

## PRESERVATION LEAFLET

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### PLANNING AND PRIORITIZING

## 3-12 Freezing and Drying Wet Books and Records

### INTRODUCTION

The successful recovery of water-damaged library and archival materials depends on timely response to a disaster. Rapid response maximizes recovery of collections materials and expedites the restoration of services. To extend decision-making time regarding salvage and replacement, freezing is the most viable option for most institutions. Because it inhibits mold growth, freezing allows the time to determine if value, use, and format of the original are important, or to deaccession or purchase replacement materials or materials in a different format. Freezing also provides a respite to review insurance policies and vendor contracts. Finally, freezing will allow time to find space for air drying, determine if there is adequate staff and time to air dry, and to handle large incidents in a smaller, more controlled atmosphere.

This leaflet will walk you through the process of freezing books and records, and it will explain how to dry them once retention and funding decisions have been made. For a more general introduction to recovery, see NEDCC Preservation Leaflets 03-06 Emergency Salvage of Wet Books and Records.

### PRIORITIZING BOOKS AND RECORDS

Begin by working with priority items first, if you know what they are. Realize that these materials are going to be fragile, especially if wet, and that they will be larger and heavier than normal. Sort materials by degrees of wetness as you remove them from the shelves. Taking time to do this will make drying much more efficient. Degrees of

wetness can be considered with these main categories in mind:

- Damp materials are cool to the touch. Exposed to high humidity, they can sometimes be identified after the event by mold formation.
- Slightly wet materials exhibit staining from water on the pages and/or on the binding or folder, typically extending no more than one-half inch in from the edges. These areas will have been in immediate contact with water.
- Wet materials exhibit staining from water that extends more than one-half inch in from the edges, up to saturation.

### RINSING BOOKS AND RECORDS

Before beginning any recovery efforts, the water source must be considered. Rarely is the water clean and free of debris. What is contaminating the water? Is the contamination corrosion from a pipe, dirt and debris from a flood, salt water, or is there sewage involved? If the water is sewage-contaminated, call in a professional recovery service immediately; do not deal with the salvage in-house. If the water is only contaminated by rust, dirt, or salt water, and if sufficient trained labor and time are available, then rinse books as described below. Rinsing wet books and records before freezing helps by removing debris that could be difficult to clean off after drying.

- Set up three or four bins of clean water.

- Holding books closed tightly, scoop them gently through the water with their spines leading, and move each book from bin to bin. This process will expose them to successively cleaner water and remove much of the surface debris.
- After a time, rotate the bins, making the last two bins the first two. Replace the dirty water in the original first two bins and move them to the final rinse stage.
- If records are mud-covered, support the records on a piece of plexiglass or other rigid, inert support, and rinse with a gentle stream of water from a hose or pitcher.
- Do not rinse if the inks are soluble; instead, freeze them immediately, mud and all

### PACKING MATERIALS FOR FREEZING

When packing books and records for freezing, work with sturdy, uniform packing containers that are small and uniform in size. Milk crates, cardboard boxes, and corrugated polypropylene cartons are often used. Line milk crates with board to prevent imprinting. For saturated materials, line cardboard boxes with garbage bags to prevent the boxes from getting too wet and collapsing.

1. First, pack materials that are on the floor to create a safer place to work. Do not close books found open on the floor; pack them as you found them. Similarly, pack loose folders as found on floor; do not take the time to try to sort materials at this stage.
2. Remove materials from shelves in order, if possible. If only some materials are wet, pack wet items together, damp items together, and dry items together.
3. Create a sling of freezer paper or waxed paper to place around the books (shiny side toward the item) or interleave every 5 folders. If books or papers are stuck together, pack as is. Wrapping prevents

materials from sticking together and dyes from transferring.

4. Pack books flat or spine-down in the box in a single row and layer. When packing folders, turn box on the side and pack flat. Try to maintain shelf or box order. Pack snugly but not tightly. You should be able to insert your hand between the box side and the adjacent book or folder.
5. Record the contents of each box as packed. Information to record should include: box number; number of books, folders, or items in box; call number range, genre (mystery, fiction, non-fiction); box and folder number range; collection name; wet, damp, or moldy; if objects, original location, accession/record number, type.
6. Seal with tape, label the box with institution name and box number, and move to a loading area.
7. Pack boxes in a freezer truck for freezing or transfer to a vendor for drying. Do not over-pack; spread materials out as much as possible to speed the freezing process. Send a copy of the inventory sheet along with the boxes.

Pack oversize materials of similar size and wetness between flattened cardboard boxes and wrap with tape. There is no need to interleave with wax or freezer paper unless the items are printed on coated paper or have colors that could bleed. Move packed items to a freezer immediately. Flat file drawers with oversize materials should be sponged out to remove standing water and can be frozen as is.

Do not freeze audio tapes, video tapes, computer tapes, CDs, DVDs, ambrotypes, daguerreotypes, or tintypes.

### CHOOSING A FREEZER

If materials can be safely frozen, doing so is often a good step to help prevent mold growth and further

warping of materials. If dealing with space constraints or water damage to a large number of collection items, freezing may be the only viable option for salvage.

Ideally, your disaster plan identifies local freezer space that is available in the event of an emergency. If there are no such spaces in your area, it is possible to rent a freezer truck or portable walk-in freezer. Make sure whatever you rent is of sufficient size and can maintain temperatures at or below 0° F to prevent the thawing and re-freezing that exacerbates distortion in paper-based materials.

For a small amount of material or materials that are only slightly damp or wet, a household upright or chest freezer may suffice. The freezer needs to be capable of reaching temperatures below -10 degrees Fahrenheit (-23 degrees Celsius) and maintaining that temperature without auto-defrosting. These freezers are typically described as “manual” or “direct cooling” and will require a staff member to defrost them manually, according to the freezer’s user guide. Many chest freezers do not have a self-defrost option. To help maintain the temperature inside of the freezer, refrain from opening it until you are ready to remove the materials. Freezers with a temperature gauge and monitor on the outside will help alert to any temperature-related issues. If materials are left in the freezer, they will eventually dry, but expect it to take many weeks to months.

A commercial blast freezer is more ideal, as it can drop the temperature quickly, efficiently hold the colder temperature needed, and are typically larger in capacity. Blast freezers can operate between -22 degrees Fahrenheit to -40 degrees Fahrenheit (-30 degrees Celsius to -40 degrees Celsius) and can freeze items in about three hours, as opposed to the 6-12 hours household freezers can take. Since blast freezers can drop temperature more rapidly, the ice crystals that will inevitably form will be smaller than those that will form in a traditional

freezer. Blast freezers are used by caterers, restaurants, and food distributors, and are not typically appropriate for domestic use, so they can be both cost prohibitive and also not readily available for purchase. They will also use more energy than a typical freezer.

Other features to consider when looking at freezers are:

- Chest vs. Upright. Upright freezers typically take up less floor space and have additional shelving inside, which can be helpful for organization and retrieval. However, the door seals on upright freezers tend to not be as tight nor last as long as those on chest freezers. Chest freezers also typically tend to have a longer life span and are more likely to keep materials frozen during a power outage since they hold a more consistent temperature under normal circumstances. Additionally, chest freezers tend to be less expensive than upright freezers and are typically more energy efficient.
- Whether or not the freezer can be locked (if security is a concern). Some freezers, particularly chest freezers, come with locks preinstalled. Others would need a locking mechanism purchased separately. Upright freezers with handles can be locked with a chain and padlock, while other types of freezer doors can be locked with specifically designed fridge/freezer locks—many of these types of locks are described as a “child-proofing” method and can be found from a variety of vendors.
- If the freezer is “garage ready.” This simply means that the freezer can handle hot and cold outdoor temperatures (or unregulated indoor temperatures) while maintaining an optimal temperature inside. If freezers are not “garage ready,” then temperatures outside of the freezer may prevent the

freezer from maintaining the temperature at which it is set.

- If the freezer has adjustable shelving. Freezers are typically made for food and beverages, so the shelving and baskets are part of the design to make this type of storage easier. However, if shelving cannot be adjusted or baskets cannot be removed, this may limit storage space for collections materials.
- If the freezer is on locking wheels. If the freezer has wheels, then it will be easier to move around if it needs to be defrosted or cleaned.

## DRYING FROZEN MATERIALS

Materials can remain in the freezer indefinitely and will eventually dry there. If drying in the freezer, expect items to be inaccessible for several weeks to many months, depending upon the temperature of the freezer and the degree of wetness. However, the goal should be to return these materials to circulation, exhibit, or their storage shelves as quickly as possible. Note that if items are placed in the freezer soon after becoming wet, they will become less distorted than air-dried materials and will require a smaller amount of added shelf or storage space following drying.

There are two primary options for drying frozen materials: air drying and vacuum freeze drying.

## AIR DRYING

Because air drying requires no special equipment, it is often believed to be an inexpensive method of drying. However, air drying is labor intensive, diverts many hours of staff time to regularly monitor the process, and often results in a distorted finished product. It is not an option for books with coated paper. The rehabilitation costs after air drying tend to be greater than other methods because most bound materials require some form of treatment from pressing to full

rebinding; documents often need flattening and rehousing.

Due to the time required for air drying, it is not unusual for mold to develop during large-scale operations.

In addition to mold growth and coated papers blocking, another consequence of air drying is the extra amount of shelf space required for collections. Depending upon how long materials spend in the freezer and the length of time spent air-drying, the amount of additional shelf space required after drying can be 20% or more.

## HOW TO AIR DRY FROZEN RECORDS

Air drying is most suitable for small numbers of records, so work with small batches from the freezer at a time. Records with water-sensitive media should be left in the freezer as long as possible or vacuum freeze dried.

1. Identify a clean, dry, secure space where controlled temperature and humidity are available. Reduce the relative humidity as low as you can to prevent mold growth and improve drying conditions.
2. Set up the space: Cover tables, non-carpeted floors, or other flat surfaces with unprinted newsprint, blotting paper, or paper towels, and hang clothesline.
3. Keep the air moving at all times using fans in the drying area. This will accelerate the drying process and discourage mold growth. Aim fans into the air rather than directly at drying records.
4. Thaw out small groups of records at a time. A small group will be one that you have the space for or time/staff to deal with from beginning to end. Depending on how long the items were in the freezer, the top and bottom pages may already be dry and separated.

5. Carefully separate the frozen records as they thaw. If the paper is stable or strong, you can carefully peel the pages as they thaw and lay them out on your prepared surface or hang them up to dry. If the paper is fragile, you can put a support sheet of Hollytex or Reemay (an open-weave spun polyester fabric) on the top document and carefully peel the single item back. Move the single document on its support to the drying space and lay face down. Take the support sheet back to remove the next document. If you encounter any resistance as you are separating a leaf, stop. Resistance indicates that the paper is still frozen and damage will occur if you continue.
6. If work on a group of items cannot be finished in time, the items can go back in the freezer until time is available.
7. Once completely dry, records may be rehoused in clean folders and boxes, or they may be photocopied or reformatted in other ways. Dried records will always occupy more space than ones that have never been water damaged.

## HOW TO AIR DRY FROZEN BOOKS

Note: Books containing coated paper should be vacuum freeze dried and not air dried after freezing.

1. Identify a clean, dry, secure space where controlled temperature and humidity are available. Reduce the relative humidity as low as you can to prevent mold growth and improve drying conditions.
2. Set up the space: Cover tables, non-carpeted floors, or other flat surfaces with unprinted newsprint, blotting paper, or paper towels, and hang clothesline.
3. Keep the air moving at all times using fans in the drying area. This will accelerate the drying process and discourage mold growth. Aim fans away from the drying books.
4. Start thawing out small groups of books. A small group will be one that you have the space for or time/staff to deal with from beginning to end.
5. Stand books on end with boards fanned open in a space with good air circulation, but – again – do not aim fans directly on the books. As the text block continues to thaw, fan open pages. Turn books head to tail daily.
6. To minimize distortion of the edges, place volumes in a press or press under a board with a weight just before drying is complete. Paper- or cloth-covered bricks work well for weights.
7. Wet books should be left frozen longest before air drying or vacuum freeze dried. As the books thaw, assess the degree of wetness remaining. If the books are slightly wet or damp, proceed as in step 4. If the books are still wet, as the books thaw, interleave every 16 pages or so with paper towels or clean, unprinted newsprint. Be careful to avoid interleaving too much or the spine will become concave and the volume distorted. Complete the interleaving by placing clean blotter paper inside the front and back covers. Close the book gently and place it on several sheets of absorbent paper. Change the interleaving frequently. Turn the book from front to back each time it is interleaved. Once the book is only damp, proceed as in step 4.
8. Frozen pamphlets should be thawed and removed from any pamphlet binders if possible. If the pamphlet opens well, open it to the center fold and carefully hang it from clothesline. If the pamphlet is thick or opens poorly, dry it on a flat surface as above. Flatten when dry.

9. Dampness will persist for some time inside the book in the gutter, along the spine, and in the boards. Due to their thickness, boards retain moisture much longer than fanned out leaves in the text block. Mold is often found between the boards and flyleaves in books that are not dried completely. Check for mold growth frequently while books are drying.
10. When books are dry but still cool to the touch, they should be closed, laid flat on a table or other flat surface, gently formed into their original shape, and placed in a press or held in place with a board and weight. A piece of Melinex or blotter paper should be put between the boards and the text block to prevent moisture wicking into the text block from the wetter boards. Press overnight and set up to dry during the day. Continue this cycle of air drying and pressing until books are dry. Do not return books to the shelves until they are thoroughly dry; otherwise mold may develop, particularly along the gutter margin.
11. If you can establish an air-conditioned room capable of maintaining a constant relative humidity of 25 to 35% and temperature between 50 and 65°F, books with only wet edges can be dried successfully in approximately one week once fully thawed. A wet book may take up to two weeks to dry so it is best to leave in the freezer as long as possible before thawing and drying. As stated earlier, exceptions are books printed on coated paper and those with water-sensitive media.

## VACUUM FREEZE DRYING

Vacuum freeze drying is best suited for large numbers of wet books and records as well as for materials with water-sensitive inks and coated paper. It is typically conducted by a recovery

vendor with access to the necessary equipment. Boxes of already-frozen books and records are placed in a vacuum chamber. The materials are dried by a process called sublimation; the water in the solid state (ice) is converted to a gaseous state without passing through the liquid state. Therefore, no moisture is added beyond what was present before the materials were frozen. If materials have been frozen quickly after becoming wet, very little extra shelf or storage space (8% or less) will be required when they are dry.

Although this method may initially appear to be more expensive because of the equipment required, the results are often so satisfactory that additional funds for rebinding are not necessary, and because mud, dirt, and/or soot are lifted to the surface, cleaning is less time-consuming. If only a few books are dried, vacuum freeze-drying can be expensive. However, companies that offer this service are often willing to dry one client's small group of books with another client's larger group, reducing the per-book cost and making the process cost-effective.

When dealing with commercial vendors for drying, make sure to communicate clearly from the beginning about costs, handling, and expectations.

## FURTHER READING

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