediately;
- Remove mold-contaminated materials;
- Regularly inspect and maintain heating, ventilating, and air conditioning (HVAC) systems;
- Routinely inspect and clean HVAC drip pans; check proper flow and that drain is unobstructed;
- Maintain low indoor humidity, ideally 30-60%;
- Vent moisture-generating equipment to the outside, where possible;
- Increase surface temperature or reducing the humidity to prevent condensation that results when surface temperature is below dew point temperature. Surface temperature can be increased with insulation or by increasing air circulation. Humidity can be reduced by repairing leaks, increasing ventilation (if outside air is cold and dry), or by dehumidifying (if outdoor air is warm and humid).
- Keep gutters and downspouts in working order and ensuring that they drain water away from the foundation;
- Provide adequate drainage and sloping the ground away from building foundations so they do not stay wet.
- Regardless of the original source of water damage (e.g., flooding versus water leaks from point-of-use fixtures or roofs), remove wet, absorbent structural items (e.g., carpeting, wallboard, and wallpaper) and cloth furnishings if they cannot be easily and thoroughly cleaned and dried within 48 hours; replace with new materials as soon as the underlying structure is declared by the facility manager to be thoroughly dry.

VI. Off-Campus Leased Facilities

- The DOHS references this policy when asked to evaluate possible mold and water infiltration at privately owned, off-campus facilities.
- For privately owned, off-campus facilities, the DOHS conducts indoor environmental evaluations and mold investigations with ORFDO Facility Managers, with the assistance of building property owners.

VII. Building Re-occupancy

- Upon completion of water and/or mold remediation, the affected areas will be surveyed using the building re-occupancy checklist. The purpose of the survey is ensuring that the building is free of excessive moisture, mold and physical hazards.
- The building re-occupancy checklist can be found in Appendix A.

VIII. References

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Center for Disease Control and Prevention (CDC). (2003). "MMWR Guidelines for Environmental Infection Control in Health Care Facilities" June 6, 2003 / 52(RR10);1-42.

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New York City Department of Health (2002). *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*. New York: New York City Department of Health, Bureau of Environmental & Occupational Disease Epidemiology.

Institute of Inspection, Cleaning and Restoration Certification (IICRC). (2006). *IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration*, 3rd edition.

"Industrial Hygiene and Preventive Medicine Mold Assessment Guide". (February 2002). Army Center for Health Promotion and Preventive Medicine.

RE-OCCUPANCY CHECKLIST

Date inspection conducted: _____ Location: _____

Name(s) of those participating in this inspection: _____

Topic	Current Status	Action Needed
Water Intrusion		
1. Have affected porous building materials been returned to a "dry" condition (unaffected state) within 48 hours?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2. After 48 hours have affected porous building materials been replaced?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Indoor Environment		
1. Is the affected area free of excessive moisture, humidity, and odors?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2. Is the area free of visible mold growth?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Housekeeping		
1. Is the area free of slip/trip/fall hazards?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
1. Are buildings materials (i.e, ceiling tile, drywall and carpet) clean and in good condition?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2. Has furniture been returned to original position?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3. Has the carpet been professionally cleaned and free of odors and stains?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4. Have electrical extension cords been removed and outlets inspected on affected walls?	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Monitoring:

Comments:
