Mold Guidelines for Contractors and Facility Owners

Risk Control from Liberty Mutual Insurance

Controlling water and moisture is key to reducing mold potential. This reference note provides examples of conditions and techniques that may be appropriate for your work in controlling indoor mold growth. Strategies are offered to help minimize conditions that can allow for fungi and mold growth.

Highlights:

- Potential sources of biological agents in buildings
- Building walkthrough assessment

The term “fungi” is used to refer to most forms of microbial contamination commonly found in buildings. “Mold” is a term used to describe visible fungal growth.

The variety of conditions that can combine to support mold growth are so varied that the following precautions only scratch the surface. However, controlling water and moisture is key to reducing mold potential. The following precautions are provided not as a comprehensive action list, but as examples of conditions and techniques that may be appropriate for your work in controlling mold growth.

Preventing water damage is the most economically effective method to control fungal growth. Prompt drying of wetted materials is the second best. If drying porous materials is not accomplished within 48 hours, they should be carefully removed and discarded. The appearance of mold, or musty odors should be addressed immediately. All sources of moisture should be stopped and the nature and extent of water damage be determined. If affected building materials cannot be dried within 48 hours, then remediation following the New York City Department of Health, *Guidelines on Assessment and Remediation of Fungi in Indoor Environments or the EPA Mold Remediation in Schools and Commercial Buildings* should take place.

Product Installation

A few precautions will help ensure that you do not install “a problem” just waiting for water to be added.

- Install materials and equipment per the manufacturer’s instructions. Follow maintenance and cleaning instructions to reduce mold development.
- Use care when installing roofs and windows and make sure they are properly flashed.
- Have materials delivered to the site just in time for installation. Reduce on-site storage time as much as possible.
- If materials must be stored on site, use pallets or scrap lumber to prevent contact with the ground or concrete surfaces.
- Leave a small air gap between concrete surfaces and porous materials.
- Inspect materials for water damage and mold growth before installation. Do not install damaged materials.
- Clean wall cavities and other enclosed areas of dirt and debris before enclosing. Dirt also contains mold spores.
- Mechanically ventilate damp areas when natural ventilation is not enough.
- Use quality building products, especially for siding, roofing, windows, and piping.

- Install porous materials only after the building is weather tight. When it is necessary to expedite the schedule before the building envelope is sealed, take steps to protect all previously installed porous materials.
  - Cover the location over all installed porous materials with a waterproof material.
  - Devise a method to divert water that could pond or pool on the floor next to or under installed porous materials.

Flooding and Water Leaks

Follow these practices and procedures to help limit growth in and on materials, and prevent water intrusion, leaks, and flooding.

- Test and certify the integrity of water supply and fire protection systems with air before charging.
- Test and certify waste and vent systems for leakage before closing wall cavities.
- Dump water used for testing systems (such as fire protection, vent, and waste) outside the building. The goal should be to reduce the amount of standing water inside the building, as it can evaporate and increase humidity.
- Within 24 – 48 hours of water damage, dry materials to a moisture level that will not support microbial growth.
- If more than 48 hours have passed since the water damage occurred, make efforts to dry out affected materials. Not all molds form quickly, and removing water eliminates a key factor in mold growth. If mold growth is visible, remove the affected material or remediate the affected area.
- Discard sewage-contaminated porous materials.
- Grade the site to divert surface water and collected rainwater away from the building.
- Ensure rainwater leaders direct water away from the building or into a collection system that can handle the flow without backup or overflowing.
- Take steps to prevent future flooding and water intrusion by using protective materials or redesigned structural elements.

Moisture within the Building

Reduce the potential for moisture accumulation and condensation with humidity control and insulation.

- Ensure that concrete and mortar have enough time to cure before closing the building up, or mechanically ventilate the space to the outside.
- Reduce water wicking into the basement through concrete walls and floors by using coatings and collection/drainage systems.
- Collect and remove water that may accidentally enter the building. Ensure that basement slabs have an effective drainage plane.
- Backfill the foundation as soon as practical.
- Prevent surface water, ground water, and capillary water from penetrating through materials with appropriate caulking, coatings, or sealants in conjunction with collection/drainage systems.
- Double check all below-grade penetrations of foundation wall and slab for leakage, especially when installed after waterproofing is applied.

- Construct flashing details at joints and penetrations according to the plans and specifications. Double check installation. Leaks from flashing problems may not show up for months and are much more expensive to repair after the building is complete.
- Joint, caulking, and other construction failures, especially around windows, can lead to water leaking into wall cavities. Exterior materials, such as stucco, may creep or crack, opening a gap that allows water to penetrate to the interior. Inspection and maintenance is the short-term answer. Alternative construction methods may be needed to provide a long-term solution.
- Preplan for the fans in the mechanical system to be available for ventilating the building as it is being closed up. Using the building's ventilation system is more effective than leaving out windows or using portable fans.
- Employ auxiliary ventilation when renovation work involves "wet" trades. Preplan ventilation to ensure adequate volume and quality of makeup air. Direct exhaust air to minimize contamination hazards to other areas of the building and neighbors.

Control Relative Humidity and Condensation

One of the largest contributors to mold is condensation inside the building envelope.

- Ventilate the building to reduce moisture levels to below those that allow condensation to occur. Locally exhaust humid air from bathrooms, shower rooms, kitchens, laundries, etc., to the outside.
- Dehumidify indoor air by operating the cooling coils in the HVAC system to remove moisture from outside or return air
- Ensure that appropriate insulation, air barriers and vapor barriers, if used, are properly installed on the warm side of ventilation systems or the building.
- Avoid impermeable wall coverings. Use permeable paints and coverings on interior walls, operate the HVAC system at a slight positive pressure with respect to outdoors, and avoid excessive cooling.
- Provide positive air pressure inside buildings located in high humidity climates. When buildings have lower air pressure (negative) relative to the outside pressure, moist air is pulled into the wall cavity. This leads to condensation, regardless of whether the wall is built correctly.

Moisture Control in HVAC Systems

The mechanical system must be sized and operated properly to avoid problems.

- Properly install and maintain air filters of the highest grade (i.e. MERV 13 or better) compatible with the system. Never run the system without filters in place.
- Protect air filters from wetting and replace them periodically.
- Avoid using porous materials inside the ductwork, especially in persistent wet areas of the HVAC system. Surfaces within 15 feet of moisture-producing equipment, such as cooling coils, should be smooth and nonabsorbent.
- Closed cell foams with protective non-porous coatings are easier to clean and limit fungal growth, compared to porous fiberglass interior duct lining.
- Design cooling coils for minimum carryover of water droplets.
- Slope condensate drain pans to drain completely.
- Physically remove growth in drain pans. Clean and sanitize drain pans and cooling coils. In humid climates, inspect these components at least monthly.
- Avoid water-spray humidifiers and discourage the use of console humidifiers. These units require frequent maintenance and cleaning to prevent microbial growth.

- Provide easy access for HVAC maintenance and inspections, especially at coils, filters, dampers, and baffles.
- Avoid supply duct leaks and supply/exhaust imbalances that bring warm wet air onto cold surfaces.
- Develop and maintain paperwork to help defend against claims. The following documentation may be helpful:
  - Test and balance documentation following installation.
  - For new installations, document if the unit specified is not the proper size, notice to the architect/engineer/GC, and their response.
  - Records of all callbacks and warranty work, including the problem found and what was done to correct it.
  - Identify other issues including improper use of the system, improper temperature maintenance, blocked return air vents, placing sweeps on interior doors or closing off vents in unused rooms. These all hamper the system's ability to circulate air for proper conditioning. Be sure the technician tells the building owner how to correct the operation, and document this agreement on the service ticket.

Educate the Owner

The builder should share general information with the owner about mold and the potential for mold growth in the building, including the following:

- Information about potential moisture sources (plumbing, HVAC systems, etc.)
- Recommendations for operation, inspection, maintenance, and service of building systems that could contribute to elevated moisture levels
- Importance of prompt action by the owner to repair any source of water leakage, and the importance of drying out or replacing damaged materials
- Be sure to document all disclosures

Moisture Control Strategy

With any moisture control strategy it is important to proactively identify potential water intrusion exposures. Review specific construction timetables of activities, jobs, and tasks that may increase the potential for water intrusion if not properly managed.

Fungal growth is encouraged by wet, warm, and humid conditions such as:

- Wet building material
- Humidity above 60 percent
- Temperature between 68 to 90 degrees Fahrenheit
- Little air movement

When these ideal conditions exist, mold amplification can quickly occur within 24 – 48 hours. In periods of melting snow and ice or heavy rain or flooding, fungal growth can be very rapid.

Prevention

Microorganisms reach indoor environments with outdoor air that enters the building or they can be transported inside by people or building materials brought inside.

The general principles for preventing microbial growth in buildings can be summarized by the following:

- Prevent microbial colonization of building materials, HVAC system, and interior space by controlling moisture in the building.
- Limit the intrusion of aerosols from outdoor sources.
- Limit indoor accumulation of aerosols from human and animal sources.

Control Strategies

A comprehensive strategy to resolve problems related to microbial growth in buildings includes a series of inclusive steps.

- Identify and control sources. Investigators must understand moisture sources and water accumulation to identify potential areas for microbial growth.
- Remove existing contamination. All items that may act as potential sources should be cleaned. Contaminated items worth saving should be decontaminated. Contaminated materials that cannot be salvaged must be discarded.
- Prevent problem recurrence. Building managers must adopt operation and maintenance practices to ensure control strategies are implemented and the potential for problem recurrence is eliminated.
- Prevent pollutant buildup. A regularly scheduled program of cleaning, preferably using high efficiency particulate air (HEPA) filtered vacuum cleaners and damp dusting is needed to control sources of particles and biological agents.

Building Design Considerations

Building design, construction, and preventative maintenance should help minimize conditions that allow fungi in indoor air to accumulate, amplify, and disseminate. Fungi contamination prevention measures include building design considerations and managing an effective preventative maintenance program.

Several aspects of building design can be implemented to reduce fungal contamination in indoor air:

- Limit access of outdoor bioaerosols into the building's air handling system. This can be accomplished by providing a tight structural envelope, a climate control system that minimizes the need to open windows, positive building pressurization with respect to outdoors, and adequate filtering of the HVAC system's intake air.
- Eliminate water from accumulating in cooling and humidification systems by designing and installing drainage components. In addition, proper insulation, ventilation and humidity control systems should be used to eliminate areas of potential water condensation on cold surfaces, such as external walls, water pipes, and ducts.
- Maintain a sufficient relative humidity (RH) level (20 – 60 percent RH), high enough to be comfortable for the occupants but not so high as to produce condensation.

Visual Inspection

A visual inspection is the first step in identifying a possible contamination problem. Investigators examine the physical building structure: walls, floors, ceiling tiles, carpets, furnishings, material storage, spaces in ventilation ductwork, fan coil units, drain pans, air filters, supply air distribution, humidifiers, sump pumps and spaces behind walls. A moisture meter can be used to detect building material moisture levels and is helpful in detecting hidden sources of moisture and the extent of past water damage.

Other sources of indoor air contaminants such as people, pets, pests, and indoor plants can produce allergic symptoms and need to be considered as possible sources as well.

Investigators look to identify potential sources of biological agents for evidence of current or past water damage or excess moisture, and as needed, form plans for either more in-depth investigation or control and remediation of noted problems.

Two resources are included at the end of this reference to help you identify sources of biological contaminants.

1. **Potential Sources of Biological Agents in Buildings.** Lists contaminant sources frequently associated with biological contamination.
2. **Building Walkthrough Checklist.** Assists in identifying sources of biological agents.

Preplanning Meeting

The purpose of a preplanning meeting is to bring interested parties together to discuss the construction process and moisture control. Participants should include architects, building designers, engineers, contractors, and building owners. Architects and engineers are responsible for proper building design. Owners and building designers' responsibilities include selecting suitable building materials and systems. Contractors are responsible for keeping stored materials dry, controlling water that may be used during construction activities, and installing materials in accordance with manufacturer specifications and contractual requirements. Upon project completion, building owners are responsible for maintaining the building envelope and building environment. Industrial hygienists or risk control consultants may offer valuable insight at this meeting as well.

Agenda

- Review history of water intrusion/mold related problems on current jobsite.
- Conduct a walkthrough survey of jobsite to identify current moisture control risk factors and controls in force.
- Review construction schedule to identify specific contracting activities such as:
  - Installation of roof mounted equipment (HVAC units)
  - Storage arrangements and handling of cellulose-rich and porous building materials (encourage "just-in-time delivery")
  - Installation of windows, doors, and arrangement of temporary wall coverings
- Review contingency planning for inclement weather conditions (tarps, temporary vapor barriers, sump pumps, dehumidifiers, etc.)
- Review policies for rejecting materials that show signs of mold growth.
- Review policies for preventing use of unvented combustion heaters.
- Review approval and sign-off procedures.
- Review notification system for water intrusion/wetted building materials at 24 and 48 hours.
- Review documentation policies for water intrusion/ wetted building materials via notes and pictures.
- Review policy for drying and cleaning materials

Additional Resources

Guidelines on Assessment and Remediation of Fungi in Indoor Environments. New York City Department of Health and Mental Hygiene. https://www.nahma.org/wp-content/uploads/files/member/NAHMAAnalysis/NYC.pdf

Liberty Mutual Insurance Risk Control reference notes:

- Fungi and Mold in Indoor Environments, RC 6106
- Remediation of Mold and Bacteria from Water Contamination, RC 5428

Potential Sources of Biological Agents in Buildings

Sources of biological agents being introduced into the building envelope or causes of amplification in the building based on environmental conditions are detailed in the following section.

HVAC Systems

Filters: Dampness, microbial growth on filters, gaps between filters and housings, low efficiency filters (when available for system, use MERV 13 or better filters).

Heat exchangers: Dirty heating or cooling coils, excessive water in condensate pans, inadequate drainage from collection pans, water droplets blowing through onto surfaces downstream of coils, dampness and microbial growth on acoustical lining, poorly maintained air washers or humidifiers, stagnant water in air washers or humidifiers.

Outdoor air intakes (OAIs): Bioaerosol sources near OAIs (e.g., plant debris, feathers, bird droppings, insect or rodent infestations, sanitary air vents, cooling towers, or evaporative condensers, standing water), below-grade OAIs.

Supply air plenums and ductwork: Excessive surface deposits, dampness and surface microbial growth, inaccessible humidifiers.

Supply air diffusers: Surface deposits, rust, or microbial growth on louvers, soiled adjacent ceilings and walls, poor air mixing.

Occupied Space

Carpet: Poorly maintained or water-damaged carpet that serves as a source for dirt accumulation or microbial growth.

Chronic condensation: Inadequate insulation or intrusion of humid outdoor air that results in chronic condensation on windows, perimeter walls, or other cool surfaces.

Fabric office partitions, wall coverings, drapes, upholstered furniture: Poorly maintained or water-damaged fabric-covered and upholstered items that serve as sources for dirt accumulation or microbial growth.

Fan coil and induction units: Dirty heating or cooling coils or filters, excessive water in condensate pans, inadequate drainage from collection pans, dampness and surface microbial growth near units.

Portable (console) humidifiers: Poorly maintained units with microbial growth in the water reservoirs, or spray or mist units.

Potted plants: Microbial growth on leaves, soil, plant containers, or surfaces in contact with containers, excess moisture from overwatering.

Return Air Plenums: Excessive surface deposits, dampness and surface microbial growth.

Water Damage: Evidence or history of plumbing or roof leaks, water intrusion or spills, high indoor humidity (greater than 60 percent), attempts to clean or disinfect carpets and other materials, musty or moldy odors.

Window Air Conditioners and Evaporative Air Coolers: Location inconvenient for maintenance, dirty grilles, standing water in condensate pans or sumps, dampness and surface microbial growth in or near units.

Building Walkthrough Assessment

Use this assessment to help identify sources of biological agents in and around the building. If there are contaminant sources near HVAC fresh air inlets, within the building envelope, or if the building's HVAC system is not being properly maintained and operated according to manufacturer's specifications, corrective action should be taken to address identified deficiencies.

Area Surrounding the Building

Describe type of location (urban, suburban, rural)

Describe surrounding land use (business, residential, agricultural)

Note special features of the surrounding area

Yes	No	*(A Yes answer indicates area for special consideration.)*
☐	☐	Animal-confinement operations
☐	☐	Construction or agricultural activity
☐	☐	Water sprays (e.g. , fountains, irrigation)
☐	☐	Cooling towers present
☐	☐	Shallow groundwater areas (e.g. , marshes, bogs)
☐	☐	Poor site drainage
☐	☐	Vegetation surrounding building

Heating, Ventilating, and Air Conditioning System

General Characteristics

Type of ventilation system

Location of air-handling units

Cooling method used

Heating method used

Locations served by individual air handlers

Outdoor Air Intake (OAI)

Identify location

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	Bird screen is present
☐	☐	There are no feathers or bird droppings near or in OAI.
☐	☐	No other organic matter is in or near the OAI (e.g. leaves, plants, insects, trash).
☐	☐	OAI is protected from rain, snow, fog.
☐	☐	There is no standing water or evidence of standing water in or near OAI.
☐	☐	Cooling tower is greater than 25 feet (7.5 m) from fresh air inlet for HVAC system. If “No,” implement controls to reduce likelihood of contaminant introduction into building’s HVAC system.
☐	☐	Exhaust air outlet is greater than 25 feet (7.5 m) from fresh air inlet for HVAC system. If “No,” implement controls to reduce likelihood of exhaust air re-entrainment into building’s HVAC system

Filters

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	Filters are present and free of organic debris and microbial growth.

Air Handling Unit Mixing Chamber

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	Mixing area is clean and free of debris and microbial growth.
☐	☐	There are no malodors, or musty or moldy smells.
☐	☐	There is no evidence of water damage or intrusion.

Heating and Cooling Coil Area

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	Coils are clean and free of organic material and microbial growth.
☐	☐	Condensate pan and drain are present.
☐	☐	Condensate pan is well drained (i.e., no standing water, biofilm, or residue.
☐	☐	No corrosion on pan.
☐	☐	There are no malodors, or musty or moldy smells.
☐	☐	No evidence of water transport from coil area to other areas.

Spray Humidifiers, Evaporative Coolers, or Air Washers

Type of unit	*List chemical or additives used:*

Define maintenance schedule

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	Microbiological samples of the water are taken routinely. If yes, show results.
☐	☐	Water originates from a potable source. If Recirculated water is used, the system should be maintained according to manufacturer's recommendations to prevent microbial amplification.
☐	☐	There is no biofilm, dirt, or microbial growth in sump area.
☐	☐	There are no malodors, or musty or moldy smells.
☐	☐	No water pooling near unit.

Supply Side of Air Handling Unit

Indicate location where ducts enter building (e.g., at ceilings, below floors)

Identify type of supply ducts (interior lined or unlined)

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	Unit enters airspace directly (or ducted to other areas).
☐	☐	Supply area is clean and free of debris and microbial growth.
☐	☐	There are no malodors, or musty or moldy smells.
☐	☐	No evidence of water damage or intrusion.

Return Side of Air Handling Unit

Identify type of return (ducted or plenum)

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	No porous linings are inside ducts or plenums.
☐	☐	Return area is clean and free of debris and microbial growth.
☐	☐	There are no malodors, or musty or moldy smells.
☐	☐	No evidence of water damage or intrusion.

Building/Occupied Space

Identify number of floors: _____

List general building uses: _____

If an attic is present, list condition: _____

If a basement or crawlspace is present, list condition: _____

Is a portable air cleaner used? ☐ Yes ☐ No

If yes, why? _____

Are console humidifiers used? ☐ Yes ☐ No

If yes, why? _____

List typical RH levels in building

Yes	No	*(A No answer indicates area for special consideration.)*
☐	☐	There are no water features (e.g. fountains, sprays, indoor waterfalls).
☐	☐	There are no malodors, or musty or moldy smells.
☐	☐	There is no visible microbial growth.
☐	☐	There is no history of water damage.
☐	☐	There is no evidence of water damage (stained or discolored ceiling tiles, walls, floors, carpeting).
☐	☐	There is no condensation on walls and windows.
☐	☐	If present, window air conditioners are adequately maintained and condensate from unit discharges outside of building envelope and drains away from outside of building.
☐	☐	Evaporative air coolers are used.
☐	☐	Sump pump is used.
☐	☐	Potted plants are monitored for overwatering. Plants can be a reservoir for mold amplification in the soil or mulch covering the soil (i.e. Spanish moss, wood bark, etc.).

Reset Form

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