



CCAHA specializes in the treatment of art and historic artifacts on paper and provides preservation education, training, and consultation. Established in 1977, CCAHA is the largest nonprofit conservation lab in the country.

## Freezing and Drying of Book, Paper and Photographic Materials

The following definitions have been compiled from CCAHA Disaster Recovery bulletins: *Salvaging Books*, *Salvaging Art on Paper*, and *Salvaging Photograph Collections*. Please see the individual salvage brochures for instructions and detailed discussions about the pros and cons of the various methods in relation to the particular class of materials. The bulletins are available in PDF format at:

<http://www.ccaha.org/publications/technical-bulletins>

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### Preliminary Considerations

Because there is no standardized terminology for drying methods among disaster recovery vendors, beware of semantic confusion. Terms like vacuum thermal-drying, dehumidification-drying, and freezer-drying may be unfamiliar to vendors, or they simply may use another term. Before calling a service provider, be sure you can explain the service you are seeking. This is particularly important with services like freeze-drying; the term could correctly be used to refer either to drying through sublimation or to freeze-thaw-evaporative-drying in a vacuum chamber (listed here as vacuum thermal- drying.) While the term freeze-drying can be used to describe both processes, the second option can have very different and potentially negative results on collections materials.

Before contracting with a drying service, there are important preliminary considerations.

- If you are unfamiliar with the drying service a vendor offers you, ask for a detailed explanation. Take good notes and be sure you understand and are satisfied with the process before you agree to anything.
- Document the disaster in photographs and in writing. This is important both for insurance claims and to establish the condition of the collection before the contracted service. Document the collection's condition both immediately after the disaster and before the collection is turned over to a drying contractor. The documentation should include condition, appearance, and presence of mold.
- Write a letter of agreement to be signed both by you and the contractor that details the services to be provided, stipulates that frozen materials will not be allowed to thaw before drying, and states when the materials are to be returned.

RECOVERY METHOD	DEFINITION	ADVANTAGES	DISADVANTAGES	APPROPRIATE WITH THESE MATERIALS	NOT GOOD FOR THESE MATERIALS
<p><b>Temporary Freezing</b></p>	<p>Most materials may be frozen as an intermediate step to drying. Freezing allows for time to safely plan and organize the many steps needed to dry the affected materials, as well as to prepare a rehabilitation site. This can be especially important if the collections cannot be treated or dried quickly enough to avoid mold growth, bleeding of soluble media, or the formation of tidelines.</p> <p>Materials can be frozen on-site in traditional self-defrosting kitchen freezers (once food and any non-collections items have been removed), or transported in refrigerated trucks to an off-site facility. Vendors usually have the capability to “<b>blast freeze</b>.” During this process, wet materials are quickly brought to low temperatures, which is desirable because it prevents the formation of large ice crystals. This is also important for large palettes as the interior can take much too long to freeze unless it is blast frozen.</p> <p><b>It is important to remember that freezing alone is an intermediary step only.</b> Always have a plan in mind for how materials will be dried before removing them from the freezer, even if the plan is to carefully execute air-drying.</p>	<ul style="list-style-type: none"> <li>• Allows for time to make informed decisions regarding recovery</li> <li>• Avoids mold growth, which can occur within 48 hours of the disaster</li> <li>• Stops expansion of paper fibers; stops bleeding of inks and formation of tidelines</li> <li>• Allows the collection to be recovered in batches</li> </ul>	<ul style="list-style-type: none"> <li>• Is not appropriate for all materials</li> </ul>	<ul style="list-style-type: none"> <li>• Paper-based materials with thin-layer, water-soluble media such as watercolors</li> <li>• Collages (adhesives respond well to freezing)</li> <li>• Photographic prints, photographic negatives on film, film-based negatives and positives</li> <li>• Gelatin glass plate negatives may be frozen one time</li> <li>• All bound materials (books with paper, paper board, leather, vellum, wooden boards)</li> </ul>	<ul style="list-style-type: none"> <li>• Artwork on paper with thickly applied media, (i.e. gouache, acrylic)</li> <li>• Varnished artifacts, such as maps, or other materials with surface coatings</li> <li>• Cased photographs: daguerreotypes, ambrotypes, tintypes</li> <li>• Wet collodion glass plate negatives</li> </ul>

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<b>Air-drying</b>	<p>Air-drying commonly refers to allowing materials to dry by evaporation in the open-air. This can be aided by circulating air with fans and by the use of absorbent materials. This procedure is best used for drying small numbers of materials.</p> <p>A variation of air-drying is <b>dehumidification-drying</b> or <b>desiccant drying</b>. Commercial vendors who specialize in this service use desiccant dehumidification. Desiccant dehumidifiers, unlike typical home (refrigerant) dehumidifiers, force very dry air into a space and pump out moist air to speed the drying process.</p>	<ul style="list-style-type: none"> <li>• Possible to do on-site, provided there is enough secure, clean, dry, and cool space and staff/volunteers available</li> </ul>	<ul style="list-style-type: none"> <li>• Process is labor-intensive</li> <li>• Lateral bleeding may occur if water-soluble media is air-dried</li> <li>• Formation of tidelines can occur</li> <li>• Paper, photograph and bound materials may have distortions (curling, warping, expansion), some of which can be treated by a conservator post drying</li> </ul>	<ul style="list-style-type: none"> <li>• Intaglio (i.e. etching, engraving, etc.) and lithographic ink prints</li> <li>• Art with thickly applied media (i.e. gouache, acrylics, oil paint)</li> <li>• Varnished /surface coated paper materials</li> <li>• All photographic processes</li> <li>• Damp bound materials</li> </ul>	<ul style="list-style-type: none"> <li>• Materials with potentially soluble media (e.g. watercolor, drawing inks, felt-tip marker)</li> <li>• Saturated bound materials</li> </ul>
<b>Vacuum freeze-drying</b>	<p>In this process, a vacuum is created while a controlled energy source (usually heat) is added to the system to promote sublimation of the frozen water into vapor. The potentially <b>damaging liquid state is bypassed</b>. Despite the heat source, the materials are kept frozen during the entire process, until dry. The materials will dry in a matter of weeks rather than months.</p>	<ul style="list-style-type: none"> <li>• Does not appear to affect the ability to treat artworks later—for example, reduction of tideline stains is typically still possible</li> </ul>	<ul style="list-style-type: none"> <li>• Due to the rapid drying system, materials may be over-dried &amp; humidification after drying may be necessary</li> </ul>	<ul style="list-style-type: none"> <li>• Paper-based materials with thinly applied media, documents, collages, prints</li> </ul>	<ul style="list-style-type: none"> <li>• Artwork on paper with thickly applied media, (i.e. gouache, acrylic)</li> </ul>

RECOVERY METHOD	DEFINITION	ADVANTAGES	DISADVANTAGES	APPROPRIATE WITH THESE MATERIALS	NOT GOOD FOR THESE MATERIALS
<b>Vacuum freeze-drying, continued</b>	Rehumidification of affected material following drying is often required to prevent embrittlement.	<ul style="list-style-type: none"> <li>• Vacuum produces less distortion of objects, requiring less conservation treatment post drying</li> <li>• Extracts salt from materials damaged by seawater</li> </ul>	<ul style="list-style-type: none"> <li>• Can adversely affect the surface of silver gelatin prints, resulting in mottled appearance</li> </ul>	<ul style="list-style-type: none"> <li>• Most photographic materials, unless aesthetics are an important consideration</li> <li>• Saturated bound materials, including leather and vellum (leather &amp; vellum must be closely monitored for over drying)</li> <li>• Coated papers</li> </ul>	<ul style="list-style-type: none"> <li>• Varnished /surface coated paper materials</li> <li>• Photographs on resin-coated paper supports (these may block)</li> <li>• Digital prints</li> </ul>
<b>Vacuum thermal-drying</b>	Materials are dried in cycles of freezing and thawing in a vacuum oven, <b>passing through the liquid state</b> . This technique can increase the possibility of mold growth and can cause permanent physical heat-damage. <b>It is not recommended for any type of cultural heritage collection material.</b>	N/A	<ul style="list-style-type: none"> <li>• Can increase the possibility of mold growth and can cause permanent physical heat-damage</li> <li>• Liquid state can cause bleeding of soluble media</li> </ul>	N/A	<ul style="list-style-type: none"> <li>• Not recommended for any book, paper, or photographic materials</li> </ul>