



The Truth About Water and Mold Remediation

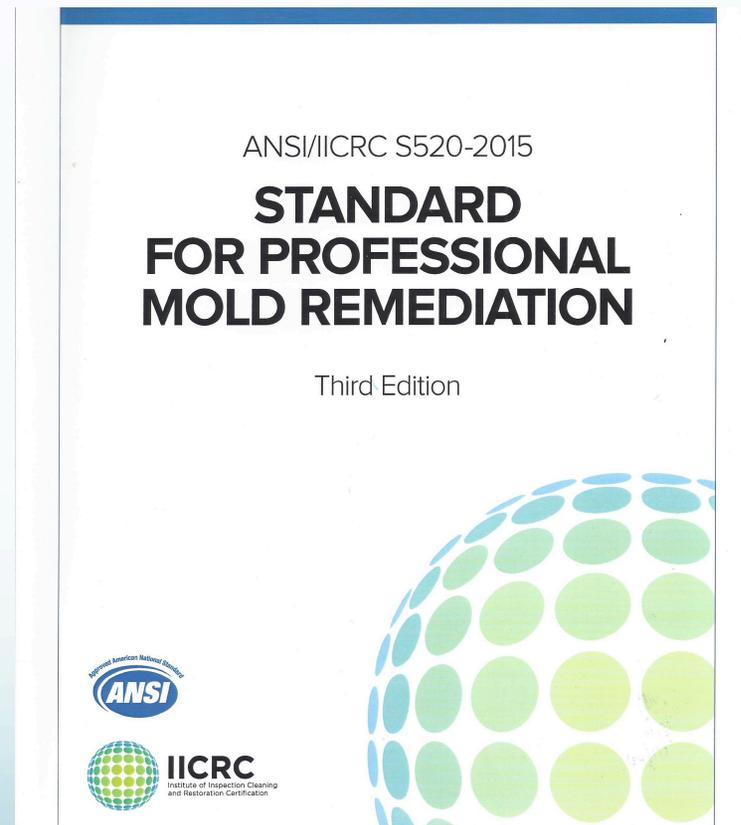
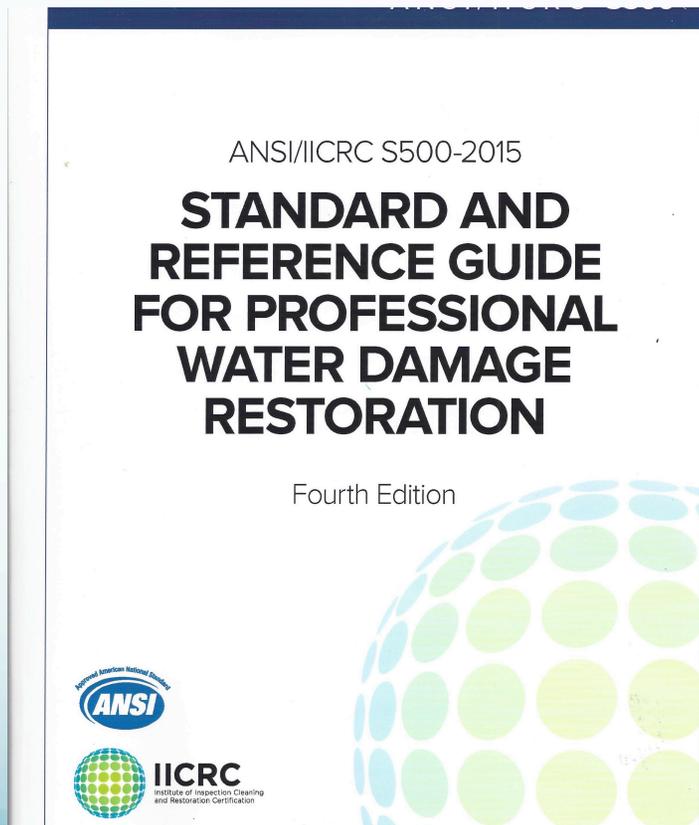
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ANSI/IICRC Standards



13.1 Introduction

The purpose of this section is to provide procedural guidance and assist restorers in applying principles of water damage restoration. The five principles are: provide for the safety and health of workers and occupants, document and inspect the project, mitigate further damage, clean and dry affected areas, and complete the restoration and repairs. This section is divided into three sections:

- Initial Restoration Procedures;
- Remediation Procedures for Category 2 or 3; and
- Drying and Completion Procedures for Category 1

If the preliminary determination is that the water is Category 1, then the restorer can proceed without contamination controls (e.g., erecting containment barriers, initial cleaning, establishing pressure differentials) and worker protection. With regard to Category 2 or 3 water intrusions, remediation should occur prior to restorative drying. For humidity control in Category 2 or 3 contaminated structures, refer to Section 13.3.5.

Standard of Care

The IICRC Standard Committee interprets “standard of care” to mean: *practices common to reasonably prudent members of the trade who are recognized in the industry as qualified and competent.*



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Shall When the term shall is used it means that the practice or procedure is *mandatory due to natural law or regulatory requirements, including occupational, public health and other relevant regulation, and is therefore a component of the accepted “standard of care” to be followed.*

Natural Law

SHOULD

When the term should is used it means that the practice or procedure is an accepted Standard of care to be followed but it is not mandatory by regulatory requirements

Recommended: When the term recommended is used in this document, it means that the practice or procedure is *advised or suggested*.

Categories of Water

CLEAN

GREY

BLACK

GO!



Category 1- Clean Water



- Clean water originates from a source that does not pose substantial harm to humans.

Category 2 - Gray Water

- Gray water contains a significant level of contamination and has the potential to cause discomfort or sickness if consumed by or exposed to humans.

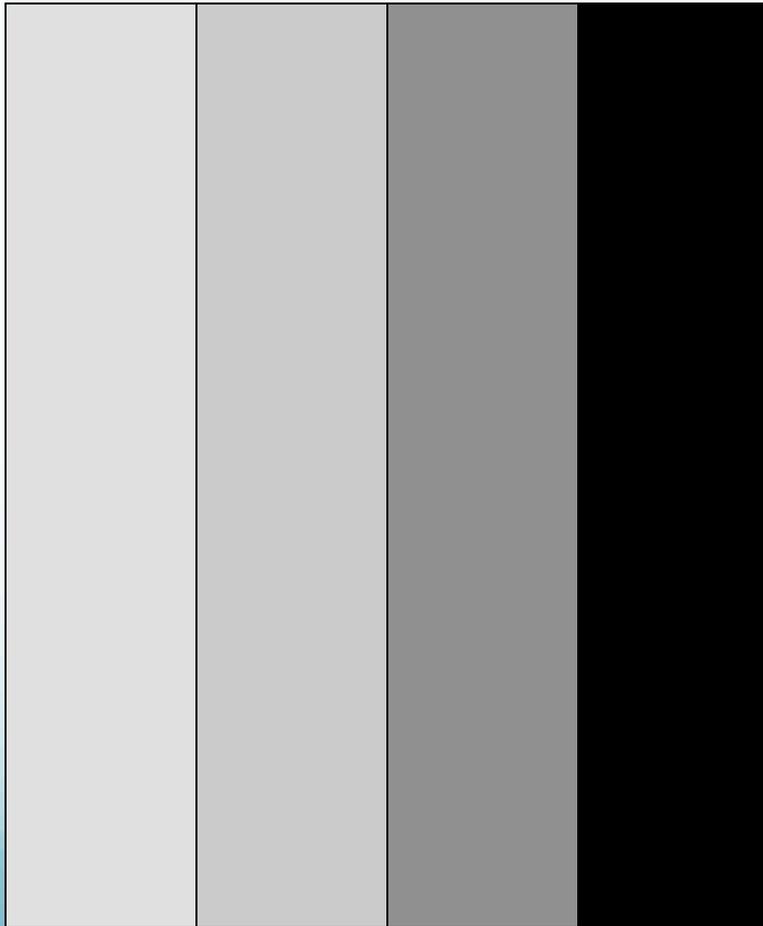


Category 3 - Black Water

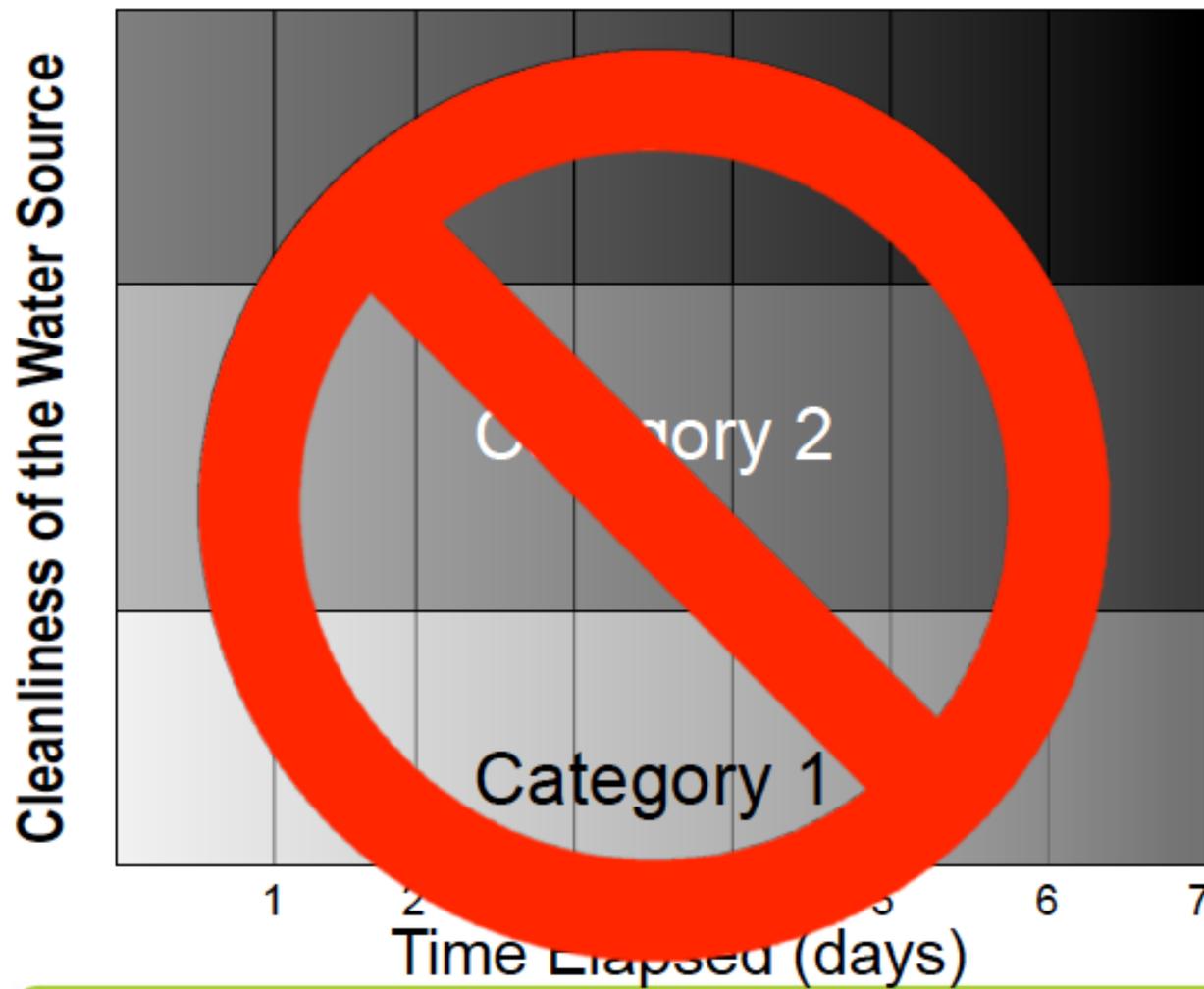


- Black water contains pathogenic agents and is grossly unsanitary. Black water includes sewage and other contaminated water sources entering or affecting the indoor environment.

Time and Temperature



Combined Category & Time Effect





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Principles of Restorative Drying

- Extraction
- Evaporation
- Dehumidification
- Temperature Control

Extraction



- Water removal
- Vacuum
- Sponge
- Towel
- Extract as much water as possible as this step speeds the drying process.

EXTRACTION



- S500 3rd Edition
- Up to 97% specialized extraction tools
- Average 85%
- Compare to wand at only 40%

RG Chapter 6 – Equipment, Instruments, and Tools

3rd Edition

Light Wand: A light wand is a non-weighted tool used for water extraction and carpet cleaning. It is simple in design but can be exhausting for restorers to use over prolonged periods and is best used for initial water removal. It is also good for follow-up extraction to remove residual water on the surface of carpets after stationary tools have extracted water from the pad/underlay.

- Light wand extraction effectiveness:
 - Poor for any carpet with pad in place
 - Fair for glue-down carpet or most other carpet after pad/underlay is removed
 - Good for low-pile carpet after pad/underlay is removed.

4th Edition

Light Wand: A light wand is a non-weighted tool used for water extraction and carpet cleaning. The light wand is an appropriate tool for initial water removal, extracting water from glue-down carpet and is also effective to remove residual water on the surface of carpets after stationary tools have extracted water from the cushion.

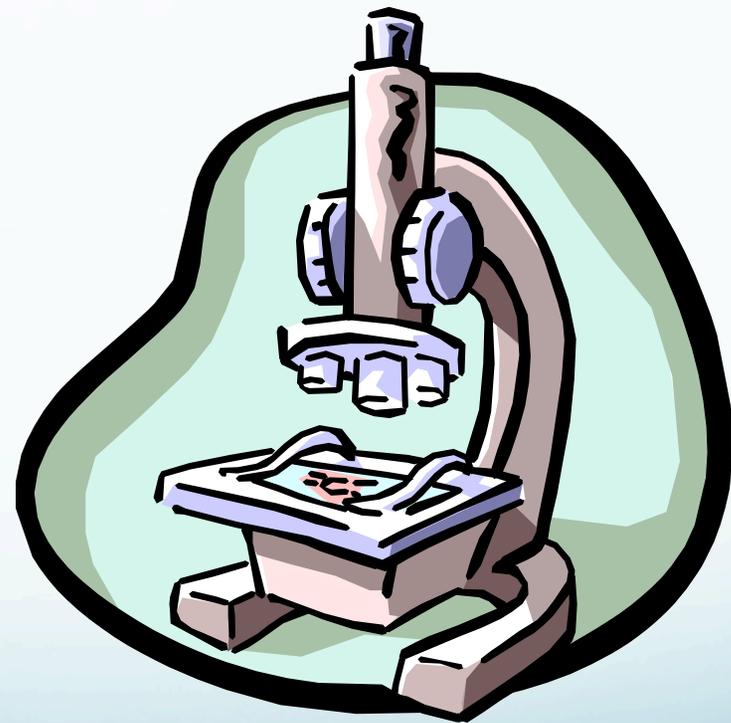
Temperature Control

- Control of temperature affects:
- Evaporation
- Dehumidification
- Growth of microorganisms



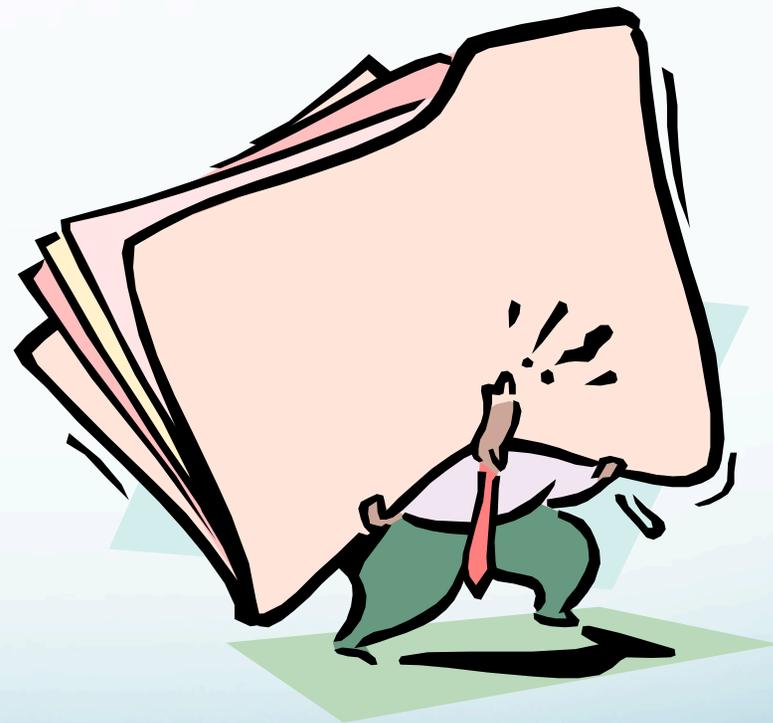
How Wet?

- Moisture meters
- Thermo imaging
- Thermo hygrometer
- Penetrating
- Non-penetrating
- Training



Record Keeping

- Daily records
- Inside
- Outside
- Air temp
- RH
- Affected surfaces
- Testing



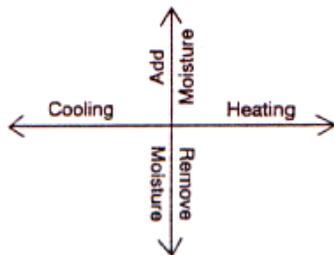
ACGIH

- “Effective remediation of water-damaged or microbial contaminated buildings involves (a) the use of appropriate techniques to promote rapid drying, and (b) complete removal of contaminated materials rather than the application of biocides without these steps”

Section 15.4 Biocide Use. “Remediators must carefully consider the necessity and advisability of applying biocides when cleaning microbially contaminated surfaces [see 16.2.3]. The goal of remediation programs should be removal of all microbial growth. This generally can be accomplished by physical removal of materials supporting active growth and thorough cleaning of non-porous materials. Therefore, application of a biocide would serve no purpose that could not be accomplished with a detergent or cleaning agent. Prevention of future microbial contamination should be accomplished by (a) avoiding the conditions that led to past contamination, (b) using materials that are not readily susceptible to biodeterioration, and (c) where necessary, applying compounds designed to suppress vegetative bacterial and fungal growth or using materials treated with such compounds.”

Psychrometric Chart

Barometric Pressure 29.92 Inches of Mercury



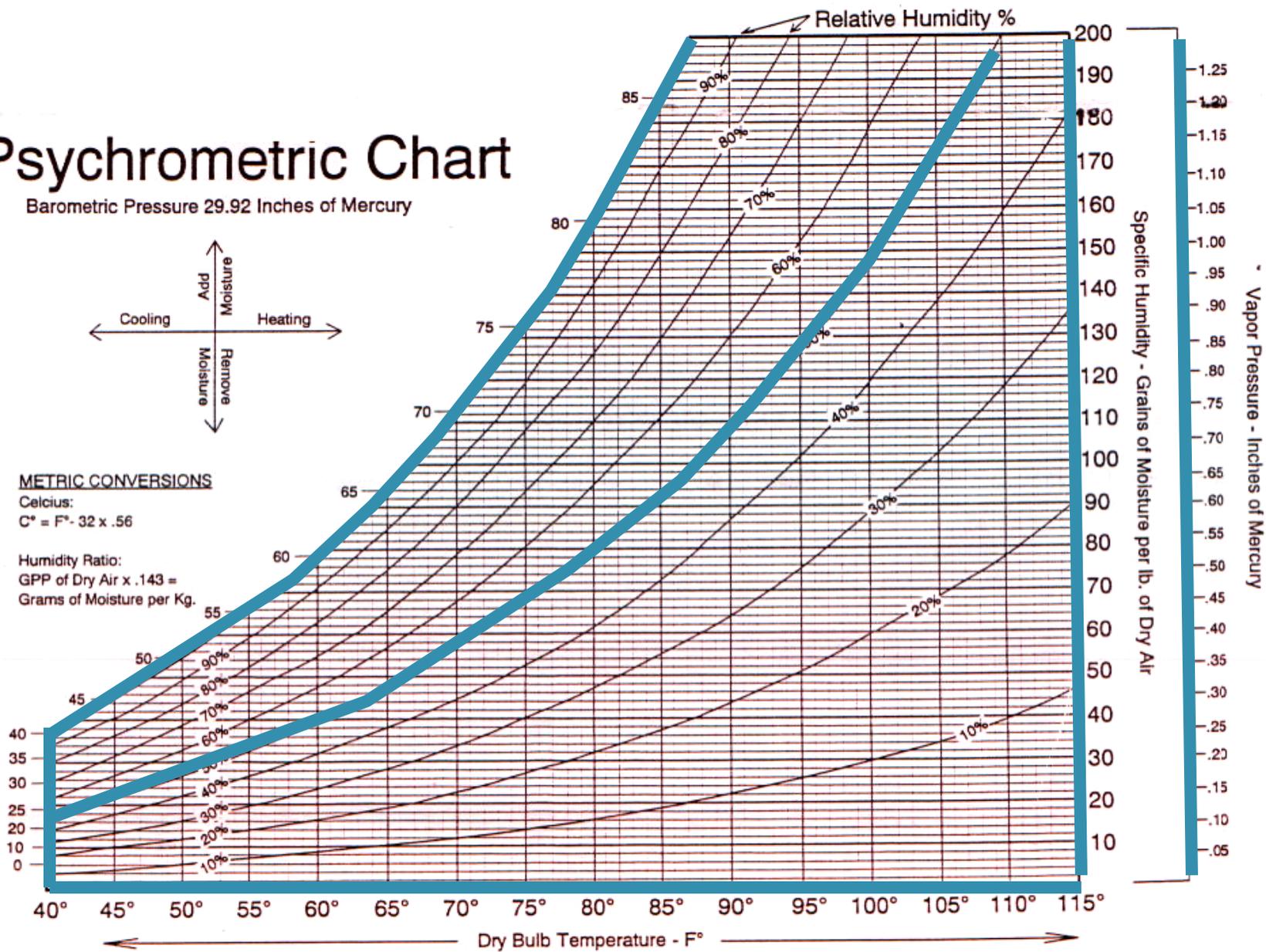
METRIC CONVERSIONS

Celsius:

$$C^{\circ} = F^{\circ} - 32 \times .56$$

Humidity Ratio:

$$\text{GPP of Dry Air} \times .143 = \text{Grams of Moisture per Kg.}$$



Air Movement - Evaporation



- Once moisture has been removed through a thorough extraction process - evaporation must take place.
- How many?

Air



Evaporation



from the surface



into the air



Psychrometry



Material



Moisture migration



in the material



to the surface



Drying Technology



Initial Airmover Calculation

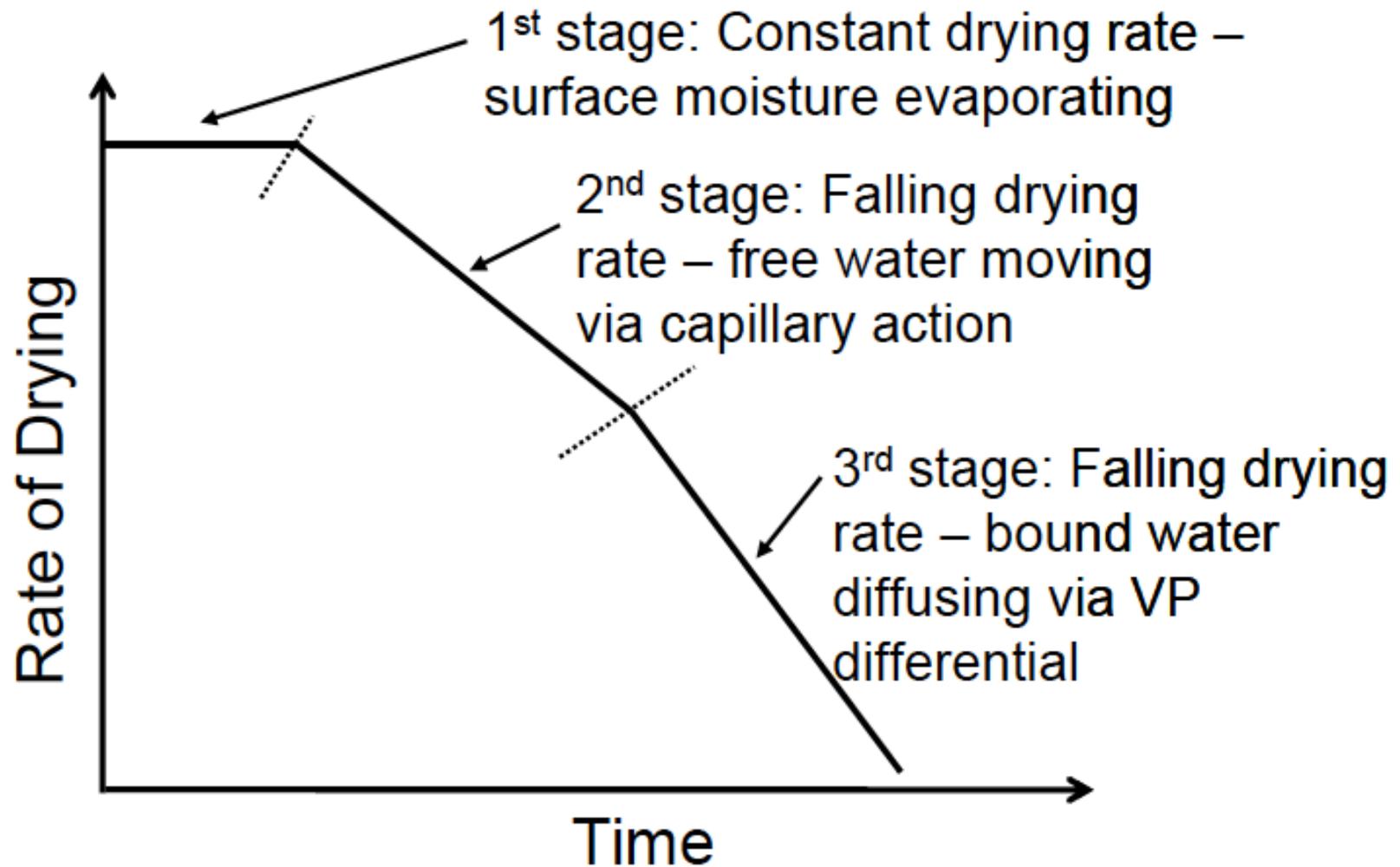
- Restorer should install one airmover in each affected room. In addition, one airmover:
- For every 50 – 70- SF FT of affected wet floor
- For every 100 – 150 SF of affected wet walls above approximately 2 feet and ceiling surfaces; and
- For each wall inset and offset greater than 18”

(IICRC S500 2015)

Initial Airmover Calculation continued

- In circumstances where water migration has primarily affected lower wall sections and limited flooring (e.g., less than 2' of migration out into the room area) restorers should install a total of one airmover for each 14 affected linear foot of wall.
- This calculation is independent of the SF calculation, and is not meant to be used in the same room or area. *(IICRC S500 2015)*

Drying Rate Stages



Typical Material Drying Curve

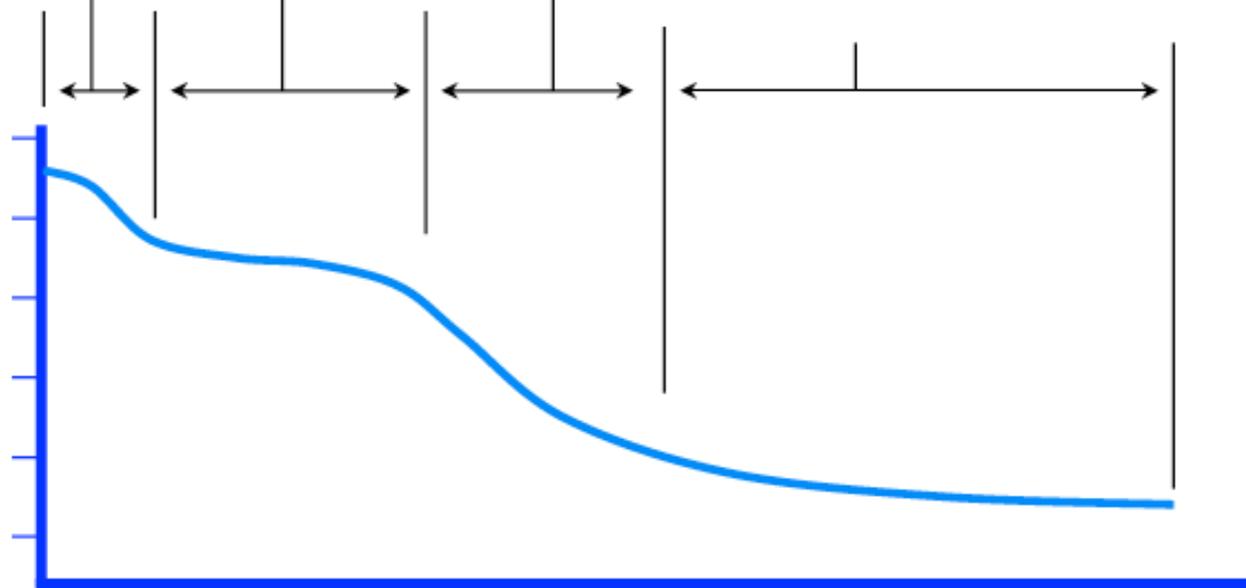
Surface Water

Water in pores

Moisture on
cell walls

Moisture held in cells by
chemical bonds

Moisture Content
(% of dry weight)



Time

13.5.6.1 Controlling Airflow (cont.)

When a calculation for a room or space results in a fraction, the indicated number of airmovers should be rounded up. In small rooms (e.g., closets, pantries under approximately 25 SF) a single airmover may be adequate, especially if upper walls and ceilings are not affected.

In Class 4 intrusions involving significant water absorption into low evaporation materials and assemblies, once surface water has been evaporated, vapor pressure differential should be increased (e.g., increase temperature of wet materials; reduce humidity of the surrounding air; or a combination of both). In these circumstances, it can be beneficial to decrease the velocity of airflow.



Initial Dehumidification Factors for Simple Calculation

Type of Dehumidifier	Class 1	Class 2	Class 3	Class 4
Conventional Refrigerant	100	40	30	N/A
Low Grain Refrigerant (LGR)	100	50	40	40
Desiccant	1 ACH	2 ACH	3 ACH	3 ACH

Detailed Calculation Factors

Build-Out Density

Building construction and finishes

Class of Water Intrusion

HVAC Impact

Prevailing Weather

13.2 Initial Restoration Procedures (cont.)

13.2.7 Determining the Class of Water Intrusion

Restorers should estimate the amount of humidity control needed to begin the drying process. The term "Class of water" as defined in Section 10.4.3 is a classification of the estimated evaporation load and is used when calculating the initial humidity control (e.g., dehumidification, ventilation). It is based on the approximate amount of wet surface area, and the permeance and porosity of the affected materials left within the drying environment at the time drying is initiated. Initial information to determine Class should be gathered during the inspection process. The Classes are divided into four separate descriptions: Class 1, 2, 3, and 4. The determination of class may be dependent upon the restorability of wet materials and access to wet substrates. Depending upon the project, this determination may occur at a different point of the initial restoration procedures.

Highlighted Changes – Class of Water Intrusion

Class of Intrusion	Description of “amount of water absorption and evaporation load”	Amount of “ <u>wet, porous materials</u> ...as a % of combined floor, wall & ceiling surface area in the space**”	Absorption into low evaporation materials or assemblies.
1	“least”	“less than ~5%”	“minimal”
2	“significant”	“~5% to ~40%”	“minimal”
3	“greatest”	“more than ~40%”	“minimal”
4	“deeply held or bound water”		“significant”**

* The drying environment (e.g. room, “chamber”)

**”Drying may require special methods, longer drying times, or substantial VP differentials”

Highlighted Changes – 13. Structural Restoration

- Significantly reworked the flow and procedures:
 1. In Cat 2 or 3 water contaminated losses, remediation should be done prior to aggressive restorative drying.
 2. Removal of wet, unrestorable materials should be done prior to aggressive restorative drying.
 3. Two examples of dehumidifier calculation methods (i.e. “Simple” and “Detailed” are offered.
 4. Airmover calculations based on amount of wet, affected surface area, which will provide needed air movement for all classes of intrusions.
 5. After “initial” installation of equipment (e.g. DH, airmovers, heaters) adjustments (i.e. increase, reduce, reposition) should be made based on monitored readings.

13.3.5 Humidity Control in Contaminated Structures

The priority for restorers is to complete remediation activities before restorative drying. However, the restorer should control the humidity in contaminated buildings to minimize moisture migration, potential secondary damage, and microbial amplification. Restorers should maintain negative pressure in relation to uncontaminated areas. Maintaining negative pressure in an affected area can increase the dehumidification capacity needed to maintain desired psychrometric conditions. This may be implemented before, during, or after decontamination. Restorers should limit the velocity of airflow across surfaces to limit aerosolization of contaminants. Restorers should complete the drying process after the remediation has been completed.



Dehumidification

- Removes water vapor from air
- Refrigerants
- Desiccants





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- Testing protocol for Refrigerant Dehumidifiers
- 80 degrees F at 60% RH for 24 Hours

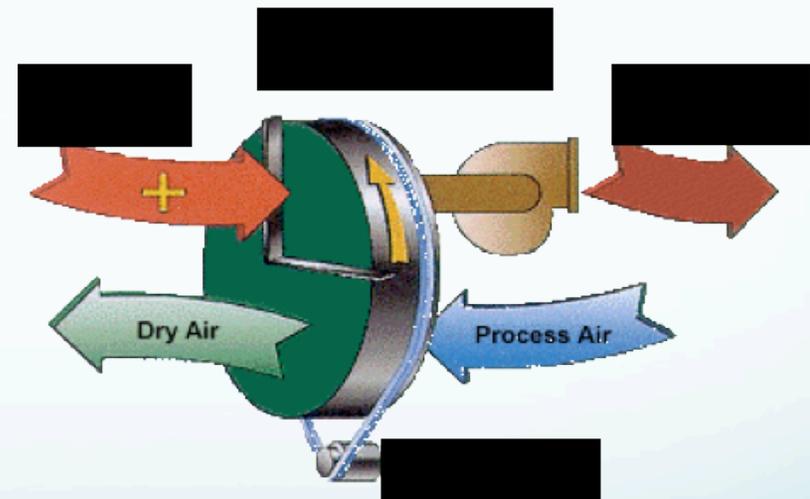
Refrigerant

- Work on condensation
- Conventional only go down to 55 GPP
- LGR lowest GPP
- LGR as low as 34 GPP



Desiccant

- Adsorption
- Absorption
- Sublimation (Solid to Gas)
- Creates Lowest Vapor Pressure
- Lowest GPP
- Units rated by CFM processed
- Cool air for regenerating



Drying Assemblies



Mold

- Millions of years
- Mold is everywhere
- It has a job



FUNGI

MOST MOLDS HAVE CELLS THAT ARE FILAMENTOUS. THESE CELLS ARE CALLED HYPHAE. COLLECTIVELY THEY FORM MYCELIUM.

- Divided into three groups.
- 1. Yeasts
- 2. Mushrooms
- 3. Filamentous fungi (mold)

WHAT IS A MICROBIAL CONTAMINANT?

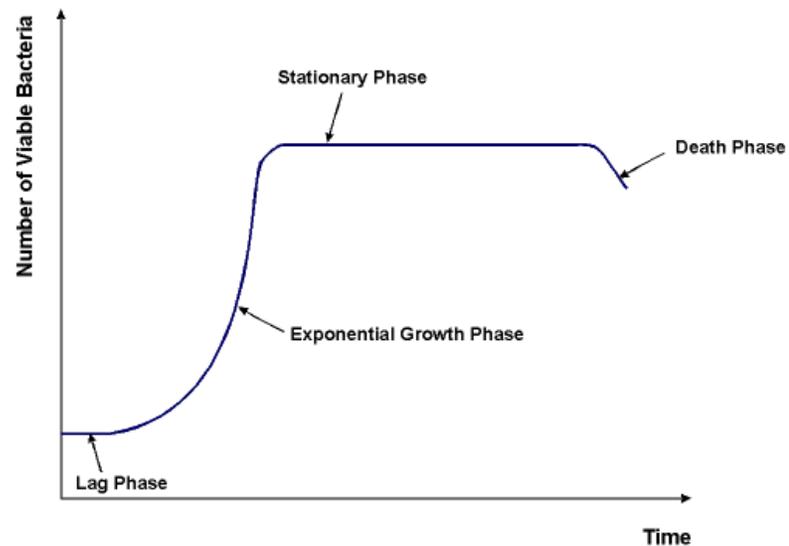
BACTERIA
FUNGI
VIRUS



Growth Criteria

- Ubiquitous
- Lag Phase
- Growth Phase
- Stationary
- Death

○ Microorganisms



From a Little to a Lot

Exponential Growth Phase

00:00	-	1
01:00	-	8
02:00	-	64
03:00	-	512
04:00	-	4,096
05:00	-	32,768
06:00	-	262,144
07:00	-	2,097,152
08:00	-	16,777,216
09:00	-	134,217,728
10:00	-	1,073,741,824
11:00	-	8,589,934,592
12:00	-	68,719,476,736
24:00	-	4,722,366,482,869,645,213,696

Allergies

- Some people exposed to mold become ill others are not affected
- allergy
- infection
- irritation
- toxicity



ACGIH

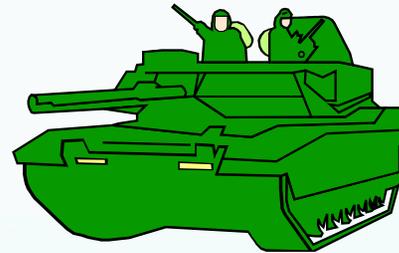
- From 1999 ACGIH Bioaerosols Assessments and Control
- -” At this present time, inadequate data exist to accurately predict the risk associated with human inhalation exposure to mycotoxins in the indoor environment.”

ACGIH From 1999 ACGIH Bioaerosol Assessment and Control

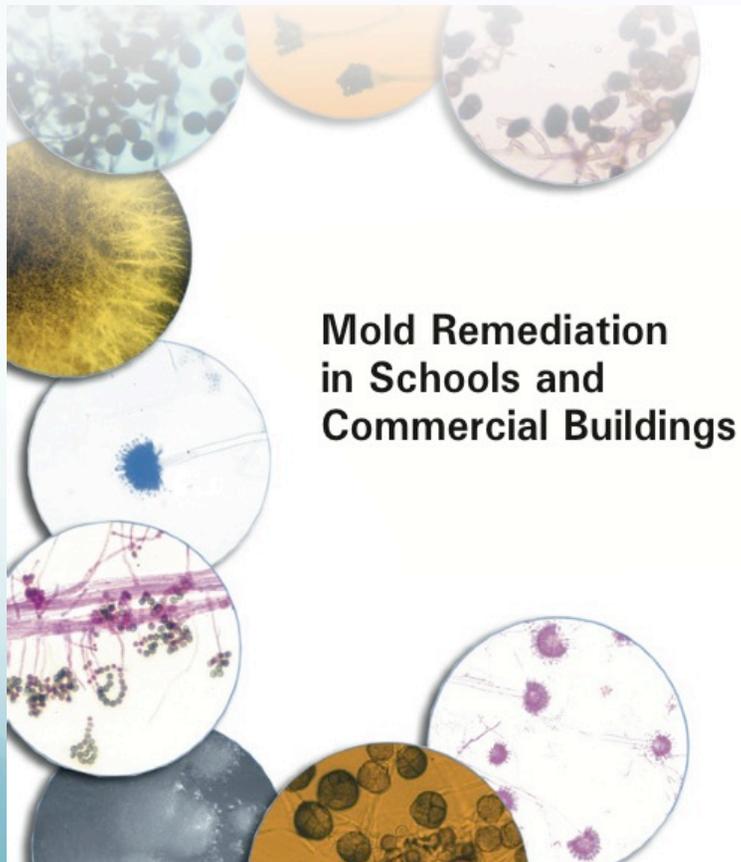
- -” Although ACGIH has given numerical guidelines for data interpretation in earlier documents (86,87,89), at the time of this publication, ACGIH does not support any existing numerical criteria for interpreting data on biological agents from source or air samples in non-manufacturing work environments.”

Endotoxins/Mycotoxins

- Mold in any quantity produces allergens
- Some secrete toxins
- mini warfare
 - Alive
 - Dead

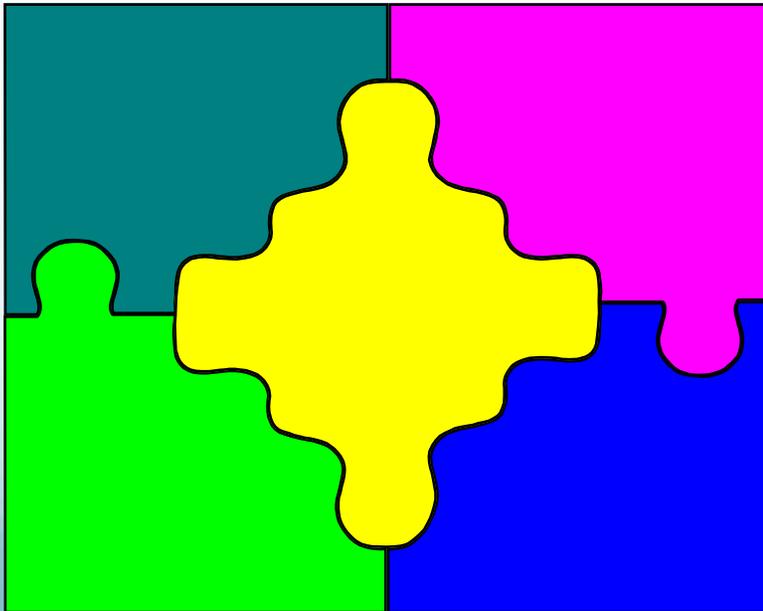


Guidelines



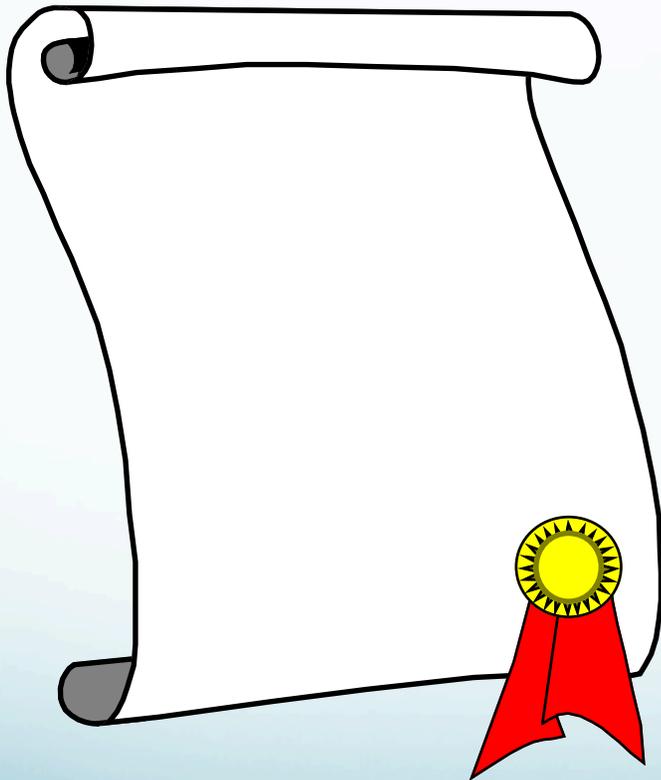
- EPA Mold Remediation in Schools and Commercial Buildings
- New York City Guidelines May 1993
- Revised October 2008
- IICRC S500 2015

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.

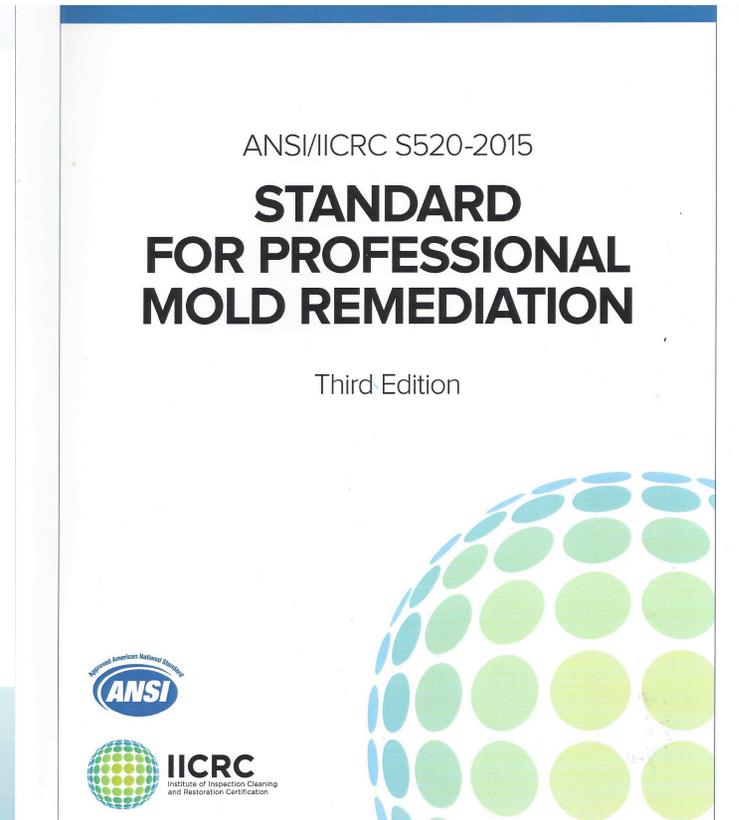
No Standards



- OSHA guidelines for the workplace
- 29 CFR Part 1910
- ACGIH
- CDC
- Covered loss?

IICRC S520 Mold Remediation Standard and Reference Guide

Procedural Standard and Reference Guide





S520 Preface

This document is written for use by those involved in the mold remediation industry, primarily for mold remediation companies and workers, and secondarily, for others who investigate mold complaints, write remediation specifications, protocols and/or procedures and manage remediation projects.

S520 Preface

IICRC S520 is presented in a two-part format: the procedural standard and a supplementary reference guide. The Standard is printed first within the document on colored pages, followed by the longer Reference Guide section.



- **Every mold remediation project has unique circumstances and thus it is impractical to issue specific procedures that universally apply to every situation**
- **In extenuating circumstances, deviation from portions of this standard may be appropriate.**
- **Carelessness is never acceptable and common sense and professional judgment are to be exercised in all cases.**



Normal Fungal Ecology

That which is reflective of the types and concentrations of molds typically found in non-water damaged, environmentally well-maintained structures, and reflective of the ecological and climatic elements of the geographical region in which the building is located.

Condition 1 (normal ecology)
– **may have** *settled spores,*
fungus fragments or traces of
actual growth **whose identity,**
location and quantity is
reflective of a normal fungal
ecology **for an indoor**
environment.

Not Always Obvious



“Condition 3”

- **Condition 3 (actual growth) – an indoor environment contaminated with *the presence of actual growth and associated spores.* Actual growth includes growth that is *active or dormant, visible or hidden.***



“Condition 2”

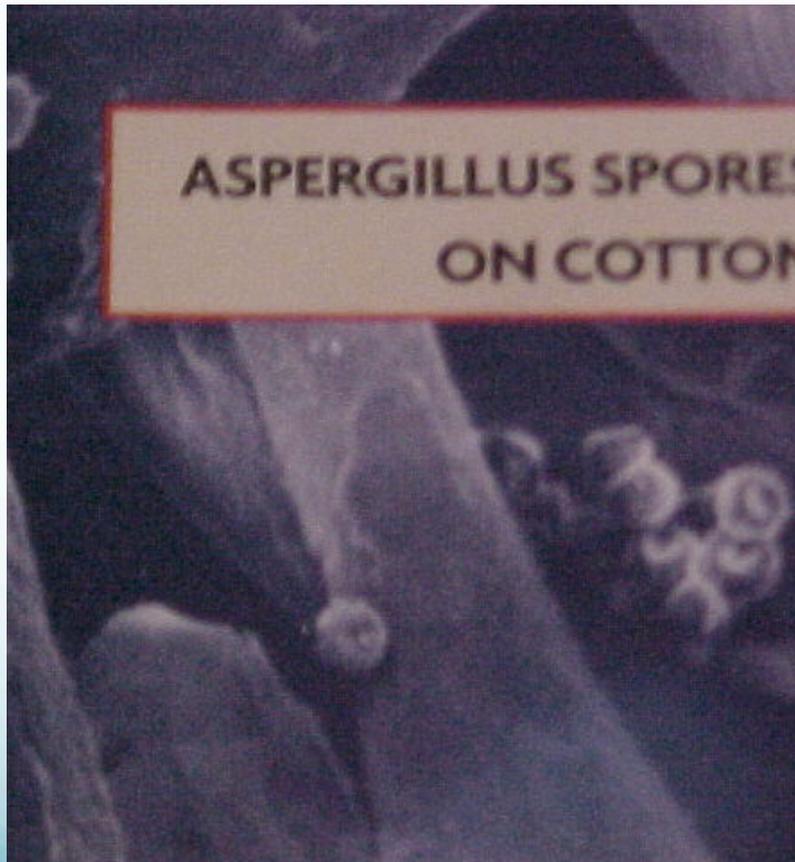
Condition 2 (settled spores) – an indoor environment which is primarily contaminated with *settled spores* that were dispersed directly or indirectly from a Condition 3 area, and which may have *traces of actual growth*.



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Aspergillus





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Stachybotrys chartarum (atra)



- Said to produce very potent mycotoxins.
- Mycotoxins are fungal metabolites that have been identified as toxic agents.
- A (usually) greenish-blackish slimy mold.



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Hygienist - Qualifications

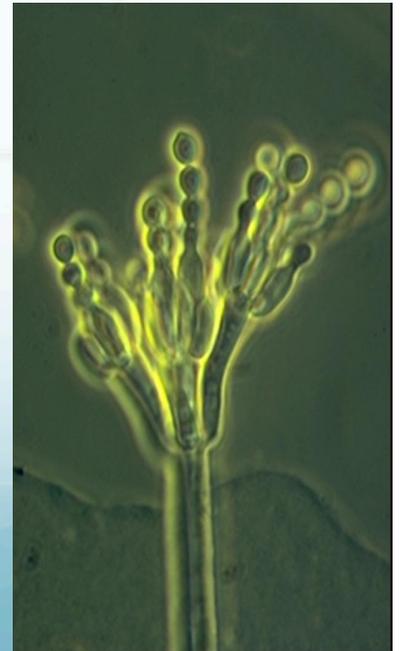
- CIH
- IH
- IEP
- Independent



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Study of Fungal Ecology of Non-Problem Homes in the North Eastern United States

Dan Bernazzani
Castleton State College



Background

- Mold is the common name for fungi that are ubiquitous on our planet and in our homes.

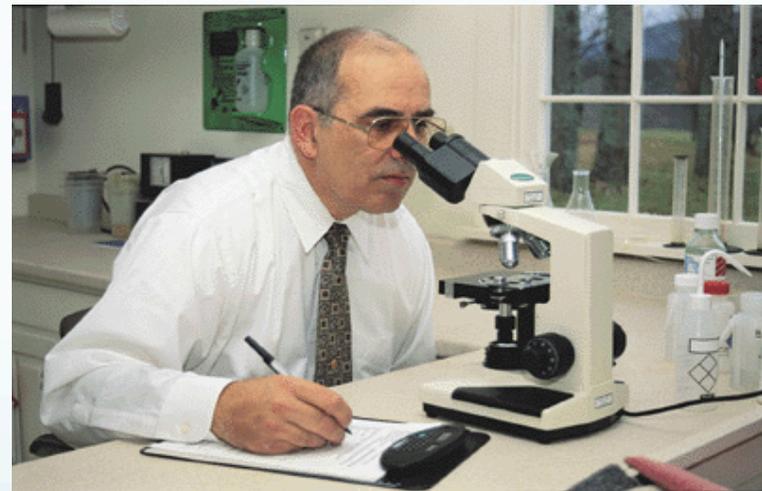


Objective

- Study 20 homes in Vermont, New Hampshire and Massachusetts.
- No known chronic moisture problems
- No building related complaints of illness.
- I expected to find a correlation between the types of fungi observed in outside versus inside air and surface samples.

Study Design

- Exterior Air Samples
- Interior Air Samples
- Tape lifts
- Swabs
- Dust collection



Collection 200 Samples





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Sampling Media & Equipment



Snow Cover



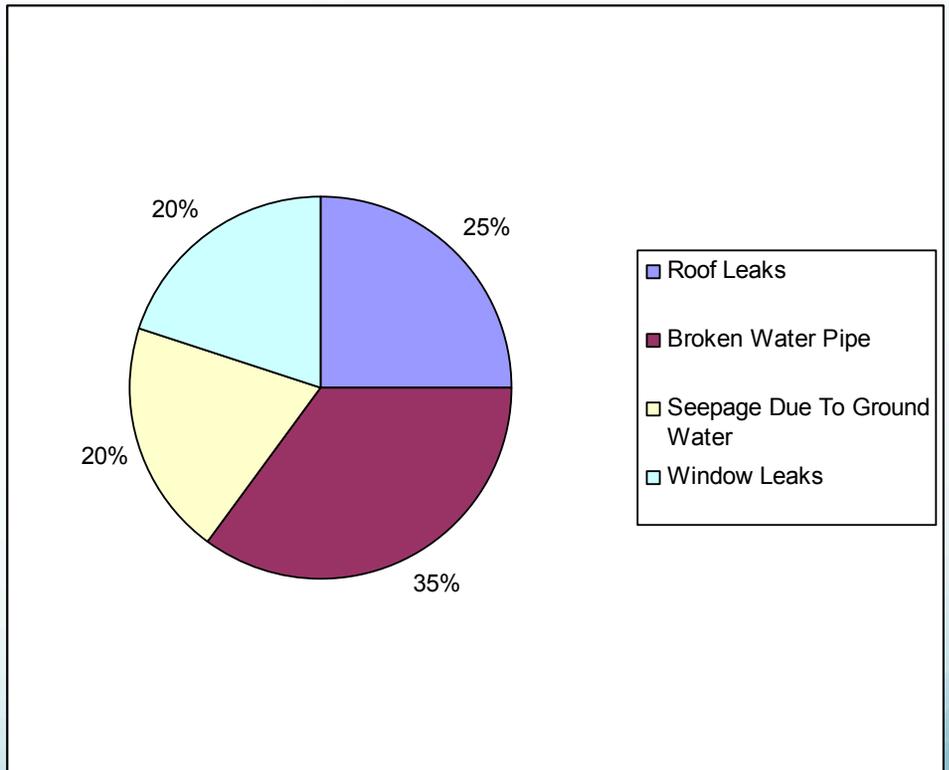
- During winter months:
- Conditions do not favor mold growth
- Lesser quantities outside = lesser quantities inside
- Cleaning removes spores
- Air pressure differentials



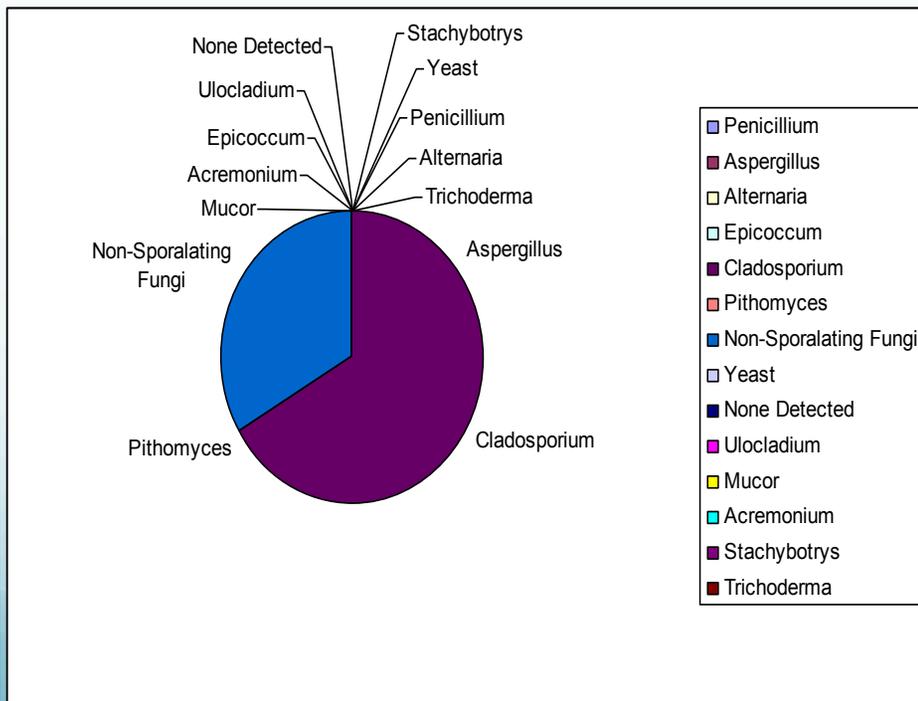
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North Eastern United States Study

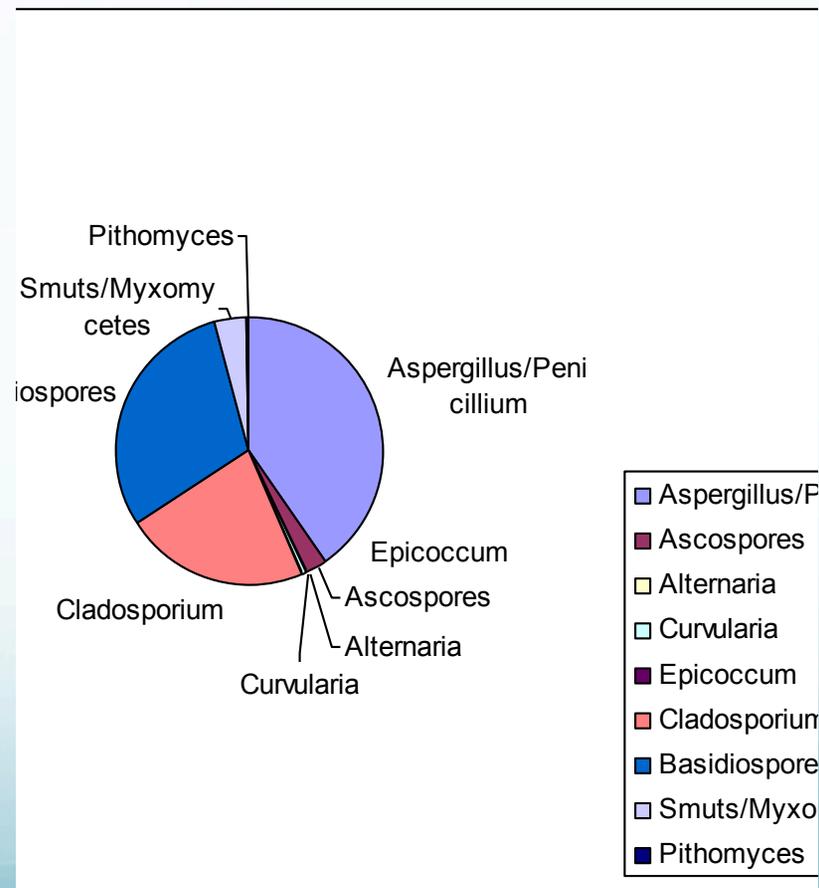
- Study Non problem Homes
- No water damage
- No building related complaints



Molds Observed in Viable Dust



Molds Observed in Air Samples



Hiding Place with Most Growth



Old MacDonald Had a Farm



- Most affected:
- Young children
- Immunocompromised
- Elderly



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Stachybotrys chartarum (atra)

- Despite 1993 + warnings/precautionary statements from CDC and NYC Health Dept. and despite some animal studies, subsequent reviews by CDC and other reputable medical/scientific organizations have not been able to make a connection between “Stacky” and health effects such as pulmonary hemorrhage in infants.

Colonization Rates

- Aspergillus sp 2-3 days
 - Penicillium sp 2-3 days
 - Coccidioides immitis 4----10 days
 - Stachybotrys atra 8-----12 days
-
- CFUs = Colony Forming Units



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Water Requirements

- Hydrophilic $>.90 a_w$
 - Mesophilic $>.80 a_w$ to $<.90 a_w$
 - Xerophilic $<.80 a_w$
-
- a_w = water activity

Growth Requirements



68⁰ to 86⁰ F

Food Source

Dark Area

Not necessarily

W
A
T
E
R

How Much is Too Much?



- Too much of anything can be harmful
- Salt, Oxygen, Dust, Water, Vitamins



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Common Indoor Molds

- Cladosporium
- Penicillium
- Alternaria
- Aspergillus



Mold Center for Disease Control

- “Mold does not always present health problems indoors”.
- It is not necessary...to determine what type of mold is present.. All mold should be treated with respect to potential health risks and removal”.



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TESTING

- WHEN
- HOW
- WHY



CDC Issues of Occupancy

- “Are there circumstances where people should vacate a home or other building because of mold”?

“These decisions have to be made individually. If you believe you are ill because of exposure to mold in a building, you should consult with your physician to determine the appropriate action to take.”

During Remediation



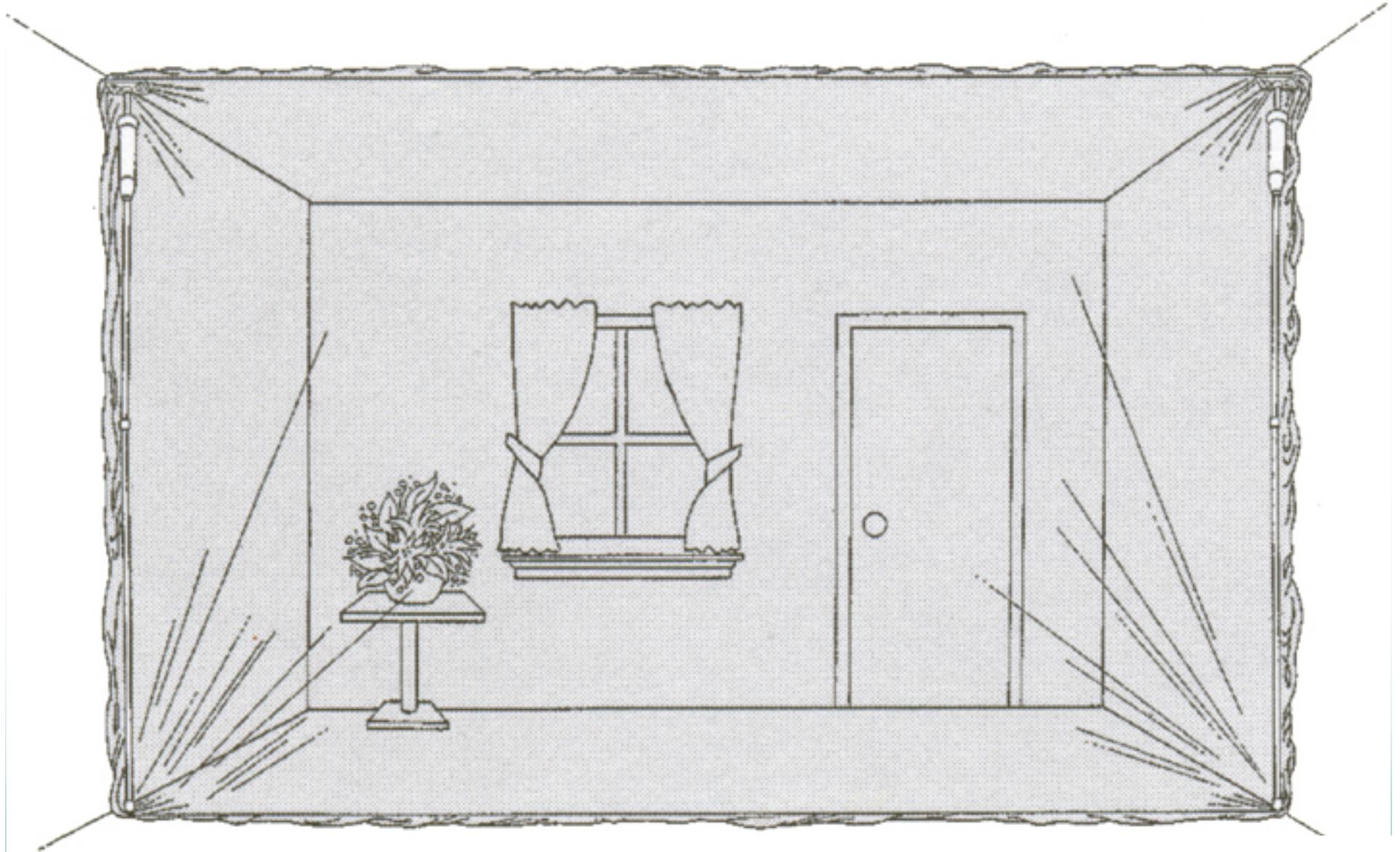
- Take precautions because of dust and debris
- Especially those with allergies, asthma, other lung conditions, children, elderly, immunocompromized

Containment Set-up

Determine necessity for and location of containment

- Verify HVAC and air conveyance system is sealed off or isolated.
- Prevents or limits cross-contamination.
- Determine if floors or ceilings should be contained
- Make containment large enough so that it doesn't have to be redone
- Caution about unintended back draft etc.





Temporary Containment

Containment



- FR Poly sheets
- Negative air
- Air Filtration Device (AFD)
- This should be done to control dust and debris

Remediators Should

Clean and inspect

- Exhaust air from HEPA AFDs should be vented outdoors.
- Seal the intake side before turning off
- Clean the exterior prior to removal



Structural Remediation

Removing Contaminated Structural Materials

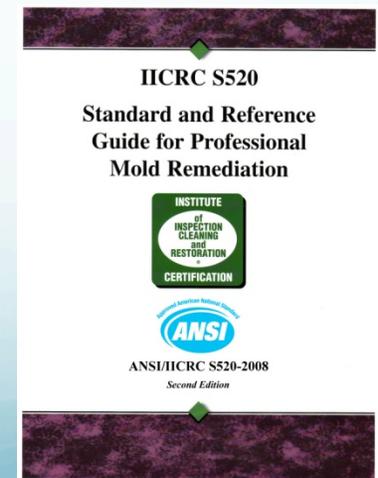
Remediation of building materials that are Condition 3 depends upon the materials porosity and susceptibility. Porous building materials (e.g., drywall, insulation, and ceiling tiles) that are Condition 3 should be removed and discarded.



Structural Remediation

Source Containment

Source containment may be used to address relatively small or limited areas of mold growth, or in combination with other engineering controls to reduce the amount of spore release and dust generation.



Mold Contamination

- A moisture issue
- Correct the source of moisture
- Remove porous contaminated materials
- Clean non – porous surfaces
- Attempts to kill or encapsulate are usually not effective.

Questions????????



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