

Water Damage Restoration Study Guide



GLOSSARY OF TERMS

ALLERGEN A substance that induces the hypersensitivity state of allergy and stimulates the formation of reaginic (type of antibody found in the serum and skin of allergically sensitive persons) antibodies.

ANTIGENS Substances that when introduced to the body is capable of stimulating an immune response, specifically activating lymphocytes, which are the body's infection-fighting white blood cells.

ANTIMICROBIAL An agent that limits or controls the growth of microorganisms (bacteria, fungi, viruses, etc.)

ASTHMA A medical condition marked by recurrent attacks of labored breathing and wheezing caused by spasmodic contraction of the bronchi.

BALANCED DRYING The point at which evaporation and dehumidification are balanced at optimum levels. In other words, more moisture is not being evaporated into the air than the dehumidification methods can remove.

BIOAEROSOLS "...Airborne particles that are living or originate from living organisms ... (i.e., culturable and dead microorganisms) and fragments, toxins, and particulate waste products from all varieties of living things." **ACGIH *Bioaerosols: Assessment and Control***

BIOCIDE A substance that kills living organisms, both pathogenic and non-pathogenic.

CATEGORY 1 "**Clean Water**" Water Source that does not pose substantial harm to humans

CATEGORY 2 “**Gray Water**” Water containing some degree of contamination. Has the potential to cause substantial discomfort or sickness if consumed by humans.

CATEGORY 3 “**Black Water**” Grossly unsanitary. Contains pathogenic (disease causing) agents.

-CIDE To kill, e.g., virucide, sporicide, fungicide, etc.

CLASS 1 **Slow Rate of Evaporation.** Affects only a portion of a room. Materials have a low permeance/porosity. Minimum moisture is absorbed by the materials.

CLASS 2 **Fast Rate of Evaporation.** Water affects the entire room of carpet and cushion. May have wicked up the walls, but not more than 24 inches.

CLASS 3 **Fastest Rate of Evaporation.** Water generally comes from overhead, affecting the entire area; walls, ceilings, insulation, carpet, cushion, etc.

CLASS 4 **Specialty Drying Situations.** Involves materials with a very low permeance/porosity, such as hardwood floors, concrete, crawlspaces, plaster, etc. Drying generally requires very low specific humidity to accomplish drying.

CLOSED (MECHANICAL) DRYING SYSTEM Using equipment to remove excess moisture from indoor air.

CROWNING A term used to describe the appearance of wood flooring strips that have *lost moisture* from the edges, leaving the *edges lower* than the center of the wood strip (plank).

CUPPING A term used to describe the appearance of wood flooring strips that have *absorbed excessive moisture* from the underside causing expansion of the edges, leaving the *edges higher* than the center of the wood strip (plank).

DELAMINATION The separation of the primary backing from the secondary backing of tufted carpeting.

DEW POINT The temperature at which the air becomes saturated with moisture and condensation forms.

DISINFECTANT A biocide that kills a broad spectrum of microorganisms, *but not all their spores*.

DRY BULB TEMPERATURE Temperature registered by thermometers with dry sensing bulbs.

DRY STANDARD Pre-determined drying goal based on the moisture content (MC) of structure in an unaffected area; pre-loss normal MC, or average MC for your particular area.

ENDOTOXIN Portion of the outer wall of gram-negative bacteria, such as e-coli, that can cause fever, increased airway resistance, raise white blood cell counts, shock and even death.

EQUILIBRIUM MOISTURE CONTENT Moisture Content (MC) of structural materials has stabilized in relation to relative humidity (RH) and temperature of surrounding air.

No more moisture can be absorbed at *that* temperature and humidity. Change the temperature and/or humidity and more moisture can be absorbed.

EVAPORATION Changing moisture from a liquid to vapor.

FUNGI (singular: “fungus”) Fungus includes molds, mildews, yeasts and mushrooms and most range in size from 2 – 20 microns.

Stage 1 of growth: **Spore** – seed-like bodies that allow survival of some microorganisms.

Stage 2 of growth: **Hypha** – As spores absorb moisture, they swell and elongate to produce thread-like structures.

State 3 of growth: **Mycelium** – Visible form of fungi. Mycelium is capable of producing additional spores. Mycelium stage generally causes destruction of its host material.

GRAIN DEPRESSION The difference between two specific humidity readings; i.e. outside SH and indoor SH.
Knowledge of grain depression needed in order to determine which drying system will be employed.

GRAINS OF MOISTURE Term used to express the weight of moisture per pound of air.
7000 grains of moisture equals one pound.
Water weighs 8.34 lbs. per U.S. gallon (128 ounces, 3.78 liters)
8 pints per gallon
7000 grains equals approximately one pint (16 ounces)

HVAC Heating, Ventilation and Air Conditioning system.

HYGROMETER Measures relative humidity

HYGROSCOPIC The ability of materials to absorb moisture. Hygroscopic materials change physically as they absorb moisture from humid air, often causing Secondary Damage.

HYPERSENSITIVITY The human immune system's exaggerated response to an allergen.

IEP An acronym referring to an Indoor Environmental Professional.

IICRC S500 “*The Standard and Reference Guide for Professional Water Damage Restoration*”, it is the Standard of Care for the water damage restoration industry.

IICRC S520 “*The Standard and Reference Guide for Professional Mold Remediation*”, it is the Standard of Care for the mold remediation industry.

INFILTRATION Seepage of moist air into a building through leaks in the building structure.

MICROBIOLOGICAL VOLATILE COMPOUNDS (mVOCs)

Volatile (evaporative) gases produced by microorganisms in their growth stage; e.g., the musty odor associated with mold growth, damp basements, etc.

MICRON Term used to measure microorganisms. One micron measures 1/1,000,000 of a meter

MICROORGANISM An extremely small life form that is visible only under a microscope.

MITIGATION To control or contain / make smaller
Loss Mitigation To control the cost of the loss and prevent further damage from occurring by taking reasonable and prudent steps to secure and protect the property from on-going damage.

MOISTURE CONTENT (MC) The amount of water by weight in solid materials, as compared to an oven dried sample of that material. The average MC in North America is 10%.

MYCOTOXIN A potentially harmful chemical compound produced by some forms of fungi to protect themselves against other microorganisms.

OPEN DRYING SYSTEM Exchanging humid air inside with dryer air outside.

OSHA Occupational Safety and Health Administration. United States

PATHOGEN A specific agent, such as a bacterium or virus, that causes disease.

PERMEANCE Measure of water vapor flow through material(s) of specific thickness.

PRIMARY DAMAGE Damage sustained by *direct* contact with water or contamination.

PSYCHROMETRY The study of the relationship between air, humidity (relative and specific), temperature and their effect on various materials and human health and comfort.

PSYCHROMETRIC CHART A graph showing the relationship between dry bulb temperature, humidity and vapor pressure. When two values are known (relative humidity and temperature), all other factors affecting drying can be determined.

RELATIVE HUMIDITY The amount of moisture in the air, expressed as a percentage of the air's total moisture holding capacity at a specific temperature.

SATURATION The point at which moisture vapor returns to a liquid condensate and/or materials will absorb no more moisture, *regardless* of increases in temperature.

SECONDARY DAMAGE On-going damage that results from absorption of moisture from abnormally high levels of humidity.

SENSITIZATION An allergic condition that usually affects the skin or lungs. Once a reaction occurs, further exposure may cause adverse reactions, even at lower exposure levels.

SPECIFIC HUMIDITY The actual amount of water vapor contained in air as expressed by weight (GPP – grains per pound).

SANITIZER An agent that reduces microorganisms to a safe level as judged by public health agencies. It is the lowest level antimicrobial.

SPECIAL SITUATION The term the IICRC S500 3rd Edition applies to a water damage containing regulated or hazardous materials.

-STAT To limit or control.

STERILIZER A biocide that kills all microorganisms *and their spores*. It is the highest level biocide.

SUBLIMATION The process of changing the state of a solid, such as ice, directly into a vapor (freeze drying).

VAPOR PRESSURE The force exerted by a gas (vapor) on its surrounding environment.
High seeks low.

VAPOR BARRIER Materials through which moisture can not easily penetrate and pass through (permeance factor of 1 or less)

VENTILATION Exchange of air from one area to another. Usually *from* inside *to* the outside.

VIRUS Parasitic submicroscopic organisms (0.03 – 0.25 microns) that lack the energy generating enzyme systems necessary to reproduce independent of living host cells. Most are pathogenic. Over 120 different viruses exist in human urine and feces.

WRT Study Guide

Category of Water: Describes the **CONDITION** of water as it relates to health.

- Category 1 (a.k.a. “clean”) - originates from a sanitary water source
 - Does not pose a substantial health risk if consumed
- Category 2 (a.k.a. “gray”) – contaminated; has to potential to cause discomfort or sickness
 - Cat 1 source over 72 hours untreated
- Category 3 (a.k.a. “black”) – grossly contaminated; includes toxins, pathogens
- Special Situations – regulated or hazardous materials

Class of Water: The **AMOUNT** of water, as well as materials affected. Has nothing to do with the condition (cleanliness) of the water loss.

- Class 1 – a portion of the room affecting materials of low permeance (dense materials)
- Class 2 - larger amount of water, absorption and evaporation. Affects a whole room of carpet; cushion. May affect walls up to 24” high.
- Class 3 – greatest amount of water, absorption and evaporation. Usually from overhead, affecting ceilings, walls, insulation and flooring.
- Class 4 – specialty drying – (hardwood; plaster; concrete) – deep pockets of saturation
 - Requires specialty drying equipment and techniques

Principles of Drying: Remove the access – extraction is most efficient. The amount of water remaining after extraction is a greater factor in the drying process than the amount of water removed. Remaining must be removed by evaporation and dehumidification.

Extraction tools:

- Light wand – perimeter of water loss; extract glue-down carpets;
- Stationary tool (Water claw) – subsurface tool; extract carpet and cushion – deep extraction
- Self-propelled tools (Rover; Xtreme Xtractor) – Self-propelled tool; multi-speed; extract carpet and cushion – deep extraction
- Vacuum squeegee – concrete; hardwood; vinyl; laminate;

Evaporation tools:

- **Airmovers** – centrifugal (laminar); axial (high-amperage; low amperage; focus ability)
 - placement – 1 for every 10-16 linear ft. of wall area; 15-45 degree focus; almost touching wall
 - safety screens – intake and output areas; clean with compressed air; do not block intake
 - electrical safety – lightweight extension cords; three-prong plugs; maintain electrical cord safety
- **Structural Cavity Drying Systems (SCDS)**
 - vented (turbovents 18”-48” widths; Octidry; Air Wolf)
 - injected (Injectidry; Dri-Force; Direct-it In)
- **Floor Drying Systems**
 - vented (Air Wolf)
 - injected – negative air mats (Dri-Force; Injectidry)
- **Air Filtration Devices** – AFDs (negative air machines; air scrubbers; HEPA filters)

Dehumidification equipment: AHAM rating – pints removed at 80° F / 60% RH in 24 hours

Type**Reduced Performance**

Type Dehumidifier	Temperature	Relative Humidity	Specific Humidity (gpp)
Standard refrigerant	68° F. / 20° C	60%	55-60
Conventional	33° F. / 1° C	40%	55-60
Low Grain Refrigerant (LGR)	40° F. / 4° C	30%	28-35
Desiccant (with silica gel)	32° F. / 0° C – below	10% - below	10-15 - below

- **Refrigerants** – Most efficient operating conditions 70° - 90° F. (most energy efficient)
- **Desiccants** – most efficient with incoming air from coolest/driest air possible; capable of creating pressure differentials; produces low specific humidity required to dry Class 4 materials
- **Uses** - closed-drying environments; multiple layers of materials; security limitations; high outside (and inside) humidity conditions; no ventilation ports; basement areas

Initial dehumidification calculations (psychrometric readings dictate further requirements after first day)

Type	Class 1	Class 2	Class 3	Class 4
Conventional	100	40	30	N/A
LGR	100	50	40	50
Desiccant	1 ACH	2 ACH	3 ACH	2 ACH

Electrical / Heat / Energy:

- **Amperes** (amperage or “amps”) – the amount of electricity (current) flowing in a circuit
- **Voltage** – the force of electricity flow in a circuit
- **Watts** – the amount of electricity an electrical device uses when operating
- **British Thermal Units (BTUs)** – heat generated by electrical device
 - **Formula** – amps x volts x 3.4 = British Thermal Units (Btu) per hour
 - **HVAC** – unit removes 12,000 Btu per ton
- **Residential vs. commercial** - generally, residential 15 amp / commercial 20 amp
- **220 splitters** – use where there is limited amperage or fuses
- Use no more than 80% of available amperage on a circuit.
 - 15 AMP service can safely use 12 amps, or three 4-amp airmovers at one time.
- **Cost of Power consumption** formula – *amps x volts (drying equipment is always 115 volts) = watts ÷ 1000 x 24 hours = kilowatt per day x cost per kilowatt = cost of power per day per unit.*

Inspection equipment:

- **Moisture sensor** – senses moisture in materials over 17% MC; helps *determine perimeter of water damage* in carpet and cushion. Unable to determine which layer is wet or when dry
- **Thermo-hygrometer** – determines temperature / Rh in all required atmospheric areas of inspection; helps determine open or closed drying system; further determines dehumidifier requirements after initial placement
- **Moisture meters** – invasive and non-invasive; used to establish, monitor and determine a drying goal.

Chemicals / biocides (antimicrobials)

- Sterilizer
 - Highest level of activity
 - 100% kill
- Disinfectant
 - 99.999% effective
- Sanitizer
 - Lowest level of activity
 - 99.9% effective
- Provide written informed consent to customer; advise occupants to leave during application; document
- EPA – Environmental Protection Agency (U.S. federal agency with regulatory control over biocides)
- F.I.F.R.A. – Federal Insecticide, Fungicide and Rodenticide Act – U.S. federal regulations administered by EPA
- Use only EPA registered disinfectants – document application details; apply only per label directions

Floorcovering carpet:

- **installation methods** – stretch-in, direct glue-down, double glue-down
- **drying methods** – in-place, full float, partial float
- **construction** – woven – Axminster, Wilton; usually natural fibers; tufted – primarily synthetic
- **delamination** – separation of primary - secondary backings; laminate strength loss up to 85% when wet; regains integrity when dried, if dried properly
- **Category 3** – must remove and dispose;
 - **High Value Area Rugs** – exception: IEP (Indoor Environmental Professional) may be required for testing after cleaning by submersion and decontamination.

Floorcovering cushion (also known as padding, underlay):

- **types** – foam (prime, bonded urethane); rubber; felt (hair/jute, synthetic); porous and non-porous
- **Category 2 and 3** - must remove and dispose;

Floorcovering wood (strip wood, plank wood, engineered – laminated wood, parquet)

- non-destructive (non-rotting) fungal growth - over 16% MC
- destructive (dry rot) fungal growth – over 20% MC
- fiber saturation (wet rot) – 30% MC
 - Wood does not appear to be wet below 30% MC
- damages from moisture
 - Cupping – water absorption from below planks
 - Edges are higher than the center
 - May be reversed *in most cases* during the drying process
 - Crowning – finishing flooring prior to proper drying and acclimation time
 - Center is higher than the edges
 - Buckling and Heaving – permanent damage – non-correctable
- dry within 2-4 percentage points of EMC

Floorcovering

- Laminate and Vinyl flooring
 - Must be removed if water infiltrates under flooring
- VCT Tile
 - Possible asbestos content
- Ceramic Tile and grout

- Water does not affect ceramic and grout
- Subflooring materials may need to be addressed

Microbiology (fungus; bacteria; virus)

- **conditions for growth**
 - organic food source (cellulose)
 - moisture (or 60% humidity or higher)
 - temperature (most prolific 68-86° F. / 20-30° C.)
 - stagnant air
 - time (some 1-2 days; others up to 10-12 days in chronic conditions)
- **ANSI/IICRC S520** – Standard and Reference Guide for Professional Mold Remediation
- Indoor Environmental Professional (IEP) – specialized experts may be required
- Mycotoxin – a chemical emitted by some molds as a defense mechanism against other mold species.
 - *Potentially* health threatening
- Endotoxin – a portion of the outer cell wall of some gram-negative bacteria, such as E-coli. When ingested or respired, endotoxins can cause fever, changes in white blood cell counts, increased airway resistance, shock and even death.

Balanced drying characteristics:

- Humidity, airflow and temperature (*HAT*) in proper proportions.
- *HAT* all influence movement toward equilibrium – wet seeks dry; hot seeks cold; high vapor pressure seeks low vapor pressure
- Specific Humidity (ratio), DewPoint and Vapor Pressure all directly related to each other
 - As one increases or decreases, all others also do correspondingly.
- As heat is applied to a material, energy is added, increasing the movement of water molecules, which increase the rate of evaporation (ice to water to boiling to steam)
- Open drying – intentionally exchanging indoor with outdoor air without using dehumidifiers
 - requires constant monitoring; above 80°F./ 27°C. – microbial growth highly probable
 - requires rapid exhausting of wet air; concerns of reaching dew point temperature
 - Most important consideration – Security. Leaving a structure unsecured (open windows, etc. could be our liability)
- Closed drying – use of mechanical dehumidification
- Combination Drying System – Intentionally using dryer outside air while technicians or homeowner is there to monitor security and then closing the structure, continuing to dry by mechanical means.
 - A quick “flush” upon arriving at the job site, then closing up the structure
- Heat drying systems – creates lower Rh; requires rapid and massive ventilation of wet air to the exterior; increases rate of evaporation by increasing the surface temperature of wet materials