
Warning Signs: When Textiles Need Conservation

Lucy A. Commoner

Textiles, in contrast to most fine art objects, are particularly vulnerable to deterioration because of their past utilitarian roles. Warning signs usually become visible only after a certain amount of deterioration has already taken place. For this reason, monitoring museum textile collections for signs of damage is an important preservation strategy. Once damage to an object becomes apparent, prompt action is indicated. A distinction must be made between remedial measures that can be taken by a technician and those that should be handled by a professional textile conservator. A program that includes the preventive measures described below can help to keep future damage to a minimum.

On exhibition, in storage, or during handling, museum textiles may be exposed to a variety of deteriorative factors. Apart from disasters, most damage to textiles is caused by photochemical and thermochemical degradation, acid environments, biological deterioration, physical and mechanical stress, improper previous treatment, and inherently unstable material. In addition, certain types of damage can cause a textile to become more susceptible to further damage. For example, photochemical degradation increases the likelihood that a textile will be damaged by mechanical stress, and general degradation can increase susceptibility to mold and mildew.

Photochemical and Thermochemical Degradation

Photochemical and thermochemical damage is caused by exposure to high levels of light and heat from various sources: daylight, fluorescent fixtures, and incandescent fixtures. This type of damage is cumulative and irreversible. Chemical changes caused by exposure to both the visible and the ultraviolet portions of the light spectrum are accelerated by high temperature and humidity.

Signs of Damage

- Dye fading is irreversible and varies depending on the type of dye and how it was applied. Some colors may fade more than others. The most apparent sign of dye fading from light exposure is the color difference between covered and exposed portions of a textile, such as the front and back of a piece.
- Embrittlement from light (especially the ultraviolet emissions from fluorescent lights and daylight) and heat can cause a reduction of tensile strength in textiles. High humidity accelerates this reaction. Embrittled areas have less flexibility and in extreme cases may actually powder when touched. Silk is particularly susceptible to this type of deterioration.
- Yellowing and browning of a textile may appear as an overall color change or local spots of discoloration resulting from

the oxidation of fibers through exposure to light. Brown and brittle areas are often noticeable along the fold lines of textiles.

Preventive Measures

- Control of the length of exposure to light during exhibition and in storage.
- Control of the intensity of the lighting in galleries and storerooms at 5–10 foot-candles (50–100 lux); evenly distributed lighting for individual objects is important.
- Elimination or filtration of all sources of ultraviolet radiation:
 - Windows should be blacked out or have UV-filtering film applied to the glass. The effectiveness of the UV film should be monitored periodically.
 - Low-UV-emission fluorescent bulbs can be used without UV-filtering sleeves.
 - Standard fluorescent bulbs should be fitted with UV-filtering sleeves that are changed when they show signs of physical damage such as embrittlement or cracks.
 - Textile exhibition cases and frames can be constructed from acrylic with a built-in UV filter.
- If possible, one should choose a light source that produces the least amount of harmful visible light, as listed below in order of less to more harmful source.

Incandescent lamps provide the safest form of visible light.

 - Tungsten halogen lamps produce a slightly higher, more damaging light than normal incandescent lamps. UV-filtering lenses and lamps are preferable under conditions of extended exhibition.
 - “Warm,” low color-temperature fluorescent lamps are preferred to “cool,” high color-temperature fluorescent lamps since they have less damaging visible radiation.
 - Full spectrum daylight fluorescent lamps produce a high amount of damaging visible light and should be avoided.
 - Natural daylight, with the highest component of blue light, is the most damaging

form of visible light. If it is used as a lighting source, a filter that warms up the color by filtering out some of the blue light should be used on the window whenever possible.

- Control of heat in exhibition cases by eliminating interior lighting. Lights should be located in a separate, sealed off lighting attic, using infrared heat filters, dichroic tungsten lamps, remote fluorescent ballasts, and ventilation with or without fans, depending on the extent of heat build-up.
- Extinction of gallery and storeroom lights whenever the spaces are not in use.
- Limiting length or intensity of exposure by having storeroom lights on several separate circuits or on rheostats.
- Storing objects in archival containers, metal drawers, or under blackout cloths to protect them from unnecessary exposure to light.
- Use of a light meter to measure light levels and an ultraviolet monitor to measure UV emission, especially if UV filters are not used on daylight and fluorescent light sources.
- Limiting length of loans and exhibitions; a three-month limit is recommended.

Acid Environment

Natural fibers are damaged or discolored by volatile acids that are transmitted through contact with sources of acid in storage or exhibitions. Sources of acid are unstable materials such as unsealed wood (especially oak and certain grades of plywood), non-archival paper and cardboard, some adhesives, non-archival backing or lining fabrics, synthetic gasket materials, and linseed oil in paints or putties. In addition, some of the chemical constituents of urban air pollution, such as sulfur dioxide and nitrogen dioxide, can combine with atmospheric moisture to form acids. Another pollutant, ozone, causes oxidation (embrittlement) of organic materials.

Signs of Damage

- Discoloration of textiles in contact with non-archival materials such as unsealed wooden stretcher frames or backing boards; this may be local or may affect the entire object.
- Brittle and discolored backing boards, rolling tubes, backing materials, or yellowed tissue paper.
- Sweet, musty odor.
- Loss of tensile strength.
- Tarnish on metallic threads or other metallic components.

Preventive Measures

- Use of neutral pH products for all materials intended for direct contact with textiles, such as rolling tubes, tissue papers, storage boxes, dust covers, and backing materials.
- Use of suitable construction materials in storage furniture or exhibition cases. If wood is used, it must be sealed with an inert barrier. Avoidance of protein-based or rubber-based glues, rubber or synthetic foam dust gaskets, wool, silk, felt, synthetic non-wovens that contain acidic bonding agents, and flame-proofed materials. Where the ambient air quality is acceptable, one should avoid hermetically-sealed cases, which concentrate any damaging interior vapors.

Biological Deterioration

Biological damage is caused by microorganisms such as molds and by insects. This kind of deterioration is encouraged by high humidity (above 60%–65% RH), high temperatures (above 70° F, 25° C), darkness, stagnant air, and poor housekeeping. In general, protein fibers (silk, wool) are most susceptible to mildew. Once mildew, or mold growth, has begun, it can easily spread to other textiles. In addition, insects may carry mold spores from one object to another.

Signs of Mold Damage

- Musty odor.
- Presence of black or white powdery growth, multicolored stains, or yellowing.
- Presence of moisture inside a storage or exhibition case.
- In extreme cases, total breakdown of cellulose with ensuing destruction of a textile.

Signs of Insect Damage

- Small, irregularly-shaped bitten holes in textiles, often penetrating through several layers if a textile is folded.
- Presence of silk cases or webbing from clothes moths.
- Presence of live larvae or molted larval skin.
- Presence of insect excreta. The color may be the same as the color of a damaged textile. A textile may be soiled by insect excreta.

Preventive Measures

- Good housekeeping is essential. Storage and exhibition areas should be kept clean and not be located near areas where food is handled. Regular inspections and vigilance are necessary to detect insect activity before a serious infestation occurs. "Sticky boards" can be used to monitor the types of insects passing through a given area. One should beware of moths, carpet beetles, firebrats, silverfish, cockroaches, and termites.
- Inspection of all new additions to a collection for signs of active mold growth or insect infestation and isolation of the *affected* textiles from the rest of the collection until they are free of any problems.
- Keeping textiles as clean as possible. Dust and soil are attractive sites for mildew and insect attack.
- Treatment of animal glues with a biocide to prevent mold growth, especially in closed systems.

- Control of relative humidity in the range of 35%–50% RH and temperature in the range of 60°–70° F. Most mildew cannot grow if the humidity is below 60%–65%, and most insect activity is discouraged by low temperature and low humidity.
- Maintenance of good air circulation in the storage rooms since pockets of stale air will encourage mold growth.
- Locating storerooms carefully; textiles should not be stored in basements, against outside walls, near possible sources of water leaks, or directly on the floor.
- Reducing the possibility of condensation within frames and cases by using ballast materials such as archival paper products, cardboard, and archival support fabrics, in storage and exhibition containers. Textiles should not be stored or exhibited in airtight containers without adequate ballast materials.
- Awareness that cut flowers and plants may bring insects into exhibition areas.
- Storage of textiles within tightly-fitted archival boxes to help deter insect entry or to localize infestations.
- Cleaning by vacuum through a protective screen to remove as much mildew, insect larvae, and excreta as possible. Vacuum head attachment and bag should be cleaned thoroughly after vacuuming.
- Fumigation with surface fungicides or insecticides in the event of an infestation; this should be handled by certified personnel using approved equipment, since serious health hazards are associated with these materials. Treatments for the removal of mildew stains should be undertaken by a textile conservator.

Physical and Mechanical Stress

Physical damage or weakening of textiles is due to uncontrolled and improper temperature and humidity levels, careless physical handling, and abrasion from particulate matter.

Signs of Damage

- Abraded or missing areas of fibers.
- Loss of tensile strength; dry "hand."
- Cracking along folds.
- Embrittlement or powdering of fibers.
- Horizontal splits along vertically hanging textiles.

Preventive Measures

- Consistent levels of recommended temperature and humidity are most important. Fluctuations of temperature and humidity cause mechanical stress to textiles as they expand and contract, absorb and release moisture. Textile storage never should be located near sources of heat, in attics, in basements, or against outside walls. Extremely dry conditions cause desiccation of natural fibers.
- Monitoring of temperature and humidity in storage and exhibition spaces with recording devices.
- Minimal handling of textiles. Black-and-white photographs or color slides can be used for many research and reference purposes, protecting a collection from unnecessary handling.
- Storing textiles flat and on an adequate support such as archival mat board whenever possible, so that the support, rather than the textile, is handled. Folding or stacking textiles (with the added weight of their support boards) can cause damage and is not recommended. Any textile that must be folded should have the folds softened by padding with neutral pH tissue; rolling is usually preferable to folding.
- Suspension of large rolled textiles from a support rod that runs through the tube on which a textile is rolled; large rolled textiles should not bear their own weight on a flat surface.
- Filtration of air for dust and particulate matter; these have an abrasive effect since they become embedded in a textile. Any unprotected objects on exhibition should be vacuumed before they are returned to

storage. If possible, all objects should be stored in drawers or containers to protect them from dust. Storage containerization and exhibition cases also can offset changes in temperature and humidity in storage and exhibition areas.

- Design of storage so that any piece can be found and retrieved without unduly disturbing other objects.
- Treatments for textiles such as hanging pieces that are damaged or weakened to the extent of needing additional support.

Inappropriate Treatment

Physical and chemical damage to textiles can result from previous treatment, such as poorly executed or inappropriate techniques, or previous uses that cause increased vulnerability of the textile. Remedial steps in this category should be handled by a textile conservator.

Signs of Damage

- Sagging or distortion of unsupported textiles that are free-hanging or in frames.
- Brittle or stained textiles that are glued to cardboard or wood.
- Stains from dye bleeding or tide marks due to previous wet cleaning.
- Heavy abrasion or staining from previous use, especially of rugs, quilts, ethnographic textiles, and costumes.
- Weakness and fiber loss from excessive bleaching.
- Fiber distortions or broken and pierced fibers from mends or sewn mounts.
- Incorrect alignment, overlapping, or folding of fragments sewn onto mounts.
- Rust stains and holes from nails and other metal fasteners.
- White deposits under glass that directly touches a framed textile.

Preventive Measures

- All of the above types of damage require complex treatments that demand the expertise of a qualified textile conservator.

Some conditions, such as damage from bleaching and wet cleaning, may be totally irreversible. Any additional new treatments that are undertaken by a textile conservator should be reversible in the future.

Inherent Instability

Inherent instability or inherent vice is the deterioration of organic materials due to their composition or manufacture. All natural fibers, especially silk, age and deteriorate. This type of damage will follow a natural course that is inevitable. The process cannot be stopped, but it can be slowed by controlling the environment and the handling of a piece.

Signs of Damage

- Overall fragmentation or sharp diagonal cracks and tears in silk textiles are often the result of weighting that was added to the silk. Additives such as metallic salts were commonly used in the nineteenth century to increase the weight of silks, particularly for garments. The weighting materials have greatly accelerated the deterioration of the silks.
- Increased fiber deterioration can result from the use of certain dyes and mordants. In particular, an iron mordant will rapidly destroy the fibers to which it has been applied. This is noticeable in textiles where dark brown or black dyes have been used, either in printing, embroidery, or overall dyeing. In extreme cases, elements of a design may be completely voided due to oxidation from iron mordants.
- Corrosion and stains often occur on areas of a costume or textile that are in direct contact with metal fasteners or other metal components that are integral parts of an object.

Preventive Measures

- Control of temperature, humidity, light levels, and physical handling of extremely

fragile textiles is especially important. The preservation of a fragile textile may require that its exhibition be severely restricted or even prohibited.

- Any treatments of extremely fragile textiles should be undertaken by a professional textile conservator.

*Lucy A. Commoner, Textile Conservator,
Cooper-Hewitt, National Museum of Design,
Smithsonian Institution, New York*