



PRESERVATION CONCERNS IN PLANNING A RECORDS CENTER VERSION 2.0

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Abstract

General guidelines for the development of local government archives and record centers

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Proper storage is crucial to the protection and longevity of records. Damage is often *irreversible*; preventing damage is far easier and less expensive than treating the damage after it occurs. Events, such as fires, mold outbreaks and theft, can cause the permanent loss of records, and it is imperative to consider these potentials when designing an archives space.

There are many factors to consider for the protection of archives and records. This document discusses aspects such as:

- Site selection
- Structural issues: roof, gutters, and downspouts, floors and floor coverings, windows, and landscaping
- Environmental control: temperature, relative humidity, light, and integrated pest management
- Storage and shelving systems
- Use policies
- Disaster prevention: security and prevention against water damage, fire damage and earthquakes

This document is only designed to address factors that affect the longevity and protection of government records. Planners must explore other aspects of construction and renovation as well, such as life-safety codes and structural and engineering concerns.

The Building Exterior

➤ **Location:**

- Take into consideration the location of the storage building and its potential hazards.
- Avoid areas prone to natural disasters, such as flood plains or areas with high wildfire risk.
 - Know the climate and what weather events you may experience, such as high humidity in summertime or the potential for tornados.
- Nearby railroad tracks and hazardous industries can be potential sites for chemical spills and industrial fires whose byproducts can be dangerous to collections.

➤ **Landscaping:**

- Exterior lights should be placed away from and pointed towards the building.
 - Insects will be attracted to the light *source*. If the light source is placed on or near the building, it will draw pests towards the buildings.
 - This will be worse if the light source is near windows or doors, as these provide potential entryways for bugs.
- Shrubs and large bushes near windows can provide cover for would-be intruders.
- Plants and organic materials also provide food and shelter for pests.
 - Keep plants at least 12" away from the building.
 - Gravel is preferred over mulch for the same reasons.

➤ **Roof and Gutters:**

- Both need to be kept in good working condition.
- Determine their age and projected lifespan. Replace them if needed.
- Make sure gutters are intact and cleaned regularly to insure they are draining properly.
- Address leaks immediately!
 - Skylights are common sources of roof leaks, and are not recommended for use when creating a new storage space.

➤ **Downspouts:**

- They must be unobstructed and draining freely.
- They should also drain away from the building.

Two examples of poor building maintenance:

Rusted gutters that require replacement (left), and a downspout draining against a building instead of away from it (right).



The Building Envelope

- The better the building envelope, the easier it is to prevent pests from getting in and the easier it is to control the building's environment.
- Windows and doors should have proper seals, have frames in good condition, and have intact caulking. Gaps and holes will provide entrances for pests, and allow for drafts.
- All glass should be intact and must be replaced if not.
- Any screens used should have openings $\frac{1}{4}$ " or smaller to prevent mice from getting through. This includes doors, windows, crawl spaces and vents. Replace screens if there are any holes or cuts.



An example of a broken building envelope, where wasps have made a nest in a broken window.

The Building Interior

- **Floor Capacity:**
 - The floor needs to be of load bearing capacity for large amounts of archival materials.
 - A recommended *minimum* capacity is 300 pounds per square foot. The capacity needs to be determined by the amount and type of records being stored, and by the size and type of storage units being installed.
- **Carpeting and Rugs:**
 - Carpet and rugs can harbor insects and are a breeding ground for mold.
 - They are particularly difficult to deal with in the event of a leak or flooding, and will act as fuel in a fire.
 - Do not put rugs in storage areas, and avoid using them in public and reference areas if possible.

➤ Plumbing:

- Avoid having water-bearing pipes above record storage areas.
- Address leaks and sweating pipes immediately.

➤ Light:

- All light is damaging; light damage is *accumulative* and *irreversible*.
 - Light causes inks and colors to fade, and makes paper yellow and age.
 - Ultraviolet (UV) light is the most damaging to objects. Sunlight is the greatest source of UV light, but it can also be emitted from certain types of light bulbs.
- Light limits:
 - Light intensity should not be stronger than 55 lux.
 - UV Light should not be stronger 75 microwatts per lumen.
 - The amount of light can be measured with photographic and UV light monitors respectively. Blue wool cards can be placed in displays to show damaging effect of light over a long period of time.



A blue wool card. The colors fade when exposed to light.

- Limiting UV light exposure:
 - If possible, have your storage space in an interior room or in a room with no windows.
 - If there are windows, use blinds or drapes to prevent light from coming in.
 - UV-blocking filters can be applied over windows and glass doors.
 - Use low-UV fluorescent bulbs or LED lights.
 - LED lights produce *no* UV light and are the preferred bulb.
 - There are UV-filtering sleeves for fluorescent tubes and UV-filtering films that can be applied to light diffuser panels if LED lights are not installed.
- Lighting for storage areas:
 - Lights should be at least 14" above the highest shelf or box.
 - Lights over stationary shelves should run parallel to and in-between shelving units.
 - Lights over movable, compact shelving should run perpendicular to the shelves.
 - 'Zone' lighting in large areas, so that all lights are not on if they do not need to be.
 - Keep lights off as often as possible.
 - Use motion-sensors with automatic lights. This both minimizes light exposure and saves money!
- For objects on exhibition it is best to limit their exposure to light by rotating out display materials every three months.
 - Do not put displays in direct sunlight and use a blue wool card to monitor light exposure over time.



Lighting over fixed shelves (left) and over mobile shelves (right).

Environmental Control

- The storage environment, as in the area’s temperature and relative humidity, is a major contributing factor to the longevity of records.
- **Temperature:**
 - Heat causes objects to degrade faster; the lower the temperature, the longer the collection will last.
 - Conversely, objects such as magnetic-based media can be damaged by cold temperatures.
 - Warmer storage temperatures will attract pests and promote mold growth.
- **Relative Humidity (RH):**
 - Relative humidity measures the percentage of how much moisture there is in the air.
 - High moisture can also accelerate the decomposition of paper and can damage certain pigments.
 - Mold grows in higher humidity percentages: there is a risk of mold growth above 50% humidity, and a *high* growth risk at 70% humidity and above.
 - Low humidity can also pose a risk, for example drying out paper or warping certain film types.
 - Extreme fluctuations in humidity can also be damaging; the more controlled the humidity the safer the collection will be.
- See our [Preservation Basics videos](#) at the Missouri State Archives YouTube page for more information on temperature and humidity in collections [<https://www.youtube.com/@MissouriStateArchives/playlists>]:
 - [How Temperature and Relative Humidity Affect Collections](#)
 - [How Temperature Affects Relative Humidity](#)
- *Not all records are created equal*; all record types have different temperature and humidity requirements!

Temperature and Humidity Recommendations for Records Storage Length, by Media type

| Long Term/Permanent Storage | | | | |
|---|-----------------------------|--------------------|-------------------------|----------------|
| Media Type | Preferred Temperature Range | Preferred RH Range | Upper Temperature Limit | Upper RH Limit |
| Paper Media – documents, books, maps, posters, drawings, etc. | 65 °F or below | 30-50% | 70 °F | 60% |
| Magnetic Media - Computer tapes and disks, video and audio tapes, and optical disks | 45 °F to 65 °F | 20-50% | 70 °F | 50% |
| Black and White Photographic Media on Polyester Film – film, x-rays, and negatives | 65 °F or below | 30-50% | 70 °F | 60% |
| Black and White Photographic Media on Acetate/Safety Film – film, x-rays and negatives | 40 °F or below | 20-50% | 70 °F | 60% |
| Color Photographic media – film, negatives, slides and photographs | 35 °F or below | 20-40% | 47 °F | 55% |
| Modern Digital Prints - Inkjet, thermal, and dye sublimation prints | 35 °F or below | 30-40% | 47 °F | 55% |

Short Term/Non-Permanent Storage (10 years)

| Media Type | Preferred Temperature Range | Preferred RH Range | Upper Temperature Limit | Upper RH Limit |
|---|-----------------------------|--------------------|-------------------------|----------------|
| Paper Media – documents, books, maps, posters, drawings, etc. | 72 °F or below | 30-50% | 75 °F | 60%* |
| Magnetic Media - Computer tapes and disks, video and audio tapes, and optical disks | 45 °F to 72 °F | 20-50% | 77 °F | 50% |
| Black and White Photographic Media on Polyester Film – film, x-rays and negatives | 70 °F or below | 30-50% | 77 °F | 60%* |
| Black and White Photographic Media on Acetate/Safety Film – film, x-rays and negatives | 70 °F or below | 20-50% | 57 °F | 65% |
| Color Photographic media – film, negatives, slides and prints | 47 °F or below | 20-40% | 50 °F | 65% |
| Modern Digital Prints - Inkjet, thermal, and dye sublimation prints | 47 °F or below | 30-40% | 50 °F | 65% |

* The maximum relative humidity is mostly determined by how likely mold will grow. At lower temperatures, the relative humidity for these media types can be safely increased to 65%.

[These recommendations are adapted from Appendix A of NARA 1571, Archival Storage Standards; ANSI/NAPM IT9.11; and NISO “Environmental Guidelines for the Storage of Paper Records”.]

- Long term and permanent record storage will have stricter requirements to prolong the records’ lifespan.
- The recommendations for short term storage are not suitable for long-term or permanent storage. They are designed to slow degradation enough to keep the records for at least 10 years.
 - Going above these recommendations will cause degradation to occur faster, which is fine for records being stored for only a handful of years
- Aim for the lowest temperature your system can maintain; even if you cannot reach the recommended levels, **the lower the temperature the longer the records will last!**

➤ **Monitoring the Environment:**

- Temperature can be measured by thermometers.
- Humidity can be monitored by humidity color strips and color cards, and measured with psychrometers and hygrometers.
 - There are also meters and hygrothermographs that measure both humidity and temperature.

- Long term data-loggers can measure both temperature and humidity continuously over time. The data can then be graphed to show long-term trends and seasonal shifts in the environment.

➤ **Heating, Ventilation and Air Conditioning (HVAC) System:**

- Each system will have different capabilities on how it can or cannot adjust the air to your storage needs, including temperature, humidity and air flow.
- Work with the building’s technicians to see what the limitations of your system are and what you can do to best protect your collection, such as adjusting the HVAC set-points to account for seasonal shifts in temperature and relative humidity.
 - Help the technicians understand your concerns so you can work together!



An example of a data-logger which can measure both temperature and humidity.

➤ **Storage Spaces vs. People Spaces:**

- Environments that are safe for archive materials are generally uncomfortable for people to work in.
- If possible, have separate environmental standards for each space.
 - This can be done with multiple HVAC systems or with a single HVAC system if it has the capability to do so.

➤ Single unit humidifiers, dehumidifiers and air conditioners can be used to adjust the environmental conditions of small spaces.

➤ **Filters:**

- Industrial pollutants can be hazardous to people and collections, and can increase the rate of paper deterioration. Buy the best filters for your air handling system.
- Help reduce incoming pollution by keep windows and doors closed and well-sealed.
- Clean for dirt and dust, and change out filters regularly, as these can also be breeding grounds for insects.

Storage

Proper storage and organization will go a long way to preventing damage to records.

➤ **Space:**

- Make sure the space is adequate for the amount of records you need to store; a large storage area for a small amount of records is wasted space.
- Plan for growth. Inadequate planning and lack of space leads to poor organization, poor storage conditions and eventual damage to records.
 - Some large records centers expect up to a 30% growth in nonpermanent records *per year*.
 - Determine the retention period of your records, and properly dispose of inactive records when needed.
 - The Missouri Local Government Retention Schedules can be found here: <https://www.sos.mo.gov/archives/localrecs/schedules>

➤ **Location:**

- Avoid basements and attics, as their environments are very difficult to control. Basements are also prone to flooding and often have water-bearing pipes.
- The same goes for exterior walls and rooms; the more space between the storage location and the outside, the more of a buffer you have from the exterior environment.
 - Interior rooms are the preferred location for storage.
 - If using a room with exterior wall, keep shelving several inches away from the walls. This will create a buffer from outside temperature and moisture.
- Ideally, the storage area should not have water bearing pipes running above or through it.

➤ **Shelving:**

- Shelf Material:
 - Metal shelves are preferred over wood.
 - Wood is flammable and it is acidic in nature, which will accelerate the aging of paper.
 - Steel shelves are preferred, with a 13- to 16-gauge minimum recommended for strength.
 - Baked enamel or powder coated finishes are preferred.
 - Paints and varnish-based finishes can pose problems. Some emit volatile organic compounds that are dangerous for objects, while others can be flammable or acidic.
 - For further information on finishes, see [Nara 1571, Archival Storage Standards](#), Section 1571.12: *What finishes are permitted in records areas?*
- Open shelves are excellent for easily accessing active and non-permanent records.
 - These can be made one or two boxes deep in width.
- High-density mobile shelving is excellent for maximizing storage in small spaces.
 - These can be installed with keypads for extra security.
 - Electric or manual options are available.
 - These are more expensive than stationary shelves, however.
- Specialized Storage:
 - Map cabinets can store large, flat objects.
 - Microfilm cabinets.
 - Proper storage for these objects will prevent damage.
- Adjustable or customizable shelves can help maximize available storage space.



An example of a large storage center for non-permanent records, using open steel shelves for easy access to record boxes.



Two more examples of shelving: On the far left is mobile shelving for records, and on the right is a map cabinet for large paper objects.

➤ **Housing:**

- Housing, such as boxes and covers, act as an extra protective barrier from dust, pests and damage.
- Boxes can be ordered or made in a variety of both standard and custom sizes.
 - There are document cases and banker boxes for documents, and large format boxes for large flat documents and objects.
 - It is important to buy of archival or acid free material for long-term storage. Cardboard is *not* suitable for permanent records.
- Large or unusually shaped objects that will not fit into boxes or drawers can be covered in polyethylene sheeting, such as Tyvek®.
 - Plastic degrades over time and is not recommended for long term use.
- Housing for oversized objects, such as maps:
 - Paper prefers to be flat. It should never be stored folded and only rolled as a last resort.
 - Map cabinets can be made in large sizes to store objects flat.
 - Very large objects can be rolled if there are no other options. Ideally, rolled objects should be placed in individual boxes or have an interior support like a tube, as rolled objects are *very* easily crushed.
- Stacking – flat boxes and oversized objects, such as large books, can be placed in short stacks to maximize storage space.
 - Put larger and heavier objects on the bottom to prevent crushing the lower objects.
 - Do not stack high. A large stack will crush the object on bottom and make it harder to retrieve and move the objects.
 - Small stacks and narrow shelf openings will help maximize your space!
- See our Preservation Basics video on storage solutions:
[Safe Storage for Collections](#)



An example of a storage space utilizing small stacks on narrow shelves for oversized books

➤ **Transportation and Moving Records:**

- Keep adequate space between shelves for ladders and carts as needed for retrieving records.
- Allow space for moving large amounts of records if necessary.
 - Keep in mind the space needed for forklifts, pallet-jacks, and moving loaded pallets.
 - A dock for loading and unloading high volumes of records may be needed. Provide a cover over the loading dock to protect objects from weather during transfer.

➤ **Mixed storage:**

- Consider devoting separate spaces for records with different storage needs.
- As mentioned before, permanent storage needs much stricter environmental control. If possible, have a small, separated area for permanent archival records, such as a vault or separate room with more rigorous environmental control.
 - For example, film has much colder temperature requirements. Dedicating a cold storage space made specifically for film is much easier than cooling a large room containing all kinds of records.
 - A smaller area makes for much easier environmental control, and saves money overall!
- Non-permanent storage can be more ‘ware-house’ in design, with open shelves and less stringent environmental control for records that are inactive and will eventually be destroyed.

Preventing Potential Disasters

➤ Security:

- Limit who has access to important records.
- Building security can include electronic detection systems, motion sensors, glass-break alarms and guards.
 - Windows and doors should have locks which should also be changed from time to time.
 - Implement a system of key control to manage access to important keys, how keys are given out and track where keys are. A good key control policy will help prevent keys from being lost or misused.
- Research Room Security:
 - Provide lockers outside the research room, so all briefcases, bags, purses, etc. can be left safely outside of the room.
 - Arrange the room so staff have a clear sight-line to observe researchers and guests.

➤ Safe Handling of Objects:

- Provide staff and volunteer training on the safe handling of documents. Poor handling can lead to damage or complete loss of a record.
- Educate and correct users in the research room.
 - Consider offering public programs for users to build greater understanding of preservation issues.
- Establish conduct guidelines in the archives and reference room, such as:
 - Pencils only – no pens or markers near records or in storage areas
 - No writing or tracing on top of documents
 - Do not use sticky notes, paperclips, staples or rubber bands to mark or hold documents together
 - Provide book snakes or other weights to safely hold down objects
 - Wash hands before handling objects – the natural oils we secrete will leave stains over time
 - Do not allow the use of hand lotion during visit
 - Provide gloves for handling photographs, film, and negatives
 - No food or drink near objects and collections



A variety of cloth-covered weights, sometimes referred to as "snakes" or "worms" used to safely hold down records during research

➤ Integrated Pest Management (IPM):

- Pests can be dangerous to collections, humans and even to the building itself.
- If possible, identify a "quarantine" space for incoming records in which to temporarily store records before they are moved into your main storage.
- IPM is designed to prevent a problem before a major infestation occurs, which is safer and less expensive than the chemical treatments that may be needed to treat an active infestation.
- IPM creates a system to monitor for pests and provides steps to modify the environment to prevent an infestation.
- Read more about creating an Integrated Pest Management system here:
- <https://www.sos.mo.gov/CMSImages/LocalRecords/IntegratedPestManagement.pdf>



An example of damage caused by pests, which have eaten through a book

➤ **Fire Protection:**

- Many record types are very flammable and a fire can easily destroy large amounts of records very quickly, whether the fire is started by faulty equipment, a natural disaster or even by arson.
- Alarms:
 - Early detection is needed to minimize the damage fire can cause. Many fires happen outside of work hours, therefore automatic detection is absolutely necessary.
 - Ideally these alarms will alert your local fire department for fast response.
- Water Suppression Systems:
 - Although exposing records to water poses a risk, it is *much* easier to treat water damage than fire damage.
 - Water-based suppression systems can use wet-pipe, dry-pipe or pre-action pipes. Each have their own benefits and disadvantages.
 - Sprinkler systems are efficient at dousing fires, but expose documents to large amounts of water and clean up can be expensive.
 - Mist systems use far less water than sprinklers, and minimize water exposure to documents. They have higher installation and maintenance cost.
- Gas Suppression Systems:
 - These systems use inert gas, such as Halon, Carbon Dioxide, and FM-200, to starve a fire of oxygen.
 - There is no exposure to water, no clean up necessary and no damage to water-sensitive materials.
 - The gas must be stored in a dedicated, pressurized canister. There is a limited discharge based on size of the gas canister and the area must have a tight enclosure for the gas to work efficiently.
 - These can be expensive and are not recommended for full-building use.
 - They are best used for protecting rare or irreplaceable records, or items with high value.
- Chemical suppression systems are not recommended due to the dangers they pose to archival materials.
- Learn more about these different systems of fire suppression with NEDCC's Preservation Pamphlets:
https://www.nedcc.org/assets/media/documents/Preservation%20Leaflets/3.2_IntrotoFire_2022_Print.pdf



An example of the storage canister used in gas a fire suppression system

- Consider using a mixed suppression system, where the most valued items are stored in a room with a gas suppression system and less-valuable records have a water-based suppression system.
- Work with your local fire department. If possible, have them walk the building and show them where important records are stored. This can help create a plan of action to save valuable records during an emergency.

➤ **Protection Against Water Damage:**

- Many archival disasters involve water, whether it is leaks, burst pipes, or flooding.
- Consider where water can enter the building and collection areas, and provide adequate drainage.
- Locate water-carrying pipes within the building, and regularly monitor them for leaks and sweating.

- Regular maintenance of roofs and plumbing systems can help detect and address issues before they become a disaster.
- Never store records directly on the floor.
 - Records should be at a minimum of 4" off of the floor.
 - Pallets are better than nothing!
- Storage, including boxes, shelves, and cabinets, will provide some protection against minor leaks and spills.
- Consider installing automatic water detectors to warn of leaks or flooding.
 - There are various alarms to detect high amounts of moisture, leaking valves, or standing water.
 - There are also specialized water detectors for use in drop ceilings in case of burst pipes.



An example of a floor water sensor that will alarm during flooding

➤ **Earthquakes:**

- Brace shelves and fixtures to protect both collections and people.
- Channel-bracing shelves and bolting units into floors and walls can also help prevent damage and collapse during an earthquake.
- The California seismic standards are recommended for reference.

➤ **Keep archival storage for archival material.**

- Limit storage of hazardous materials in the building, i.e. gasoline and gas-powered equipment, paints and solvents, and flammable cleaning supplies.
- These can be dangerous for archives in case of a spill, and can create hazards during emergencies.



A shelving unit bolted to the floor for in case of earthquake

➤ **Have an emergency response plan to prepare for potential disasters.**

- Outline steps for how to deal with an emergency in progress and with the recovery of records afterwards.
- Have a contact list of vendors and service providers that can offer aid during and after an emergency.

Building the Archives Space

- Determine the size of the space needed to store your records.
 - Determine if the collection will grow and estimate by how much. Plan the storage space to accommodate such a growth as needed.
- Determine the type of record being stored.
 - This will determine what environment the storage area will need, such as minimal environmental control for non-permanent records or cold storage for a collection of film.
 - Know the value and permanence of the records. Higher value and permanent records will require stricter storage conditions, while non-permanent and short-term records will need less maintenance.
- Consider separating different groups of records based on their value and needed storage conditions, and dedicate storage space with specific conditions for each one.

➤ **Renovating versus new construction:**

- If renovating a pre-existing building, consider buildings with open floor plans and high load-bearing capacity. Libraries, banks, and even grocery stores can be excellent starting points.
 - It may be easier to construct a new building – purpose-built facilities have their advantages:
 - Although they have a higher upstart cost, new buildings will need less maintenance or upgrading to meet storage requirements and can be less expensive in the long run.
 - Old and historic buildings may not be able to accommodate the necessary changes or need major renovations to meet storage requirements.
- Do the best you can do. Even if you cannot meet all the needed standards, any effort put towards organizing and maintaining your collection will prevent neglect and the eventual loss of records.

Learn more about our Local Records Grant Program for aid in records management and preservation projects:
<https://www.sos.mo.gov/archives/localrecs/grants>

The Local Records program has identified firms that provide preservation supplies and services, focusing on the state of Missouri [NOTE: inclusion on the vendor list is done by request and is not an endorsement by Local Records or the Office of the Secretary of State]:

[https://www.sos.mo.gov/CMSImages/LocalRecords/Vendors Information.pdf](https://www.sos.mo.gov/CMSImages/LocalRecords/Vendors%20Information.pdf)

The Local Records staff are available to provide additional guidance and support.

Contact them at: P.O Box 1747, Jefferson City, MO 65102, (573) 751-9047, or local.records@sos.mo.gov.