

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION PRESERVATION PROGRAMS

The information provided below is intended for emergency recovery and response, not general treatment recommendations.

GENERAL INFORMATION ON DRYING THE ENVIRONMENT AND WET MATERIALS

Many criteria affect the choice of a drying method during recovery efforts. Among these are:

- Ability to appropriately stabilize the environment in order to begin recovery efforts
- Scale of damage and number of items affected
- Best drying method depending on type, format, and volume of material
- Costs of recovery using various drying methods
 - Air drying
 - Freezer Drying
 - Dehumidification drying
 - Vacuum freeze drying
 - Vacuum thermal drying
 - Thermaline or Cryogenic drying

Stabilization of the environment

Stabilizing the environment is critical, since most wet materials are subject to mold growth after only 48 hours.

Temperature and humidity

- Keep temperature and humidity as low as possible to reduce the risk of mold growth
- Leaving materials more than 48 hours in temperatures above 70 degrees Fahrenheit and a relative humidity above 60 percent without good air circulation will likely result in mold growth
- Try to keep temperatures lower than 70 degrees F and RH lower than 50%
- Remove any standing water using mops, wet vacuum cleaners or other equipment
- Remove any wet building materials such as soaked carpets and furniture

Building systems

- The season, weather, and condition of building systems will affect how quickly temperatures and relative humidity can be controlled
- Reduce the temperature - In winter, turn the heat down
- In summer, keep air conditioners on 24 hours a day and maintain temperatures lower than 70 degrees F
- In the case of water damage, do not be tempted to turn up the temperature to "dry" materials out - this just encourages mold growth

- Run the system fans continuously to encourage air movement throughout the facility and in rooms housing wet materials
- All wet carpeting and furniture should be removed from areas where materials are air-drying and/or being packed for drying offsite

Use of fans and dehumidifiers

- Water-soaked materials should be kept as cool as possible and good air circulation should be provided until they can be stabilized
- The objective is to avoid pockets of stagnant air and to reduce moisture content
- Create maximum air flow through all affected areas by opening doors and windows
- If electrical facilities are operational, use as many fans as can be acquired to create a current of air so directed as to expel humid air from the building
- Train fans into the air and away from any drying records
- Keep fans on 24 hours a day
- Use dehumidifiers together with air conditioning and a good air flow to maintain humidity at or below 50 percent
- Fans and dehumidifiers should be kept running until the relative humidity has stabilized and remains at 35% for several days
- Dehumidifiers work best in smaller spaces where doors and windows can remain closed
- Dehumidifiers may raise temperature slightly
- If power is out, bring in portable generators to power the equipment

Contract services with vendors

- Many vendors provide building restoration services, such as water extraction, building dehumidification using industry grade dehumidifiers, water damage recovery to the building fabric, debris removal, HVAC decontamination, mold mitigation, etc. to help stabilize and restore the building environment. (These vendors also provide drying services for paper and other formats). Selected vendors are listed at:

<http://www.archives.gov/preservation/disaster-response/vendors.html>

Drying Methods for Books and Paper Documents

Selection of drying methods(s) will likely depend on number of items damaged and the type/format of the material. The following approaches to drying are for paper and books. See each separate audio/visual/photographic format for drying methods for these materials.

Air-drying

Most suitable for small numbers of damp or slightly wet books and documents. If air-drying large quantities, materials can be frozen and later thawed in manageable amounts in order to be air-dried as time and resources permit.

- Requires no special equipment
- Materials remain accessible and onsite

- Labor intensive
- Occupies a great deal of surface space
- Can result in badly distorted bindings and text blocks that may later need to be rebound
- Will likely require additional shelf space
- High risk of mold development during drying
- Drying time varies
- Not recommended for soaking wet materials
- Not recommended for coated papers

- Air-drying must take place in a cool, dry place
- Air-drying rooms should have the capacity to maintain a constant relative humidity of 25 - 35% (or at least below 50%) and a temperature of between 50 and 65 degrees F
- Air circulation should be constant, and may be aided by the use of portable fans
- Dehumidifiers may be used but must be maintained daily and will only work in smaller, enclosed spaces

- Air-dry materials indoors if possible
- Sunlight may cause some materials to split, warp or buckle
- Prolonged exposure to direct sunlight may fade inks and accelerate the aging of paper

Freezer Drying

- Uses a self-defrosting blast freezer
- Ideal for small quantities of damp to moderately wet books and documents
- The temperature in the freezer must be maintained no warmer than -10 degrees F
- Materials should be placed in the freezer as soon as possible after becoming wet
- Books should be firmly supported to minimize swelling
- Small numbers of leather and vellum bindings can be dried successfully this way
- This method can take several weeks to many months, depending upon the temperature of the freezer and the extent of water damage
- Not recommended for coated paper
- If materials are frozen shortly after they become wet, additional shelf space will be held to a minimum

Dehumidification drying

- Uses large commercial dehumidifiers onsite to stabilize environment
- Introduces dry air at very low humidity (below 15%) into the environment and circulates the dry air using fans
- Air temperature can rise to 79 – 99 degrees F
- Often used when there has been extensive water damage to building structure itself
- Suitable for damp, not wet materials
- Materials remain onsite and accessible
- Leaves collections in place, on the shelf and in storage containers
- More suitable for drying large quantities of damp materials than air-drying
- Not safe for water-soluble inks/pigments
- Drying may be complete in several days

Vacuum freeze-drying

- Ideal for large quantities of wet books and paper
- Recommended for coated paper and water-soluble media
- Minimizes distortion – however, materials come out of freeze drying exactly as they went in – best results are achieved if packing is done properly prior to freezing
- Materials must be kept frozen before and during drying - the logistics of keeping materials frozen during transport is an additional cost factor
- No access to records during drying
- The process:
 - Frozen books and records are placed in a vacuum chamber
 - The vacuum is pulled, a source of heat introduced, and the collections, dried at temperatures below 32 degrees F, remain frozen
 - The physical process known as sublimation takes place: ice crystals vaporize without melting
- If materials have been stabilized quickly after becoming wet, very little extra shelf or storage space will be required when they are dry
- Drying may take 1-2 weeks

Vacuum thermal drying

- Good for books and records that are slightly to extensively wet
- Materials can be placed into chamber either wet or frozen
- Vacuum is drawn, heat is introduced, and the materials are dried just above 32 degrees F
- Materials stay wet while they dry
- No access to records as drying is done offsite
- Often produces extreme distortion in books
- Not recommended for coated paper
- Extensive rebinding of books should be expected, as should the need for expanded shelf or storage space

Thermaline or Cryogenic drying

- Intended for manuscript and rare book collections bound in leather and vellum
- Uses blast freezers at very low temperatures
- Minimizes distortion of materials
- Safe for coated papers and water-soluble media
- More expensive than vacuum freeze drying
- Long drying times
- No access to records as drying is done offsite

Description of drying methods above taken from *The Efficacy of Various Drying Methods*, by Hilary A. Kaplan and Kathleen A. Ludwig, Document Conservation Laboratory, National Archives and Records Administration, available at <http://www.archives.gov/preservation/disaster-response/drying-techniques.html>

and also from *Emergency Salvage of Wet Books and Records*, by Sally Buchanan, Preservation Leaflet 3.6, NEDCC, available at http://nedcc.org/resources/leaflets/3Emergency_Management/06SalvageWetBooks.php.

The information and links provided by NARA are offered as a service and do not imply endorsement of any company, institution, or person. The scale of the

emergency and types of materials affected will determine the specific actions or techniques to be taken and whether in house salvage is possible or whether external resources and expertise are necessary.