Collections of Contemporary Works of Art on Paper

CONSERVATION, HANDLING AND EXHIBITION GUIDE

Jorge García Gómez-Tejedor / Pilar Montero Vilar

FUNDACIÓNMAPFRE

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Paper has been the narrative thread through which FUNDACIÓN MAPFRE's artistic collections have been created. The reason is twofold. On the one hand, paper is the medium that records the artist's immediate expression towards his work; the first sketches are captured on paper. But paper is also a fundamental medium in the fine arts. It is the base for drawing, a keystone form of expression for every artist, and it is also the medium for a language as contemporary as photography. For this reason, we have invested in paper, believing that through it we can open a window towards a better understanding of artistic creation.

Nevertheless, paper is paradoxically the most fragile and forgotten medium in the fine arts. Consequently, our aim is not only to collect it, but also to protect it. This is the fundamental motive behind this guide: not only promoting collections of works on paper, but also disseminating the basic principles of their conservation.

With this guide we want to share twenty years of enthusiasm, dedication and experience in order to provide a reference for institutions and persons interested in art collections on paper.

Pablo Jiménez Burillo
Director of the Culture Department
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INTRODUCTION

Interest in the preventive conservation of cultural assets has grown exponentially in recent years. This growing interest has been accompanied by the proliferation of both theoretical and practical studies that attempt to address the increasingly pressing need to preserve works—some of which are made using unprecedented procedures, media and materials—for posterity.

This guide, containing all the information a user needs in order to properly care for a collection, has been prepared based on the conviction that conservation is not an activity that can be carried out from time to time; rather, it should be an integral part of a carefully planned, long-term project that addresses every aspect and all potential parties involved in the task of collection care. The guide also reflects our firm belief that this activity is no longer the sole prerogative of conservators and restorers. From the moment that certain materials, such as those used in photography, are deemed to require intervention, a whole team of specialists from different fields must be called into action, including engineers, industry professionals, chemists, etc. The complexity of the techniques used in works on paper means that collection caretakers must possess a high degree of professionalism and skills that allow them to identify the processes and media employed in the works under their care, as well as a special sensibility that enables them to detect different types of deterioration, determine what caused them and figure out how to avoid them in the future. Nor should we overlook the set of material resources and tools that conservators of such collections must have in order to properly fulfil their responsibilities.

This conservation, handling and exhibition guide for contemporary works on paper aims to be a reader's companion, combining specialised knowledge with practical advice on everyday tasks to make it a useful resource for people who are taking their first steps in the world of conservation, as well as a valuable aid for experienced professionals as they go about their daily routine. The document has been organised with both types of users in mind, creating a narrative text that reads smoothly and opting to supply an exhaustive, up-to-date bibliography rather than peppering the text body with footnotes.

The primary focus of the guide is works on paper, but we must take into account that contemporary artists use a wide variety of media on this type of support. As conservation criteria are similar for the majority of these media, we have refrained from going into the particulars of each, except in the case of certain media with specific conservation needs, such as photography.

Conservation is an evolving field in which new determining factors, tests and studies are constantly opening our eyes to different research perspectives, often forcing us to reconsider or even discard ideas we once regarded as unassailable truths. For this reason, we have chosen to incorporate different conclusions on similar topics, drawn from studies by various authors, instead of offering a single dogmatic opinion on the matter that would probably turn out to be an exercise in gratuitous speculation.

We find further proof of the growing interest in acquiring a better understanding of conservation practices in the recent proliferation of standards and recommendations—issued by the European Union, the European Committee for Standardisation (CEN), the International Organisation for Standardisation (ISO) and various government agencies in EU member-states, such as the French Association for Standardisation (AFNOR) or the Spanish Association for Standardisation and Certification (AENOR)—aimed at all the individuals and organisations involved in the conservation of cultural heritage. Consequently, throughout this guide readers will frequently come across references to compliance with international and national standards. These standards, which have been reviewed and approved by the international community, are guidelines that serve to standardise our operating procedures in accordance with universally accepted practices.

The guide consists of three chapters and an appendix. The first chapter discusses how the work should be handled while in storage, explaining not only how it should be stored to ensure proper conservation but also what kind of environmental conditions and requirements the storage facilities should meet. Today, it is quite common for artworks to travel extensively, giving different audiences a chance to enjoy them in temporary exhibitions. As such exhibitions are critical junctures in the life of an artwork and tend to expose it to additional risks, the second chapter deals specifically with conservation criteria for the handling and transport of works in this situation. In the third chapter, which focuses on the public display of artwork, we analyse the requisite conservation conditions for temporary exhibitions of works on paper, explaining what kind of requirements the venue should meet and under what circumstances the works should be exhibited. Finally, the appendix contains tables listing the principal agents of deterioration affecting works on paper.

CHAPTER 1

COLLECTIONS IN STORAGE

1. ARCHIVE ROOMS

1.1. Design and planning. The archive or storage rooms are a crucial aspect in the preservation of a collection. After all, these are the places where the works we wish to protect spend most of their time. Another consideration to bear in mind regarding the archive is that a state of absolute repose is the most appropriate condition for guaranteeing optimum conservation.

More often than not, we have neither the opportunity nor the resources to design and plan a room from scratch, but even if it is a question of turning an existing space into an archive to accommodate a collection, the design must always be based on certain criteria, the ultimate aim of which is to protect and preserve the works. Consequently, all decisions regarding the conditions in which the collection is to be kept are of vital importance if appropriate conservation requirements are to be met.

These requirements fall into two broad groups: those affecting the structural conditions of the buildings that house the works and those related to the facilities and equipment involved and how they are used.

1.1.1. Structural requirements of spaces used to store a contemporary collection of works on paper. First of all, we must accept the premise set out in the introduction to this guide: preservation is a long-term task, part of which is to plan and conceive a space that can accommodate a growing collection without overcrowding the storage facilities or necessitating urgent relocations. Thinking about the average annual growth of the collection and how to protect it is a useful exercise because it can help to prevent many of the problems that often stem from a lack of planning.

Another crucial aspect to consider is the load-bearing capacity of the structure of the space that will accommodate the collection, both now and in the future, when it may well have grown and therefore be heavier.

Equally important is the location of the archive within the building. The choice of a place to store the collection must be given careful consideration to ensure that it serves its intended purpose. The space chosen must not be subject to fluctuations of temperature or humidity, or be exposed to direct sunlight or damp. The most suitable location is the ground floor, as this offers direct access without the need to use lifts. Basements and top floors are therefore not recommended. A windowless room with a stable

temperature is the most adequate setting. If the archive does have windows, these must be adequately covered, since sunlight is particularly harmful to works on paper. For this reason, an archive should ideally face north, as this prevents exposure to the sun's daily cycle. Other locations to avoid for an archive of these characteristics are spaces close to cafés, restaurants, toilets and waste storage areas.

Mechanical, electrical and plumbing (MEP) systems are another aspect to bear in mind when choosing the physical location of the archive. Ideally, no water or gas pipes should pass through the room. If this cannot be avoided they must be clearly identified and extreme precaution and the strictest maintenance measures must be taken to ensure that they are always in perfect condition and to prevent any leaks. The same care and attention should also be paid to other installations, such as the electrical, fire-prevention, security and heat, ventilation and air conditioning (HVAC) systems. HVAC units should not be located in the same room as the works.

With regard to the ceiling, walls and floor, these should have smooth, completely inert surfaces that do not secrete any substances or trap dust and airborne particulates. Ideally, the materials used should be dust-repellent and suitable for dry cleaning with a vacuum cleaner or dust mop. The joints between walls and floor should be rounded, as these are less likely to collect dust and are easier to clean. As a general rule, continuous flooring material is recommended to reduce vibrations when carts are rolled across the floor. Furthermore, the spaces used to store collections should be separated from other areas by fireproof walls and doors.

Another point to bear in mind with regard to the archive space is that, if the collection is very large, the room should be divided into different areas for different types of works to ensure that optimum environmental conditions can be maintained in each case. Similarly, since they hold large quantities of materials, the rooms should ideally be compartmentalised into airtight medium-sized spaces so that, in the event of a disaster, each area can be handled separately. For reasons of security, fire prevention and efficient climate control, the archive itself should also be divided into compartments.

In all cases, the physical structure of a space used to store works on paper requires the following adjoining rooms:

- **Transit room**. This is the space through which the works enter and exit the archive. It is used to receive and prepare incoming works

for storage, and to prepare and pack outgoing works. This room must be adjacent to a quarantine room, where works suffering from biodeterioration can be isolated from other works in storage to prevent them from contaminating the rest of the collection, and to an acclimation room where incoming works can be stored for at least 24 hours before being unpacked. The acclimation room should contain a space where works can be inspected. Ideally, it should also have storage facilities for the works (movable panels for vertical storage and flat file cabinets). This room requires good light with fixtures oriented to allow staff to inspect and check the condition of works, and there should be appropriate furniture to store the tools used for these tasks. Also highly recommended for this room is a work station with access to the database so that information can be regularly updated. The transit room is a much-used multi-purpose space that should be located at the entrance to the storage facilities. Its design will depend on the working method planned for the collection.

- **Reference room**. This is a space where researchers can access the works and where the works are prepared for examination or inspection. Researchers spend a great deal of time studying archive works and the environmental conditions of this room should therefore contemplate their comfort as well as the preservation of the works. It should be equipped with conservation lighting, generous desks and flat file cabinets for the temporary storage of items in use. This is an important space, and care should be taken to ensure that it facilitates the task of researchers and offers a risk-free environment for handling works. It should also be connected to the IT network and have access to the database and the Internet.
- **Box storage room**. If possible, the archive should have a space for storing empty packaging. This space should be easily accessible, clean and quite large. Strict climate control is not necessary, though the appropriate environmental parameters should be observed. Good organisation is essential for this space as its usefulness will depend on how efficiently it is managed. In fact, if the human and material resources are insufficient to maintain the room in optimum conditions, it might even be better to do without this space.

The environmental conditions of the adjacent spaces also need to be controlled, and although strict stability is not required, attention should be paid to all the variables. Works will never remain in these spaces for very long, but a simple oversight, like leaving an item exposed to direct sunlight while waiting to be treated, can cause irreparable damage. An important point to note in this respect is that these spaces should all have their own HVAC systems, rather than sharing the system in the main storage area, in order to prevent the spread of insects, mould/mildew and other undesirable pollutants through these channels.

Furthermore, all the other facilities in the building, such as the restoration workshop, mounting rooms, galleries and other areas through which works without protection or special packaging may pass, must have temperature and humidity control systems, accesses compatible with the systems used to transport unprotected works and smooth continuous flooring. Ramps and stairs should be avoided as far as possible to prevent vibrations that may affect the preservation of the works.

Box 1: Criteria to consider when planning an archive in terms of the building

- Potential growth of the collection.
- Load-bearing capacity.
- Appropriate environmental conditions.
- Situation inside the building.
- Location of MEP and HVAC systems.
- Suitable building materials and fixtures.
- Compartmentalised space.
- Adjoining yet independent spaces.

1.1.2. Conditions of use and furnishing of spaces used to store a contemporary collection of works on paper. In order to preserve a collection in optimum conditions, the space designated for the archive should be used for that specific purpose and no other. In other words, it should not be used as a reference area, a work space, a place of transit or a conference room.

With regard to equipment, the space should have the appropriate light, security, environmental control (HVAC) and access conditions, as well as an Internet connection and suitable furniture.

A special **lighting** system must be installed and used sparingly and selectively. If the space is to be used exclusively as an archive, it cannot have

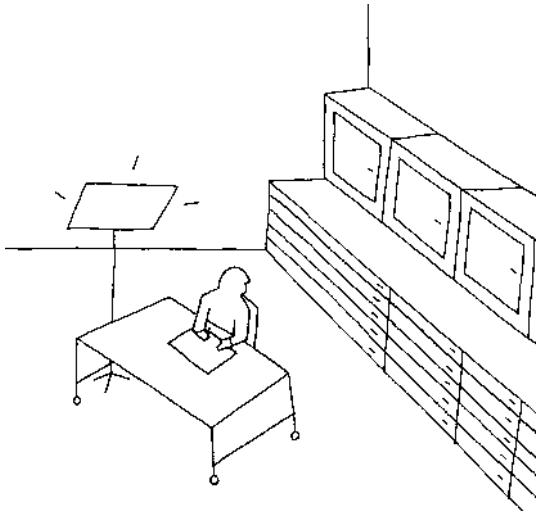
the same lights as those used in the rest of the building for other purposes. The lights must be switched off at all times except for the exact length of time required for the staff to enter the archive and carry out their task. In this respect, the people who have access to this room should only enter it to search for an item or for maintenance purposes (cleaning, surveillance, etc.). Therefore, a cold light emitted by long-life energy-saving bulbs with an ultraviolet (UV) filter and a light intensity of 50 lux will be sufficient. Another aspect to bear in mind when planning the lighting system is the possibility of installing it in independent modules so that all the lights do not need to be turned on every time someone enters the space. When distributing the light fixtures, it is important to avoid incompatibilities with the furniture and ensure that maintenance jobs, such as changing bulbs, and inspections of the different elements can be carried out without hazard to the artworks or their enclosures.

An archive of the type contemplated here must have an appropriate anti-theft and fire-prevention **security** system.

In relation to the **furniture** required for the archive, this should be limited to the bare minimum; all obsolete or unserviceable furniture must be removed. The market currently offers a wide variety of models and systems, and it should therefore be possible to choose the furniture best suited to the format of the works in the collection. One of the minimum requirements of the system chosen, apart from its suitability to the purpose in hand, is its robustness. This rules out wooden furniture, because even though wood helps to stabilise humidity levels it is highly inflammable and prone to attack by numerous biological organisms. Besides, if rotting wood furniture is not isolated properly, it releases oxidising gases that cause silver-based images and paper to yellow. Thus, furniture with a chrome or metal alloy finish, like anodised aluminium, is the best choice because of its chemical stability.

Inside the archive, the furniture should be arranged so that all items in the collection are easily accessible. Furthermore, the furniture should not be in direct contact with the floor, ceiling or walls to avoid humidity in the building structure caused by capillary rising damp or flooding, and to minimise the impact of dust that may have settled on the floor and is dislodged by people passing through the rooms. When arranging the furniture it is also important not to block the HVAC systems or compromise security system functions.

In addition to storage furniture, there should also be a small desk that collection managers can use for reference purposes in situ or for inspecting or preparing a work for transport.



Inspection equipment in storage area

With regard to **environmental control**, the archive should have an HVAC system to maintain the appropriate levels of temperature, humidity and air quality. Several factors need to be taken into account to guarantee the efficiency of an HVAC system, such as the specific characteristics of the collection, its geographical and physical location, the cubic volume of the archive and the existence of any objects that might obstruct air flow. Climate control systems create a specific air quality, pump it into a space and maintain the desired parameters. They can heat, cool or ventilate a room, as well as moisten or dehumidify the atmosphere. Installing and implementing such a system requires an initial outlay of funds and regular maintenance, which must be taken into account when planning a long-term conservation system.

A monitoring system to obtain key information about the conditions of the building is another requisite feature. It is also important to bear in mind that all control methods installed should be continuous—that is, they must operate 24 hours a day, 365 days a year. They should also be automated to preclude subjective decisions about their use.

Both the reference room and the transit room must have **Internet access** and be connected to the collection management Intranet via Ethernet, Wi-Fi and mobile.

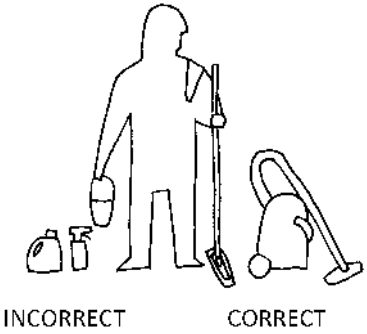
Box 2: Criteria to consider when planning an archive in terms of its intended use and furnishings

- Separate space.
- Access.
- Environmental control.
- Ventilation.
- Security.
- Adequate furniture.
- Monitoring systems.
- Internet access.

1.2. Archive access. Particular importance should be paid to physical access to the archive, since this implies direct access to the artworks and it is also the means of entry for most of the risks to which they are exposed (pollutants, fire, etc.). The doors leading into the archive must therefore meet stringent security and fire-prevention standards. Double doors are also recommended to prevent draughts and contamination by dust from the outside.

1.3. Maintenance and cleaning strategies. The archive has to be cleaned on a daily basis to prevent the accumulation of dust and particulates. Depending on the characteristics of the materials and frequency of use, the archive will also require more thorough cleaning from time to time, and once a year all the furniture and installations will have to be inspected.

All high-risk chemical cleaning products, such as solvents, solutions, detergents, etc., are to be avoided. Daily cleaning must be performed exclusively with dry methods, using a vacuum cleaner, dust mop and dry cloths. Extreme care must be taken to ensure that these cleaning materials



Cleaning

are only used in the archive and don't have any contact with those used for general cleaning purposes, and all cleaning tools and products must be stored outside the archive. A very important point to note in this respect is that while the cleaning staff may remove the surface dust from folders and furniture, only restorers may clean the actual works and their enclosures. Also, under no circumstances should the cleaning staff move or alter the position of the items in storage. We strongly advise drawing up a set of clear, concise instructions for the cleaning staff so they know exactly which tasks they have to perform, which procedures to follow and which products they are allowed to use. Ideally, a system for recording these tasks should also be implemented. All of these documents should be reviewed and approved in advance by the collection caretaker.

1.4. Security. The security of the archive is a matter of great importance because, as noted above, it is the place where the artworks spend most of their time. An efficient security system should contemplate the possibilities of theft, fire, flooding, improper use and natural disasters. In all of these cases, two different types of sensors should be used so that, if one system fails, the integrity of the collection is still guaranteed by the backup system. The archive must be fitted with systems to detect intruders and

burglars, such as window break detectors, motion sensors, etc. Human surveillance by trained personnel is also important. At the end of the day, it is they who will control and maintain security logs on the people and materials that enter and exit the archive. Another important aspect to bear in mind is that all the security systems must be connected to the central alarm station. They must also function in complete darkness or in very poor light, given that light is a very harmful agent of deterioration. One of the improper practices that the security system must prevent is leaving the lights on when there is no one working in the space.

With regard to fire prevention, there must be sensors as well as a manual extinction system. The market offers a wide range of systems, such as optical, ion, thermostat, flame and rate-of-rise heat detectors. Whichever system is installed, it must trigger an alarm to alert the security guard and it must be connected to the local fire department to guarantee immediate response. The system chosen should also automatically shut down other equipment, such as the electrical and climate control systems.

Table 1: Storage security and prevention systems

Theft	Natural disasters	Fire prevention	Flooding	Improper use
Physical barriers (bars on windows, security locks).	Specific devices for exceptional circumstances (archive located in high areas, earthquake-proof buildings, etc.).	Physical barriers (entrance doors, use of fireproof materials).	Physical devices (water evacuation systems, drains, pumps, etc.).	Staff training. Posters or leaflets publicising basic guidelines.
Electronic systems. Guaranteed power supply for security systems with sensors to detect interruption of supply.	Electronic systems. Guaranteed power supply for security systems.	Electronic systems.	Electronic systems. Guaranteed power supply for security systems.	Electronic systems.
Human surveillance / regular inspections of the systems.	Human surveillance / connection with government emergency response systems.	Human surveillance / regular inspections of the systems.	Human surveillance / regular inspections of the systems.	Human surveillance.

With regard to the manual extinction systems, the fire extinguishers must be strategically located to ensure immediate access in an emergency. There are many types of extinguishers containing different agents. The best one in the case of a collection of works on paper is an extinguisher that does not leave any residue, which rules out foam and water extinguishers. The preferred types are therefore those that contain inert gases (though not halon, as this is now illegal due to its harmful effects on the ozone layer). However, gas extinguishers should only be used for fires when there are no metals or combustible gases present, and they are only effective in airtight environments. Another drawback is that they cause a sharp drop in temperature, which can create condensation on the materials. In the event of a large fire where staff may be in danger, fire fighters will use water, which means that high-capacity drainage systems must be installed in all protected areas.

With regard to the response from the fire department, it is important to bear in mind that once the building has been evacuated only the fire fighters will have access to it. Consequently, to ensure that their intervention is as efficient as possible and causes the least possible damage to the materials in storage, the project and design of this space should be approved by them.

Both the detection and manual extinction systems must be properly maintained and inspected regularly to guarantee their efficiency.

With regard to flooding, the prevention systems include, as noted above, choosing the appropriate location for the archives (in this respect basements should be avoided) and ensuring that no water pipes pass through these spaces. However, one of the greatest risks is presented by the climate control systems, which can cause condensation. It is therefore important, as with all the other installations, to exercise caution and plan regular inspections to ensure that they are in proper working order and minimise the risk of flooding.

1.4.1. Risk management plan. One of the most important things to bear in mind when planning a conservation system is the implementation of an efficient risk management plan. Although most disasters are unpredictable or the result of circumstances beyond reasonable control, a well-planned prevention structure can attenuate their consequences considerably. The creation of a "Risk Management Plan", which every institution should draw up based on the specific risks to which its collection is exposed,

is beyond the scope of this guide. However, the conservation plan should contemplate the internationally recognised Spanish standard UNE 31000:2010, *Gestion del riesgo: Principios y directrices* [Risk Management-Principles and Guidelines] adopted in Spain in 2010. One of the objectives outlined in the introduction to this standard is the need to establish a set of principles that must be met in order to guarantee that risks are managed efficiently. This standard recommends that organisations create, implement and continuously improve a framework in which to integrate risk management in all governance, strategy, planning, managing and reporting processes, as well as in their corporate policies, values and culture. The standard itself contemplates establishing this plan either for the entire organisation or for each area, which implies that an institution must be in a position to draw up a risk management plan whose purpose is consistent with the scope of this guide: in other words, a plan for the storage, handling and exhibition of works on paper.

2. ENVIRONMENTAL CONDITIONS

Preserving a collection entails analysing key environmental factors, such as temperature, humidity, light, air quality and biological activity, which have an enormous impact on the conservation of cultural assets. Stefan Michalski refers to the parameters considered here as "incorrect temperature" and "incorrect relative humidity", the inference being that temperature and humidity in themselves are factors that cannot be avoided (unlike infestations and fire, which can be treated), while "incorrect" temperature and humidity can be corrected. Planning a system to control these variables is a task that requires careful consideration and efficient, decisive action because deterioration stemming from incorrect environmental conditions is often irreversible. Proper planning is the best possible environmental control system. In the case of paper, which is a hygroscopic material, the harmful influence of inappropriate surroundings can have a devastating effect on its conservation.

Standard UNE-EN 15757:2011, *Conservación del patrimonio cultural. Especificaciones de temperatura y humedad relativa para limitar los daños mecánicos causados por el clima a los materiales orgánicos higroscópicos* [Conservation of Cultural Assets. Specifications for Temperature and

Relative Humidity to Limit Climate-Induced Mechanical Damage in Organic Hygroscopic Materials] states in the introduction that it is not easy to determine the optimum temperature and humidity ranges for conservation purposes, due to the variety and complexity of the materials of which the objects are composed.

A few decades ago, humidity and temperature control was governed by a set of simple, inflexible standards. The aim was to obtain a temperature of 21 degrees Celsius and a relative humidity of 50%, with only minor fluctuations. Nowadays, however, experts agree that optimum levels of temperature and relative humidity are not universal and should not be extrapolated to all materials. Specifically, works on paper require a lower temperature and humidity level. Furthermore, a collection of works on paper may contain objects with different technical characteristics, which means that the appropriate environmental conditions will have to be defined on a case-by-case basis and solutions devised to overcome any incompatibilities.

Consequently, based on the premise that the optimum values are not universal, it seems logical that the first step should be to ascertain the influence of the local climate on the collection in order to determine the environmental parameters that will define the conservation plan. Current practices tend to focus not so much on correcting the situation through sophisticated heating and climate control systems as on preventing incorrect environmental conditions and promoting energy efficiency and environmental sustainability through insulation and natural ventilation measures. In short, this means approaching climate control from a more eco-friendly, sustainable perspective. The aforementioned standard proposes a methodology based on analysing the historical annual averages and examining the most vulnerable objects. Today, the ultimate goal is to achieve the greatest possible stability of the parameters: the best environment is the most stable one. Consequently, it is sometimes more beneficial not to move too far away from the initial environmental values and to try to avoid sharp fluctuations, rather than trying to create ideal temperature and relative humidity parameters. In short, the aim is to avoid sharp and frequent variations in temperature and relative humidity and to achieve zero fluctuations in the daily cycle, meaning that values should remain constant over the course of 24 hours, regardless of whether it is day or night. In keeping with the recommendations of the standard, the

historical annual averages—defined as the climate conditions of the micro-environment in which a cultural property has always been kept or has remained for a long time (at least one year) and to which it has acclimated—must be maintained as closely as possible when the object is moved elsewhere for exhibition or restoration purposes. This means that these conditions must also be maintained during the transport and exhibition of works, although, as explained in Chapter 3 of this guide, this requires striking a balance between conservation demands and human comfort, insofar as the exhibition conditions are concerned.

Box 3: Basic recommendations on environmental conditions

- Identify the historical annual average of temperature and relative humidity levels.
- Define the climate control levels according to the specific characteristics of the works in the collection.
- Maintain the climate conditions best suited to the characteristics of the collection, creating, if possible, separate areas for different types of works.
- Avoid abrupt changes.
- Strive to maintain a constant balance between parameters in order to preserve the environmental ecosystem.
- Prevent incorrect environmental conditions, rather than correct them.

2.1. Temperature. As indicated above, in conservation terms temperature and humidity are closely related and should therefore be controlled jointly. As interdependent factors, variations in one value affect the other and have an impact on how the materials behave. Although we have already seen that, rather than setting universal parameters, the trend today is to establish thresholds beyond which the probability of deterioration increases,[1] a set of more or less acceptable ranges is provided here as a reference for users of this guide. However, these parameters are not set in stone and the importance of identifying the environmental conditions of our particular collection cannot be overestimated.

Temperature values are easy to modify using heating or cooling systems. The international recommendations for preserving cellulosic materials is around 18°C maximum, with a fluctuation of less than 2°C and a maximum daily fluctuation of no more than 1.5°C. In general, for works on paper, a temperature above 23°C doubles the speed of chemical reactions and, by extension, the degradation of the materials.

[1] Climate risk tables drawn up by Stefan Michalski.

Photographs are a different matter. Due to their chemical instability, they need to be preserved in the long term at lower temperatures, as cold significantly prolongs their original state. In fact, the manufacturers of photographic film and paper publish tables stating the estimated lifetime of their products. Reducing the temperature in an archive by 5°C can double the lifetime of a colour photograph. Nowadays it is generally accepted that cold storage is the most efficient way to preserve chemically unstable photographic materials. It is also possible to make estimations regarding the ideal conditions for preserving the archived material for more than one thousand years, although this requires establishing a set of very strict procedures to control relative humidity.

Table 2: Storage temperatures for works on paper

Works on paper	Black and white photographs	Colour photographs
18°C. Fluctuations of +-2°C.	18°C or less. Fluctuations of +-2°C.	Cold storage (4°C or less).

However, the following parameters and factors must be taken into account when creating cold storage conditions:

- Long-term storage.
- Hibernation.
- The possibility of removing individual images without causing any deterioration to the others.
- Economic sustainability (equipment and energy).

Cold storage is regarded as a long-term solution and works are therefore only removed from the conditions created in exceptional cases and in accordance with a fixed procedure and a very strict protocol. For this reason, a photographic collection that is used on a regular basis should not be stored at very low temperatures, as the thermal shock that can occur is more harmful from the conservation point of view than the hypothetical ideal condition of sub-zero temperatures.

The data in Table 3 is based on the findings that Michalski[2] published in 1999 and offers a set of temperature and relative humidity specifications for

[2] Compiled by Stefan Michalski and the CCI for inclusion in the ASHRAE guide, first published in 1999 and reprinted in 2004 and 2007 (*Indoor Air Quality Guide*, Atlanta: ASHRAE, 2009).

mechanical control systems in museums, as well as the risks and benefits for chemically unstable collections, such as photographic collections, whether they are protected in different types of storage areas or on display in a gallery.

Exposing photographs to higher temperatures by removing the material directly from cold storage, without any form of protection, can cause irreversible damage to the works. For example, a cold material that is suddenly exposed to a room temperature of 18°C causes water particles to condense on the cold surface, producing droplets of water. Consequently, items kept in cold storage must always be protected by the right kind of material. Even so, if they are not allowed to acclimate slowly and gradually, the material stress caused by the sudden change in temperature may be accompanied by alterations in the various material components of the works, as these react differently to a rise in temperature. Another risk is

Table 3: Storage of chemically unstable collections (Michalski)

Collection type	Temperature and relative humidity (RH) adjustment levels or annual average	Maximum fluctuations and gradients in controlled spaces	Risks/benefits for collections
Chemically unstable collections.	Cold storage: -20°C and 40% RH.	+-2°C and +-10% RH.	Chemically unstable objects remain usable for thousands of years. RH fluctuations that last for less than one month do not affect the majority of archives preserved properly at these temperatures. (The time spent outside the archive impacts on lifespan.)
	Cool storage: +-10°C and 30–50% RH.	Even if only achieved during one winter, this is a net advantage to collections as long as damp is not incurred.	Chemically unstable objects remain usable for a century or longer. Books and papers tend to have low mechanical vulnerability to fluctuations.
Exhibition galleries in general.	Temperature between 15 and 25°C. 50% RH (or annual historical average for permanent collections).	Precision control with no seasonal changes (+-2°C and +-5% RH).	Chemically unstable objects become unusable in decades.

the precipitation of water droplets on the materials due to the relative humidity inside the bag and the dew point, depending on their thermal conductivity.

In the conservation of colour photographs stored in the dark, it has been demonstrated that, even in conditions where relative humidity is controlled, an incorrect temperature can cause damage. This is because of Arrhenius' equation, according to which a rise in temperature increases the rate of a chemical reaction.

2.2. Humidity. Humidity control is a very important factor as it is more difficult to stabilise given its direct relationship with other factors, such as temperature and ventilation. Furthermore, its effects on works on paper are extremely harmful as it can lead to the development of microorganisms and to reactions that cause the hydrolytic and oxidative degradation of paper.

In conservation, humidity is generally referred to as relative humidity (RH), as opposed to absolute humidity, which would be the total amount of water vapour present in a given volume of air. Relative humidity values refer to the amount of water present in the atmosphere at a given temperature in relation to the maximum amount of water that could be present at the same temperature. This relationship is expressed as a percentage, where 100 is the maximum value. In normal everyday conditions, relative humidity tends to regulate itself, so that when the temperature rises the relative humidity falls. Meanwhile, heat causes seawater to evaporate, which tends to raise the relative humidity.

The different components of a work on a cellulosic support contain different proportions of water and react differently when the concentration rises or falls. Depending on the concentration value, cellulosic materials swell or shrink and undergo changes in their molecular structures. Maintaining a balance is fundamental because paper needs an internal degree of humidity of around 7%, which involves a relative atmospheric humidity of 50%. Below these values, paper dries out and loses solidity and elasticity. Above them, microorganisms proliferate and the cellulose oxidises.

Some authors advocate relative humidity values of between 30 and 60%, while others suggest moderate values of around 45 to 65%. In the specific case of photography, the ideal relative humidity is estimated to be between 30 and 50%, with fluctuations of less than 5% (values recommend by the International Organisation for Standardisation [ISO]). However, there are exceptions to this general rule, such as the case of cellulose acetate

Table 4: Recommended temperature and relative humidity values for storing different types of works on paper*		
Black and white photographs	**Temperature**	**Relative humidity**
Cellulose nitrate.	10–16°C.	15–50%.
Cellulose esters.	Below 21°C.	15–50%.
Polyester supports.	Below 21°C.	30–50%.
Paper.	15–25°C.	30–50%.
Colour photographs	**Temperature**	**Relative humidity**
Polyester supports.	Below 2°C (in precision controlled conditions as low as -31°C).	25–30%.
Cellulose esters.	Below 2°C (in precision controlled conditions as low as -31°C).	15–30%.
Works on paper	**Temperature**	**Relative humidity**
Different media.	18°C.	35–50%.

* Data extracted from different sources. See, for example, ANSI/NISO Z39.79-2001, *Environmental Conditions for Exhibiting Library and Archival Materials*, published in 2001 by the National Information Standards Organization; and Jordi Mestre i Vergés: *Identificación y conservación de fotografías*, Gijón: Trea, 2004.

film, which should be kept in an atmosphere where relative humidity is below 30%.

Fluctuations in relative humidity are an important factor in the deterioration of objects with heterogeneous components, like photographs, in which the different materials from which they are made have different hygroscopic reactions that can lead to stress and warping. Gelatin prints, for example, tend to curve outwards when the relative humidity is too high and inwards when it is too low, because gelatin is more hygroscopic than paper and has a greater tendency to swell. Consequently, it is important to avoid major cyclical fluctuations, such as those derived from switching on and off the HVAC system every day. HVAC systems should function 24 hours a day, 365 days a year.

Table 5 states maximum temperature values that should never be exceeded. The standard recommends -20°C for cold storage, but as a practical guideline rather than as a limit. However, it is more categorical regarding the stability of chromogenic prints, which is between ten

Table 5: Maximum temperature and average relative humidity ranges for long-term storage*

Process	Maximum temperature	Relative humidity range
Silver halide (b/w prints). Silver dye. Western blot. Dye/silver (snapshots). Dye transfer. Pigment. Diazo.	18°C. Maximum daily fluctuations of +-2°C.	30–50%. Maximum daily fluctuations of +-5%.
Chromogenic dye. Dye-sublimation printing.** Ink injection printing.**	-20 to 2°C. -20 to 5°C.	30–40%.

* Values taken from UNE 54129:2003, *Materiales para imágenes. Fotografías de reflexión procesadas. Prácticas de almacenamiento* [*Imaging Materials-Processed Photographic Reflection Prints-Storage Practices*].
** These values are taken from the 2011 international version of the same standard (ISO 18920:2011, *Imaging Materials-Reflection Prints-Storage Practices*).

and fifteen times higher when they are stored at 2°C compared to room temperature.

As the contents of Table 5 illustrate, identical climate conditions cannot be established for all works, although the basic principle "store in a cool and dry place" applies to all types. As a general rule the stable temperature should be as low as possible, around 18–20°C, and the relative humidity at approximately 40%. However, these conditions do not apply to colour photographs, which require cold storage.

Another interesting and increasingly important issue is how to store digital images processed with contemporary technologies, like dye-sublimation printers and inkjet plotters, which are gradually beginning to enter the collections of many institutions and museums. Little by little, environmental resistance and ageing tests are being conducted and providing values for inclusion in reference tables regarding the recommended storage conditions for works of this type. Naturally, their stability depends on the quality of the paper or image support and on

the quality of the inks used. The paper must be of the highest possible quality, preferably premium quality photographic paper with long-term conservation properties.

2.3. Light. Light is a form of energy that causes alterations in works on paper, such as the fading of the dyes used and the photodegradation of paper. Light falling on paper triggers photochemical and photo-oxidative reactions that cause the ageing that leads to yellowing and a loss of resistance. Consequently, in storage rooms it is very important to prevent the exposure of the works to luminous radiation. In fact, the archive should be in total darkness. Another point to bear in mind is that the effects of exposure to light are accumulative and irreversible: the effect of a single exposure to a given light intensity is exactly the same as many short exposures to the same light intensity that amount to the same length of time. As explained in the section on furniture used to store the collection, this means that while the works are in the archive the lights should only be switched on for as long as it is strictly necessary for maintenance or inspection purposes. In any case, and as pointed out before, the light intensity should not exceed 50 lux and the light source must not emit UV (the most harmful) or infrared (IR) rays. If this cannot be avoided, every precaution must be taken to ensure that radiation does not reach the works.

2.4. Air quality. Another factor to bear in mind with regard to the preventive conservation of the collection is the air quality of the ecosystem inside the storage area. Once again, cleanliness and keeping facilities in perfect condition, combined with proper ventilation, are effective measures for avoiding risks that can compromise the integrity of the collection.

Pollutants can come from sources both outside and inside the storage area, but it is important to remember that not even the oxygen in the air is innocuous. In fact, oxygen is what causes materials to oxidise. There is an undeniable direct relationship between the concentration of pollutants and the risk of degradation, and there is no question that the greater the air quality and, therefore, the smaller the concentration of pollutant particles, the better the collection will be preserved. As with the climate conditions, the degree of protection required will largely depend on the pollution levels of the external environment and the characteristics of the collection, as well as on the sustainability of the plan we choose to implement.

There are two different approaches to controlling pollutants according to their provenance, that is, whether they are external or internal. With regard to the former, it is a question of preventing them from entering the archive's atmosphere. In the case of the latter, various measures can be taken to avoid them.

2.4.1. **External pollutants.** The presence of pollutant substances in the air is now regarded as an important risk factor in the conservation of art collections as a result of increasing levels of urban pollution in recent decades and its demonstrably harmful effects. As with all the other factors, the actual effects vary according to the type of material, although photographs are particularly sensitive to chemical contamination.

Table 6: Principal pollutants*

Name	Description	Maximum concentration (volume of parts per billion)
Sulphur dioxide (SO_2).	Acidic gas. Turns into sulphuric acid when it comes in contact with materials. It is the compound responsible for acid rain.	5–10.
Nitrogen oxides (NOx).	Formed when nitrogen combines with oxygen. Nitrate cellulose supports, such as celluloid, also emit these gases when they decompose. Nitrous and nitric acids damage most materials.	5–10.
Ozone (O_3).	A secondary pollutant generated by the complex photochemical reactions of primary pollutants when exposed to oxygen and the sun's UV rays.	5–10.
Peroxides.	Like ozone, formed by the reactions of primary pollutants. An oxidising agent that causes materials to age.	No data.
Hydrogen sulphide (H_2S).	It specifically oxidises silver and is therefore very harmful to photographs.	No data.
Volatile organic compounds.	Gases emitted by different products (hydrocarbons, solvents, etc.).	No data.

* Table drawn up in accordance with standard UNE 54110:2000, *Información y documentación. Requisitos en el almacenamiento de documentos para materiales de archivos y bibliotecas* (Information and Documentation-Document Storage Requirements for Archive and Library Materials). No data is given when not provided in the standard.

2.4.2. **Internal pollutants.** Internal pollutants arise from the presence of materials that are harmful to the works and originate in the works themselves, as well as from building materials, the furniture or the enclosures of the works. As far as possible, the presence of materials that give off damaging volatile compounds and the use of toxic products must be avoided. Strict control, isolation and ventilation are the key procedures to be followed in this respect.

Table 7: Basic pollution problems*

Pollutants	Sensitive material	Risk	Hazards, sources	Risk reduction methods
External sources (primarily)				
Particles, especially silicates (sand) and carbon (smoke).	All artefacts, especially if porous or with a complex surface.	Soiling. Accelerated corrosion of bright metals. Damage during subsequent cleaning.	Blowing sand, dust. Urban pollution, especially traffic.	Enclose artefacts in airtight cases, packages or cabinets. Reduce outside air entry to the building, especially during peak traffic or dust storms. Operate the building's filters.
Ozone. Nitrogen dioxide. Sulphur dioxide.	Some colorants in watercolours and illuminations (indigo, crimson, basic fuchsia, curcumin).	Colour fading.	Urban pollution, especially traffic.	
Internal sources (primarily)				
Hydrogen sulphide.	Silver.	Silver tarnishing (and subsequent abrasive cleaning).	Rubber compounds. Wool when exposed to UV radiation. Humans.	Avoid all listed sources inside display cases. Avoid all listed sources in rooms and furnishings. Seal or coat any source used in construction.
Carboxylic acids.	Lead. Carbonates, such as shells.	Lead tarnishes. Shells effloresce.	Wood and wood fibre products. Oil and alkyd paints. Water-based paints while fresh.	

* Stefan Michalski: "Care and Preservation of Collections", in *Running a Museum: A Practical Handbook*, Paris: UNESCO, 2006, p. 82.

Creating constant, adequate ventilation not only helps to stabilise the temperature and relative humidity but avoids the accumulation of dust, volatile gases and pollutant particles. It is also important to keep the atmosphere in storage rooms free of solid airborne particulates and, in particular, of any chemical substances that may be harmful to the stability of photographic works.

2.5. Biological action. Maintaining the appropriate temperature and humidity conditions and cleanliness are the key factors for preserving works in storage from the harmful effects of biological action. The very nature of collections on paper makes the archive a particularly attractive place, as a source of food, for a wide range of living organisms.

2.5.1. Animals. Any activity caused by the cohabitation of animals in a storage area is extremely damaging. The presence of animals in an archive of works on paper, even if they are pets and do not feed on paper, is to be avoided at all costs since they may be carrying numerous parasites that do.

The most common and possibly the most harmful species are rodents, which live in buildings without being seen and can make holes and enter storage rooms almost imperceptibly. Their activity poses a serious threat, not only because of their destructive capacity as they search for food (they eat and gnaw on all kinds of organic materials) but also because of the excrement they leave in their wake. Rodents also reproduce very quickly and can form large colonies in a very short space of time.

2.5.2. Insects. If due care is not taken, insects have a tendency to circulate freely through spaces dedicated to storing artworks. As indicated above, a storage facility can be an important source of food and therefore attracts a wide variety of species. Furthermore, the presence of insects can attract other species or predators (such as arachnids), which may colonise the archive and generate similarly harmful activity.

Regurgitated remains of paper, detritus, eggs, nests or insect remains are clear signs of undesirable biochemical activity in the archive that will undoubtedly have an effect on the objects we want to preserve. Paper surfaces that have been eroded and perforated, emulsions eaten away, excrement stains and grime are all the results of activity that should be prevented before it occurs.

Table 8: Most common insects and materials damaged in the storage of works on paper

Order	Family	Common name	Material damaged	Signs of its presence
Blattodea.	Blattidae. Blattellidae.	Cockroaches.	Paper/cardboard. Glues of animal origin. Glues of plant origin.	Damaged materials. Excrement.
Zygentoma.	Lepismatidae.	Silverfish.	Paper/cardboard. Photographs. Glues of animal origin. Glues of plant origin.	Damaged materials. Discovery of nymphs or adults.
Coleoptera.	Anobiidae. Dermestidae. Lyctidae. Nicobidae.	Woodworms. Moths. Beetles.	Paper/cardboard. Glues of animal origin. Glues of plant origin.	
Isoptera.	Mastotermitidae. Hodotermitidae. Rhinotermitidae. Termitidae. Kalotermitidae.	Termites.	Paper/cardboard. Photographs. Glues of animal origin. Glues of plant origin.	Discovery of nymphs or adults. Damaged materials. Grains of excrement.
Corrodentia.	Liposcelidae.	Booklice.	Paper/cardboard. Glues of animal origin. Glues of plant origin.	Damaged materials. Discovery of nymphs or adults.

The most common species include the following:

- **Silverfish**. This species takes its name from the grey, metallic sheen of its body. It has a very characteristic appearance with two long antennae sprouting from the head and three similar tail-like appendages. The silvery grey colour comes from its scales, which appear after its third moult. It may grow to one centimetre

long, not including the extremities, and it is very agile, with a strong negative phototaxis, which means that it shies away from the light. Silverfish feed off various plant materials, such as mould, paper, starchy foods and other polysaccharides, such as the glues used in book-binding (dextrines) and the gelatins found in photographic emulsions. This is also one of the few species that can digest cellulose. The female has a high reproductive rate at temperatures between 25 and 30°C and can lay up to one hundred eggs. It is less active in cold, dry atmospheres.

- **Cockroaches**. Frequently found in warm, damp, inhabited places, these omnivores can be very harmful in storage rooms of collections on paper, since they will eat any organic material, such as starches, gelatins and glues. They are mainly active at night and have a very high reproductive rate. There is a variety of wood roach belonging to the *Cryptocercus* genus which, although unable to digest cellulose, maintains a symbiotic relationship with protozoa that can digest it, allowing them to derive nutrients. In this respect it is similar to the termite (current research suggests that the *Cryptocercus* genus is more closely related to termites than other *Blattodea*).
- **Termites**. *Isoptera* belong to an order of *Neoptera* insects known as termites, drywood termites, dampwood termites or white ants, the latter on account of the fact that they resemble ants. These social insects build nests (mounds), sometimes at quite a distance from the affected area, with tunnel-like galleries through which they move in the darkness. They feed off the cellulose found in wood and its derivatives, which they can break down thanks to the action of protozoa in their digestive systems, with which they maintain a symbiotic relationship. Although most termites are found in tropical or subtropical climates, some species live in temperate climates and colonies can also be found in coastal towns or trade hubs. They are not easy to detect as they shy away from sunlight and live in the least visible areas, and the holes they make do not always show. Sometimes objects in storage may look fine on the outside but be severely damaged on the inside. Their presence is usually revealed by dead specimens or detached wings.
- **Booklice**. These members of the *Neoptera* group are around six millimetres long and vary in colour from translucent grey to light

yellow or dark brown. They have a soft body, may be winged or wingless, and thrive in damp conditions at a temperature of around 25°C. They are omnivores and their diet includes starches and gelatins.

- **Moths**. The various species of moths that feed off and cause deterioration to paper, fabrics and leather are small, nocturnal butterflies. They cause the greatest damage during the larval stage.
- **Coleoptera**. This family includes the common woodworm, a species with chewing mouthparts and hard front wings (elytra) that serve as shields. Most woodworms can fly by raising their elytra and spreading their hind wings. These insects can cause extensive damage to collections of works on paper.

Table 9: Optimum temperature and relative humidity levels for insects to thrive in an archive of works on paper

Insects	Temperature	Relative humidity
Silverfish.	16–25°C.	90%.
Termites.	26–30°C.	97–100%.
Cockroaches.	25–30°C.	>70%.
Booklice.	25–30°C.	75%.
Coleoptera (woodworms).	18–28°C.	70–90%.

2.5.3. Mould/mildew and bacteria. These are primitive living organisms that cannot synthesise food and therefore feed off organic matter in the manner of parasites. They are microscopic and reproduce by sporulation, and they thrive and are active in warm, dark atmospheres. Mould and mildew are the most damaging types of fungus for art collections. Large concentrations of spores form inside the hyphae, fluffy filaments that spread across the surface of the infected material, and are then released into the air and dispersed, often remaining alive but dormant for long periods of time. Once they land on materials that provide them with nutrients, such as paper, gelatins, glues and other organic substances, in the right environmental conditions the spores are reactivated and hatch new colonies of mould. The appearance of coloured stains is a sure sign that they are acting on the support material on which they are growing, with the consequent deterioration of the object.

The best way to eliminate mould and mildew is by vacuum methods. It is vital to act quickly, taking care not to spread the spores. The cleaning equipment used should then be sterilised to prevent the growth of new colonies through the propagation of spores.

Table 10: Optimum conditions for the growth of mould/mildew and bacteria on photographs

Microorganism	Temperature	Relative humidity	pH
Bacteria.	25–37°C.	85%.	7–8.
Mould/mildew.	22–38°C.	70%.	4–6.

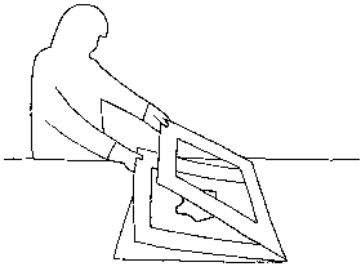
3. ENCLOSURES AND STORAGE

One of the issues that a collection must contemplate is the specific space where the works are placed and how they are stored. In addition to performing the vital function of protecting the works, an archive should permit easy, comfortable access for reference and examination purposes. Every work in the collection should have three layers of protection:

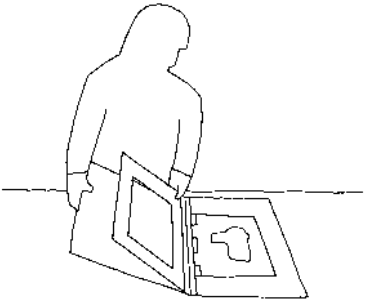
- Individual storage material.
- Collective storage material.
- Storage furniture.

However, although we recommend three levels of protection—for example, a work may be protected inside an envelope which is kept inside a folder, which is kept inside a flat file cabinet—in practice this is not always the case. Depending on their characteristics, works are sometimes placed directly in collective folders and these in flat file cabinets, or a work with individual protection might be placed in the cabinet directly (for example, a work mounted in a mat folder that is placed directly in a flat file cabinet).

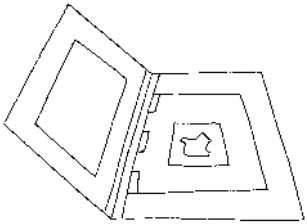
3.1. How to store works. Every item in the collection must be protected individually to ensure that its entire surface is preserved. The individual package of a work—that is, the material and type of enclosure in which it is protected—is one of the most important decisions in collection care.



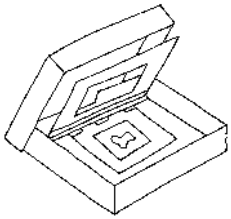
Using a mat folder for individual protection



Mounting a protective cover for a hinge-mounted work stored individually in a mat folder



Mounting a work for individual protection in a mat folder with lateral hinges



Conservation box for storing various works with individual protective enclosures

After all, this enclosure is going to be in direct contact with the work for many years, and if it is not of good quality and properly made it can cause irreparable damage. The most common materials used for individual enclosures are paper, cardboard and plastic, and the most common types of enclosures are folders, mat folders with windows, envelopes and sleeves.

Table 11: Advantages and disadvantages of materials used to make individual protective enclosures

	Paper/cardboard	Plastic
Advantages.	Inexpensive. Can be written on in pencil. Doesn't scratch. Protects contents from light. Being porous, it acts as a buffer against environmental changes and the gases released by unstable materials.	Transparent. More physically resistant than paper. Can be heat-sealed, avoiding the use of glues that may contaminate the paper of the protected work. Waterproof. Insulates from dust particles.
Disadvantages.	Works are handled more frequently, as the material's opacity prevents direct observation. Poor resistance.	As a relatively new material (50–100 years old), its long-term performance is unknown. Doesn't trap dust. Attracts dust through static electricity. Doesn't protect contents from light. Easily scratched. Non-transpiring. In conditions of high relative humidity, it sticks to photographic emulsions. Made out of non-renewable materials.

In any case, not all papers and plastics are suitable for use as direct enclosures, and the characteristics of the material must be suited to its intended purpose in each case. Specifically, to be used with photographs, they must pass the Photographic Activity Test, a standardised international test (ISO 18916:2007, *Imaging Materials-Processed Imaging Materials-Photographic Activity Test for Enclosure Materials*) that evaluates the interactions between photographic images and the enclosures in which they are stored. Table 12 illustrates the requirements they must meet.

Table 12: Required characteristics of materials used as individual protective enclosures for works on paper

Paper	Plastic	Cardboard
pH=7 (neutral or slightly alkaline). Preferably white. Made out of rag, cotton or purified wood pulp. Soft, smooth surface. Must not contain lignin. Paper whitened with bleaching agents is to be avoided. If the paper is glued, it must be with gelatin or starch. In general, use paper with an alkaline reserve, except in the following procedures, where envelopes without an alkaline reserve are preferred to prevent discolouration: Calotypes and salted paper in general. Albumen paper. Modern colour procedures, both in positives and negatives.	**Polyester** (PET). The best plastic for conservation enclosures due to its chemical stability and hard-wearing properties. It does not burn and is very transparent. Mylar D film is the recommended polyester for conservation enclosures. **Polypropylene** (PP). As transparent and chemically stable as polyester but quite fragile. **Polyethylene** (PE). Chemically stable, this is the softest and most malleable plastic of the three. However, it is also the least transparent and is permeable to water vapour.	Should be consistent, sturdy and capable of being folded and creased without breaking. Made out of cotton fibres or purified wood pulp. pH factor of up to 8.5 (neutral or slightly alkaline). Depending on the type of work being preserved, it may require an alkaline buffer.

Table 13: Characteristics to be avoided in materials used as individual protective enclosures for works on paper

Paper	Plastic	Cardboard
Acid pH. Brightly coloured paper. Glassine paper.	Chlorine in the composition or cladding (e.g. PVC).	Acid pH. Made with mechanical wood pulp. Industrial-grade cardboards.

Table 14: Most common types of individual protective enclosures for works on paper

Name	Description	Indications	Disadvantages
Envelopes and sleeves.	A variety of types adapted to the works: open on one or two sides, or with a single flap as large as the envelope to avoid marks. Another very common type is the four-flap envelope in the shape of a Maltese cross, which offers greater security and protection than thin folders and open envelopes. They should ideally be made of a single piece to avoid glues, but if adhesives are used they should have a neutral pH and be reversible and stable.	For very small works or works whose condition requires individual protection.	The direct contact of the material with the emulsion or treated part can exert pressure through friction.
Folders.	Two pieces of 100% cotton card with a neutral pH and alkaline reserve joined together by a flexible material like cloth.	One work per folder is recommended (if combined, a maximum of ten).	Unwieldy for reference purposes if too many works are in one folder.
Conservation window folders.	Folders with a window on the front showing the work inside that is protected by a sheet of transparent Mylar film.	For small and medium-sized works or frequently exhibited works, as they can be displayed with the folder inside the frame.	They considerably increase the bulk of each work.
Protective boxes.	A variety of types adapted to the works. They should be larger than the protected work but not overly large to prevent the work from moving inside. The material should have a neutral pH with an alkaline reserve. They should ideally be made of a single piece to avoid glues, but if adhesives are used they should have a neutral pH and be reversible and stable.	For small leaflets, letters and documents that need to be kept together, each placed in its own envelope inside the box.	

Table 14: Most common types of individual protective enclosures for works on paper (cont.)			
Archival tubes.	The work is rolled inside a compact cylinder made of inert material and slightly larger than the work itself.	Only used for large documents and when there is no other viable option. It is advisable to make copies of documents that are frequently consulted.	Handling problems. Not recommended for fragile documents containing temperas, charcoals or pastel crayons, or for documents in poor condition. The support loses its shape and the medium can suffer alterations.
Capsules.	Custom-built enclosures made of sheets of aluminium and plastic. Heat-sealed.	For long-term conservation of works at low temperatures.	Very expensive. The work needs to acclimate to the conservation temperature before it is placed inside the capsule. Capsules enclose the entire atmosphere around the work, including spores and pollutants. If the material is not stable it will release gases that cannot be eliminated due to the absence of ventilation.

There are also a series of common household materials that should be avoided, such as staples, paper clips, erasers, adhesive tape, artificial solvent glues or protective glass.

With regard to the individual enclosures, these can either be purchased ready-made or tailor-made, depending on the quantity needed, whether the formats are standard or not and the price. In any case, they should be suited to the characteristics of the work (medium, format, type of paper, etc.) and appropriate for its conservation and use.

In her manual on conservation mounting for prints and drawings,[3] Joanna M. Kosek lists five possibilities that should be considered before protecting the work, depending on the anticipated use of the mount:

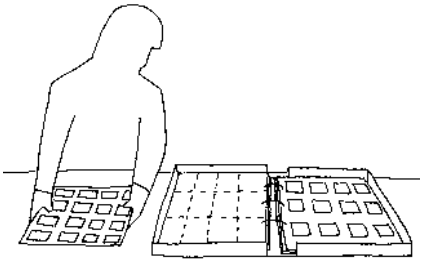
- Storage with occasional handling.
- Storage and handling.
- Storage, handling and exhibition.

[3] Joanna M. Kosek: *Conservation Mounting for Prints and Drawings: A Manual Based on Current Practice at the British Museum*, London: Archetype Publications, 2004, p. 30.

- Storage and exhibition.
- Temporary exhibition.

Most of these enclosures are made out of paper or plastic, but while plastic is sometimes preferred because of its transparency, resistance and variety, this is not always the case as plastics have their own drawbacks, such as attracting more dust.

3.2. Collective storage types and protective measures. There are many systems for storing collections. The most common types are drawer cabinets, closed shelving and compact cupboards, each of which has its own advantages and disadvantages. As shown in Table 15, a combination of all three systems may be used depending on the conservation factors involved (spatial, economic, specific characteristics, etc.). In the case of photography collections, the items are usually stored in their original order and by provenance, taking care that the materials are not packed too tightly or too loosely. Photo albums are treated as single photographic objects and as such their integrity and original arrangement should be preserved. Another common criterion used is the organisation of the collection by format to save space, facilitate safe handling or avoid unnecessary pressure.



Storing negatives

Objects should always be stored horizontally, except where the format of the work requires a different orientation or in the case of small photographs whose dimensions do not exceed 28 x 36 centimetres, which can be stored vertically or horizontally according to the collective system chosen.

Table 15: Collective storage systems for collections

	Advantages	Disadvantages
Drawers or flat file cabinets.	Easy access to works if they are not too full. Ideal for preserving flat graphic works. Shallow drawers are recommended to avoid storage of too many works in the same drawer.	The formats currently on the market are not always suitable for the works to be stored.
Closed shelving and compact cupboards with boxes.	Large storage capacity. Maximum protection from dust and luminous radiation. They mitigate the effects of environmental changes. They provide a physical barrier against possible incidents (impacts, pollutant gas absorption, leaks, flooding, etc.).	The old-fashioned boxes used for storing photographic materials are not recommended since the materials from which they are made release acids that are extremely harmful from a conservation perspective.

4. SOCIAL CONDITIONS

4.1. Access: loans and reference service. If it meets the requirements described in this guide, the storage facility offers the best possible conditions for the conservation of works of art: on the one hand, these are released from the constraints and pressures of public display, and on the other they benefit from measures designed to protect them from potentially altering factors. We might even say that works in storage are "sleeping", shielded from stress and deterioration.

A place that has to meet such stringent requirements and allows only the narrowest range of variations clearly needs to be further protected by restricted access, limited to what is strictly necessary. However, a collection storage area should contemplate at least four different access circumstances and establish a set of criteria for each of them. Table 16 lists these circumstances and the personnel involved.

The institution should establish criteria governing storage access in all of the above cases, but from the conservation point of view this is particularly important in the case of loans and access by external researchers.

Table 16: Archive access: process, personnel and duration		
Process	Personnel	Duration
Building maintenance.	Maintenance/cleaning staff.	As scheduled/daily.
Collection maintenance.	Conservation/restoration staff. Handling staff.	As scheduled.
Loans.	Collection staff. Conservation/restoration staff. Handling staff.	As needed.
Research access.	Internal and external researchers. Handling staff.	As needed, according to the criteria established by the institution.

With regard to loan criteria, the opinion of the conservator-restorers should always be respected. External researchers should only be allowed access to the reference room adjacent to the storage facility, taking all appropriate protective measures and using the material and human resources specified in the criteria that the institution will have established for these purposes.

5. INSPECTIONS

A conservation plan must monitor the procedures implemented in order to achieve the desired goals. Collection managers should therefore establish a specific protocol for issues related to the inspection of the building and its environmental conditions, the condition and conservation of the collection and the management of the tasks performed and the procedures carried out. If the institution already has a quality management system and a risk management plan, these inspections will be part of the organisation's management scheme and the system will integrate all of these protocols.

5.1. Inspection of the building and equipment. Regular inspections must be carried out to guarantee the correct maintenance of the building that houses the collection and to ensure that everything functions as planned. Inspection protocols should be drawn up for each

risk factor. In relation to the building, this means checking and reviewing all systems and equipment—HVAC, security, fire detection and extinction, electrical, monitoring, etc.—as well as structural elements such as walls, ceilings, windows, etc., to prevent leaks and other malfunctions that could compromise the collection. The control mechanisms for recording environmental factors should also be reviewed. Furthermore, it is vital that the protocol includes inspecting the cleanliness of the archive. In this respect, special attention must be paid to the places most likely to collect dust, such as the more inaccessible nooks and crannies and areas behind, on top of and underneath the furniture. A good solution is to create inspection routines for the storage areas that will detect any problems associated with maintenance tasks.

5.2. Inspection of the collection. The need to review the works in a collection to make sure that they are in perfect condition seems obvious. After all, regular inspection of the collections is a routine duty for conservator-restorers. However, every collection has its own conservation issues, which means that it is impossible to make specific recommendations. We must bear in mind that all works should have been inspected and documented in a detailed condition report when they first entered the archive. Ideally, this report should be entered in a database that keeps track of all studies, inspections and changes the works of art may undergo over time. If any weakness or need for treatment is detected, this must be flagged and addressed in the manner deemed most appropriate by the restorer or collection managers. Assuming that the works are in good condition and have been protected in accordance with the collection's established protocol, they will remain in storage in an environment where optimum conservation conditions are guaranteed, freed from the constraints of exhibition and with all necessary measures in place to protect them from factors of deterioration.

There is no need to systematically subject the works to unnecessary handling in order to monitor the condition of a collection. During the first inspection, we must determine whether the materials used in a work will require periodic check-ups. This process can be managed and automated using the database, where inspection protocols for each at-risk element should be duly entered and followed. Logically, in collections that contain

many works in good condition with stable parameters, a piece may go several years without being inspected. When dealing with very large collections, we should consider the possibility of performing inspections using statistical sampling methods which, if done properly, yield reliable results that guarantee accurate information on the condition of the entire collection. In any case, the condition of a work must always be re-evaluated when it is going to be moved or taken out of storage.

5.3. Inspection of management tasks. Another vital aspect of collection care that should not be overlooked is how conservation tasks are managed. The focus of collection care is long-term conservation, which has a considerable impact on our work. Conservator-restorers play a fundamental role in managing a collection. In addition to carrying out the immediate tasks that are part of their daily routines, they also have to draw up a medium and long-term work schedule to address the conservation needs of the collection in their care and meet the objectives set by the institution. This schedule should be analysed and reviewed on specified dates in order to incorporate any necessary improvements.

CHAPTER 2

HANDLING AND TRANSPORT OF WORKS OF ART ON PAPER

1. INTRODUCTION

The risk of damage increases dramatically when works are moved or handled. In the specific case of works on paper, because they are fragile and particularly vulnerable to mechanical forces, incorrect handling and bad habits can have disastrous consequences that may eventually cause alterations in the works. Moreover, we should not forget that works on paper tend to be small, lightweight objects, meaning that the risk of misplacing or losing them is especially high if not handled properly. Therefore, in any handling or moving process it is very important to have a set of clear, well-defined rules that are followed by an organised, qualified and competent team.

1.1. General principles. The term "handling" refers to the procedures used to move works, whether inside or outside the institution that is their home base. There are many different reasons why a work may need to be handled, from study and research to restoration and exhibition. In any case, while handling works is inevitable, it is also one of the greatest risks faced by any collection. Therefore, one of the basic rules of thumb is that works should always be handled as little as possible and never by anyone other than professionals who understand the importance of what they are handling or supervising. One of the first priorities of any institution owning a collection must be to establish the criteria governing who has access to the works and to set down some basic rules of conduct and handling; in other words, it needs to have a plan for handling works, a procedure clearly specifying the steps that must be followed when handling works and the order in which these are to be performed.

In any collection, the key is to achieve a compromise between accessing and handling the works and ensuring their conservation. This delicate balance can be struck by applying two basic principles:

- Limit handling to what is strictly necessary.
- Avoid incorrect handling practices.

Working from these premises, we can come up with a series of more specific principles that should always be followed:

Box 4: General principles for handling works

- Works must only be handled by staff that is qualified to perform such procedures.
- Eating, drinking and smoking are forbidden while handling a work.
- Do not use sharp tools or materials that may leave indelible marks. Always use pencil.
- Always handle works carefully, with clean, dry hands and adequate protection, such as clean clothes and gloves.
- Remove any rings, bracelets, watches, belt buckles or any other element that might scratch or leave a mark on the surface of the work.
- Immediately notify the appropriate person/s (restorers, collection supervisors, etc.) if you notice that the work is in poor condition (presence of mould, insects, etc.).
- Create staff training programmes.
- Take advantage of handling operations to review and organise the works.
- Provide easy access to detailed and up-to-date information about the works to avoid unnecessary handling.
- Digitise the works.
- Limit the handling of fragile works to what is strictly necessary.
- Prepare an action plan in case of accidents that may occur during handling. If an accident should occur, record all damages.
- Do not move works to another location without documenting the change properly.

The Spanish standard UNE-EN 15946:2012, *Conservación del Patrimonio Cultural. Principios de embalaje para el transporte* [Conservation of Cultural Property-Packing Principles for Transport] and the French standard NF 040-010:2002, *Prescriptions de conservation des documents graphiques et photographiques dans le cadre d'une exposition* [Preservation Requirements for Exhibiting Graphic and Photographic Materials] touch upon many of the issues addressed in this chapter.

2. HANDLING

2.1. Planning handling procedures. One of the fundamental principles of handling is, as mentioned above, to avoid incorrect practices. However, this is not easy to achieve without a well-coordinated action plan that takes into account all the different elements and factors, which are closely interrelated.

Taking into account the principles of minimal and proper handling, the first order of business must be to familiarise ourselves with the work by examining it and studying any existing documentation to assess the risks involved in handling the work and to ensure that handlers have a thorough knowledge of the right methods to use.

Box 5: Planning handling procedures (key steps)

- Identify the steps involved in the handling process.
- Determine the order of those steps.
- Choose the people who will handle the work, based on:
  a/ their qualifications,
  b/ the requirements of the work,
  c/ the requirements of the handling procedure.
- Establish a procedure to monitor the handling process.

2.2. Examination. A visual examination should always be conducted before handling any work. Basically, this consists in inspecting the object and observing its technical features. During this examination we should pay particular attention to the work's condition and decide whether it can be handled without exposing it to an obvious risk of deterioration. We must also determine the most appropriate methods in order to handle the work according to its condition.

Box 6 lists the most important aspects to bear in mind during examination.

Box 6: General guidelines for examining works on paper

- Handle the work as little as possible and examine it on its own support or on a backing board.
- Make a written record of the work's physical characteristics to avoid unnecessary future handling: materials, dimensions (of both the work and the support), detailed description of the reverse, weight, shape and, if it comprises more than one element, a description of how the parts are held together.
- Create a written evaluation of the work's condition and fragility. Locate any damaged or fragile parts and check against the restoration records, if they exist.
- Immediately notify the appropriate person/s (restorers, collection supervisors, etc.) if you notice that the work is in poor condition (presence of mould, insects, etc.).
- Take specific precautions based on the needs of each particular work, such as wearing gloves, masks, etc.

2.3. Risk assessment. After the technical visual examination, we need to conduct a risk assessment. Standard UNE-EN 15946:2012 states that the object should be examined by a conservator-restorer in order to contribute to the decision-making process for moving the object and to indicate any areas where the object may present fragility or vulnerability. It also establishes that this assessment should consider risks related to the nature of the object itself as well as those involved in its handling and transport.

Table 17: Parameters to be considered in a risk assessment	
Related to the object	**Related to handling and transport**
The nature of the object. The media it is made with. The current condition. Previous actions. Maintenance of environmental conditions.	The handling procedure. The location and accessibility of collection and delivery points. The human team and companies responsible for handling and transport. The means of transport and logistics. The physical environment in transit (weather, condition of roads, etc.). The international working conditions and regulations and security risks. The presence or absence of a courier.

2.4. Handling guidelines and principles. In many cases, handling a work of art requires nothing more than the right sensibility and sufficient training to be able to consciously evaluate every aspect of the object, for even the most insignificant handling operation must be performed methodically.

Many of the handling guidelines provided in Box 7 are simply common sense, such as the recommendation that several people handle a single work rather than having one person handle several works. Even so, we feel it is important to review all of them.

We know that photographs are especially vulnerable to physical and chemical deterioration, which is why we also enumerate some of the specific considerations to bear in mind when handling photographs.

Box 7: General guidelines for handling works on paper

General

- Follow the rules of safety when handling.
- Keep the duration and number of handling operations to a minimum. These should always be performed slowly and carefully to minimise the risk of damage such operations inevitably entail.
- Never handle more than one work at a time. Do not stack or pile materials.
- Minimise the need to access original works by creating copies, digitised images or duplicates.
- Use medium-soft lead pencils to write labelling information on the enclosure. If the original must be labelled, use the same type of pencil and make a small mark on the support.

General (cont.)

- Do not fold the work.
- Do not roll up the work. When handling large-format works, the side where the work is should always be facing inwards and protected.
- When handling very old or fragile photographs, it is advisable to be assisted by a photography restorer.

Regarding the space

- Keep the space and work surfaces clean and tidy.
- Make sure to clear a space on the work table before removing the object from storage.
- Never place a work on the floor.

Regarding transit

- Before moving a work, we must plan out the route and make sure that it is clear of obstacles, that all doors along the route are open and that the destination space is prepared to receive the work.
- Avoid brusque movements.
- Use a tray to carry small works and a cart for larger ones. In both cases, the work must always be supported by a rigid backing board.
- Nothing should extend beyond the edges of these trays or carts.
- When moving a work, use suitable packaging material to cushion the work and minimise the risk of vibrations and abrasions.
- Never drag objects.
- Never walk backwards or run.

Regarding environmental conditions

- Be aware of the potential risks of light exposure when handling works on paper.
- When handling photographs kept in cold storage, respect the prescribed acclimation periods.

Regarding the position of the work

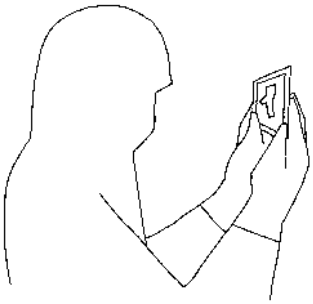
- Unframed works should always be handled in a horizontal position. Framed works should be handled in their habitual upright hanging position.
- When moving a work in an upright position, hold the top side firmly and carefully. If the work is kept in a folder, envelope or sleeve, always note which sides are open to prevent it from slipping out and keep the closed end down.
- Never place works upside down.
- Keep the mount flat and facing up.
- Avoid resting the work on its protruding or fragile parts.

Regarding manual contact

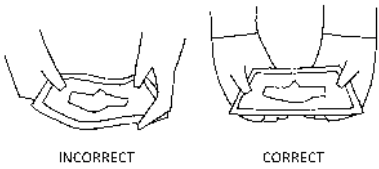
- Avoid any direct contact with the surface of the work to prevent fingerprint marks. Do not apply pressure with the fingers, as this may alter the surface of the image.
- Use the type of gloves best suited to each work.
- Never handle two different types of materials—for example, metal and paper—at the same time.
- Always use both hands, even when handling small-format works.
- Do not lift a work by the corners or edges if they are fragile. Do not hold a work by one corner, as this may warp or distort it.
- If works are stacked in a pile, do not try to remove one by pulling on it; remove them one by one until reaching the desired piece.

Regarding the protection of the work

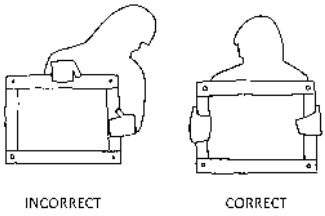
- Protect graphic works with mats, sleeves or boxes and minimise direct handling.
- During handling, works must be protected by a secondary rigid support, such as a folder or box, whose characteristics are suited to the work.
- Only use stable materials that can come into contact with the work without damaging it.



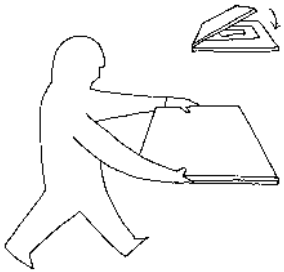
Small-format photographs should be handled with gloves and without touching the emulsion



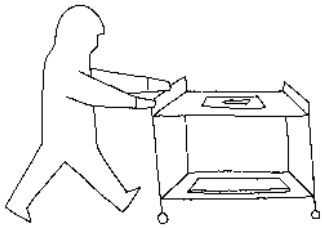
Handling small-format photographs



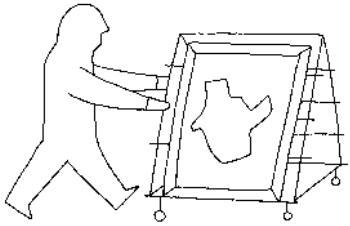
Small framed work carried by a single person



Unprotected medium-format works should be carried horizontally



Cart for moving unframed works



Cart for moving framed works

Works on paper should always be handled with gloves to avoid leaving stains or marks caused by the natural secretions of human skin. In the specific case of photographs, we must also consider the particular sensitivity of emulsions. We also need to remember that different types of works require different types of gloves. Table 18 contains recommendations on the type of gloves to use for each material.

Table 18: Types of gloves recommended for handling works on paper

Material	Works on paper	Photographs
Bare hands.	No.*	No.
Cotton.	Yes.	Yes.
Latex.	Yes.	Yes.
Leather.	No.	No.
Nylon.	No.	No.
Polyethylene.	No.	No.
Vinyl.	Yes.	Yes.
Nitrile rubber gloves.	Yes.	No.
Gloves with rubber nubs.	No.	No.
Thin gloves with textured surface.	No.	No.

* In this case, standard UNE-EN 15946:2012 states that, depending on their characteristics, some works can be handled with bare hands. However, we advise against this.

As Table 18 clearly shows, not all types of gloves are recommended for works on paper or photographs. Even so, we must bear in mind that, although cotton gloves are generally advisable for handling works on paper, they

should not be used if the surface of the work is very rough or textured since the cotton fibres might come into contact with the surface. Vinyl gloves are thinner and offer enhanced sensitivity and better grip than cotton gloves. Latex gloves, which are more resistant to tears but easily perforated, are the most flexible and offer excellent tactile sensitivity, but some people are allergic to this material. Finally, nitrile rubber gloves, which offer good skin protection, should not be used to handle photographs as they may contain traces of sulphur, left over from the vulcanisation process, that would affect objects containing silver or silver composites, such as photographs.

It is important to remember that gloves can reduce manual dexterity. Therefore, we must be particularly alert and take extra precautions when working with them.

3. PROTECTING OBJECTS BEFORE PACKING

3.1. Choice of packaging. Standard UNE-EN 15946:2012 sets out some general principles regarding the choice of packaging materials. Packaging must provide the object with suitable protection, in accordance with the conclusions of the risk assessment. Any material used to pack a work on paper must be highly stable, chemically inert and totally innocuous; therefore, it cannot be abrasive nor have any characteristics that might harm the work. The same principles apply to protective materials and cushioning to absorb shocks and vibrations, as well as to all insulation materials designed to prevent fluctuations in temperature and relative humidity during transit. In most cases, when a work leaves its home institution it embarks on a two-way trip, and packaging materials must therefore retain all of their protective qualities for the duration of both journeys. Another equally important consideration is the fact that packaging materials are not designed to be used in permanent storage and should therefore be reserved exclusively for moving operations. Suitable transport packaging is not necessarily suitable for medium or long-term storage.

If the object is accompanied by monitoring devices or data logging systems, the packaging must provide for them.

Packaging should be designed to facilitate mechanical or manual handling and should be free-standing. The dimensions must be adapted to those of the object, but they must also factor in the constraints of the chosen means

of transport (lorry, aeroplane, etc.). External dimensions must be compatible with the narrowest point to be passed en route. Small objects should be packed together if they are compatible and have the same destination.

Whenever possible, sustainability should be kept in mind when choosing packaging materials and means of transport.

3.2. Surface protection. This innermost protective layer might be described as the first enclosure, as it is in direct contact with the surface of the work. This layer should primarily protect the object from deposits and abrasion. The materials used must be as chemically inert as possible. In some cases, the surface of the object should not be in direct contact with any packaging to avoid deterioration.

3.3. Cushioning. Cushioning is a second layer of packaging whose primary purpose is to protect the work from impact. The material should therefore be selected based on its ability to absorb shocks and vibrations. Only materials compatible with the intended purpose should be used. PVC-type adhesives are totally inadvisable for cushioning.

The type, density, thickness, quantity and position of cushioning must be chosen based on the means of transport and the physical environment, the weight of the object and its packaging, the surface of the object in contact with the cushioning and the object's vulnerability. Cushioning material should also be such that it is not distorted on impact. Material for external protection should be rigid in order to safeguard the work. Cushioning is usually made of plastic, as its durability, stability when exposed to temperature fluctuations, low permeability to gases and liquids and low thermal conductivity make this material an excellent insulator. The most recommended plastics, given their stability, are polyethylenes (usually flexible, shock-absorbent foams like Plastazote) and polystyrenes (normally stiff foam, like Styrofoam, used to line and insulate the interior of boxes and crates).

Remember that cushioning material should support and secure but never compress the object. In addition to mitigating variations in humidity and temperature in transit, these insulating materials must also protect the object from water under normal conditions.

3.4. Rigid enclosures. Finally, all works must be placed in a third layer of packaging. These are always rigid enclosures and may be made

of plastic, wood or metal, but they must always be perfectly prepared to protect the works from isothermal shock. If they are made of wood, the enclosures must comply with regulations governing the use of this material in packaging and crates for international trade in order to prevent pests and insect infestations. In the case of works on paper, the external protection should consist of enclosures or crates adapted to their format.

4. PACKING

Packing should be done in a secure place that has been prepared for this purpose. This place must be very clean and well-lit, and its environmental conditions should be similar to those of the place from which the objects were collected. It must also be spacious enough to allow safe handling of the object, the packaging materials and any necessary equipment. The packing process should be planned in advance, based on the conclusions of the risk assessment completed beforehand. Packing should be performed by qualified staff immediately after the restorer has prepared the work's accompanying condition report. The restorer and, when applicable, the courier should be present during packing. Throughout the process, always observe the basic principles: handle works as little as possible and use proper handling practices.

Box 8: Key steps of the packing process

- Plan every step in advance and make sure that all parties involved are aware of these steps.
- Prepare and deliver the empty packaging to the packing location at least 24 hours in advance to allow time for acclimation.
- Check the packaging to make sure it is in perfect condition and suitable for the work to be transported.
- Clear routes before moving the object.
- Check the condition of the object against the accompanying condition report.

Works must be clearly identified at all times. To this end, markings should be made inside the crate and on the cushioning to facilitate packing, unpacking and repacking. Crates should also be labelled on the outside with markings that conform to standard EN-ISO 780, using durable materials. Packed crates must be clearly marked as "packed" or "full", while unpacked crates must be labelled "unpacked" or "empty".

It is important to remember that, once the work has been packed, the crate should be placed in the position for which it was designed. The crate may be moved to a different position to open or close it, but afterwards it should always be returned to the position indicated by the markings on the outside of the crate.

If the work is to be shipped by air, the institution must be certified as a KC (Known Consignor), which authorises it to pack and prepare air cargo at its own facilities. This certification means that crates can be loaded directly on the aircraft without having to undergo airport inspections that might cause serious damage to the work (for example, if the crates are opened in unsuitable environmental conditions). However, it also means that strict security measures must be in place at the time of packing to make sure the consignment is not manipulated in any way, and that the packing process can only be performed in the presence of trained personnel, known as AvSec staff, in order for the goods to be considered "identifiable air cargo". If other people are present during the process (couriers, for example), they must be accompanied by AvSec staff at all times.

These security measures will only apply to outgoing air shipments of artworks in the following cases:

- Air shipments of works loaned to other institutions.
- Return of works received on loan for temporary exhibitions.

5. TRANSPORT

Works of art are usually transported by a specialised haulage contractor, who also handles the packing, collection and transport to the exhibition venue and guarantees its return in the same conditions.

Works may be transported by land (road or rail), air or sea. Each type of transport has specific advantages and disadvantages, aside from those inherent to any moving operation, which will always condition the nature of the packaging elements used in transit. In general, the preferred method for moving works of art is by road, as it involves the least amount of handling. For longer or transoceanic journeys, works are preferably shipped by air. When considering transport alternatives, we must plan out the route that the objects must travel to reach the exhibition venue, considering the

preventive conservation needs of each work and always attempting to take the shortest possible route.

Today, overland transport of artworks is a highly specialised, sophisticated industry. The vehicles are fitted with electronic monitoring devices and equipment that guarantee a high-quality service thanks to innovative technology that minimises the risks involved in moving cultural assets (fire-detection and extinguishing systems, systems for measuring and regulating temperature and humidity from the cab, anti-theft alarm systems, GPS devices that track the cargo's location at all times, etc.).

Table 19: Means of transport for works on paper

	Road	Air
Advantages.	Fewer loading/unloading operations. Flexible schedules. Controlled environmental conditions. Less expensive. Excellent features. Safety.	Adequate when road transport is not an option. Faster in long distances.
Disadvantages.	Vibrations.	Changes in air pressure. Handling on pallets. Mixed cargo. Risk of vibrations due to air turbulence.

When transporting works on paper by air, if the packed object is small enough it should travel in the passenger cabin with the courier supervising the transport operation. Otherwise, it will need to travel inside an enclosure in the cargo hold. If this is not possible due to its size, the crate must travel on a suitable pallet in the position indicated by the external markings. In such cases, we will need to consider what other kinds of cargo will be in the hold during the flight (live or dead animals, food, toxic products, etc.). Another important decision from a conservation perspective is choosing the most direct flight routes in order to keep the number of layovers to an absolute minimum to avoid the risks involved in changing aircraft (delays, fluctuating air pressure, etc.).

Maritime transport is generally indicated for works that are very large or very bulky, which is not usually the case of works on paper. Therefore, this means of transport is not recommended for such objects. Moreover, shipping works by sea would mean exposing a hygroscopic material (paper) to very high humidity.

Whatever the chosen means of transport, crates should always be secured on pallets inside the lorry, aircraft or vessel, arranged lengthwise in the direction of travel and placed in the position for which they were designed. This position should be indicated on the outside of the crates with orientation arrows.

Crates must be carried one at a time by at least two people (unless they are small and can be carried comfortably by one person using both hands). If wheeled systems are used, these should be designed to create as little vibration as possible, and the crates must be held in place by a person at all times. A crate must never be left unattended on a wheeled device.

Finally, it is important to note that a representative of the collection, preferably a conservator-restorer, should ideally supervise every step in the process of handling the crates.

6. UNLOADING AND REGISTRATION

These are vital considerations when planning any artwork transport operation. Therefore, both unloading and registration should be planned in advance, making sure that all necessary human and material resources are in place at the time of arrival.

Like every process, registration involves a number of sequential steps which are described in Box 9.

Box 9: Key steps in the registration of incoming works

- Identify each incoming object and check it against the packing list.
- If any modifications or irregularities are detected, note them immediately on the delivery receipt.
- If infestation is detected, or suspected, immediately isolate the entire shipment and notify the owner/custodian of the work.
- If the shipment is in order, move it to a prepared acclimation area to await unpacking.

7. UNPACKING

First of all, we must prepare a spacious area where the works can be unpacked properly. This space must have environmental conditions similar to those of the work's destination. It also needs to be a safe, secure place equipped with all the materials needed to properly unpack the shipment. Among other requirements, it should have an area where objects can be placed for inspection, with enough room to allow safe handling of both the object and the packaging.

Before removing the packaging, we must make sure that the works have had time to acclimate to their destination. Once the acclimation time has elapsed, we can begin to open the packaging. This should be done in accordance with the instructions given by the owner/custodian of the work, under the supervision of the consignee and in the presence of a conservator-restorer and a representative of the work's owner/custodian.

At this stage in the process, it is advisable to draw up a report detailing the unpacking sequence, the original packing method and the orientation of the object, which will make the job of repacking much easier. The contents of the shipment must also be checked against the inventory list. After removing the objects the packaging should be checked to make sure that no pieces have been overlooked. Once this has been done in the presence of a representative of the owner/custodian, a conservator-restorer must examine the objects and draw up a condition report documenting all the characteristics of the works at the time of their delivery to the receiving institution.

If there is even the slightest suspicion of infestation while unpacking, the packaging and all its contents must be isolated and the owner/custodian notified of the situation immediately.

Finally, given that most works will eventually return to their place of origin, unless otherwise specified all original packaging must be stored together. If there is a crate, packaging should be placed inside along with the crate's interior fittings, which should not be removed.

Empty packaging to be used for repacking should be stored in a clean, secure storage area, preferably in conditions (temperature and relative humidity) as similar as possible to those in the area from which the objects will be collected. If this is not possible, these materials should

Box 10: Key steps of the unpacking process

- Prepare a suitable space in which to perform the unpacking operation with the same environmental conditions as the work's intended destination.
- Leave the packaged items in this space at least 24 hours for acclimation.
- Remove the packaging in the presence of at least one representative of the owner/custodian and a conservator-restorer.
- Prepare a detailed report of the unpacking process.
- Check the contents against the inventory list.
- Check the packaging to make sure that no pieces have been overlooked.
- If an infestation is suspected, isolate the packaging and all its contents and immediately inform the owner/custodian.
- Have a conservator-restorer inspect the objects and prepare a condition report.

be acclimated prior to repacking so that their environmental conditions match those of the objects.

Packaging must be labelled for identification and clearly marked as "full" or "empty".

8. ACCOMPANYING DOCUMENTS

Throughout the process, a number of documents are created and must accompany the work as it travels.

Table 20: Documentation generated in transport operations

Document	Prepared by
Condition report (outgoing works).	Conservator-restorer.
Loan agreement.	Lender.
Packing list.	Haulage contractor.
KC certificate (for air cargo).	AvSec staff at the institution.
Condition report in transit (for multi-leg trips).	Haulage contractor and representative of the work's owner/custodian.
Export permit (if required).	Government authority.
Customs declaration (if required).	Government authority.
Receipt of delivery of the works.	Borrower.
Condition report (incoming works).	Conservator-restorer.

CHAPTER 3

EXHIBITING WORKS OF ART ON PAPER

1. INTRODUCTION

An exhibition project involves a great many people. In addition to the curator, the exhibition designer and the various people with technical and administrative responsibilities, proper conservation of the works also requires the involvement of specific staff to mount and handle the works, as well as the mandatory presence of a professional conservator-restorer who will often be ultimately responsible for verifying that the works are in perfect conditions to be exhibited and that the venue and display elements meet the necessary requirements for exhibiting the works. One of the most dangerous moments in the lifetime of a work is when it is being handled. Mounting an exhibition is a particularly risky endeavour as it entails handling and moving a large number of works at the same time. Therefore, it is vital that every operation be performed by specially trained staff with a thorough knowledge of the material needs and physical/chemical condition of each object.

2. EXHIBITION HALLS

The following paragraphs describe a series of factors we cannot afford to overlook and which must always be taken into account when planning a temporary exhibition. It is also important to remember that the exhibition halls must be prepared well in advance to ensure that they are ready to receive the works when the mounting process begins.

2.1. Determining factors in an exhibition

2.1.1. Physical conditions

2.1.1.1. The venue. One of the first things we must consider is the physical conditions and technical requirements of the venue where the exhibition will be held. It is important to make sure that this space will provide the right conditions for the work's maintenance and conservation while it is on display.

Obtaining a facilities report that describes the characteristics of the exhibition venue (number of rooms, location of windows and doors, partitions, etc.) is crucial, especially when it comes to designing the exhibition layout. The distribution and location of the pieces and

the itinerary and flow of foot traffic must all be designed with the works' safety and wellbeing in mind: for example, displaying works on paper in a place exposed to direct sunlight that cannot be controlled or exceeds the established limits of light intensity is something to be avoided at all costs.

We must therefore bear in mind the location of windows and doors and of all elements of the lighting, HVAC and security systems, and make sure that the building materials and finishes are chemically stable, solid and strong enough to support the mounts and display systems, the works themselves and heavy foot traffic. Another equally important consideration when conducting a preliminary assessment of the venue is to note any structural problems in the building that may affect the works, such as damp or poor insulation. Ideally, the walls should also have a smooth finish.

2.1.2. Material conditions

2.1.2.1. Equipment. In addition to meeting a series of physical requirements, a space used to display works on paper must also be equipped with everything needed to guarantee the preservation and proper exhibition of the works. We know that works are at the greatest risk when they are being handled or exhibited, and we must therefore take every precaution in such cases.

We need to make sure that the exhibition venue has an appropriate HVAC system with devices for monitoring environmental variables (temperature, relative humidity and air quality) that operate 24 hours a day, as well as security and fire-prevention systems.

2.1.2.2. Maintenance. A maintenance plan should be drawn up for the duration of the exhibition, addressing all of the factors that may affect the preservation of the works. Depending on the total display time, the following matters must be considered:

1. Regularly checking the condition of the works.
2. Cleaning the halls, display cases and frames.
3. Verifying that the following systems are working properly:
    - Lighting.
    - HVAC.
    - Security.
    - Fire-prevention.

In the case of cleaning and security, the two maintenance tasks that require the daily presence of personnel in the exhibition space, conservation training activities should be organised to explain the special methods to be used in each job position and the duties each person is expected to perform. It is important to provide the cleaning staff with a set of guidelines, specifying which systems and products to use and the procedures they need to follow. We recommend that all cleaning be done with vacuum cleaners or dust mops, avoiding brooms (as they stir up dust) and the use of water-based products and solvents.

2.2. Environmental conditions

2.2.1. **Temperature and relative humidity.** A work on paper is a hygroscopic material that absorbs or releases water, depending on the humidity of the air around it. When discussing the ideal conditions for exhibiting works on paper we must bear in mind that our goal is to achieve a compromise between what is best for the works and an environment that is comfortable for humans. In most cases, the works will be coming from a storage facility with optimum conservation conditions, and we must prepare them to be temporarily exposed to a different set of environmental variables. Any change in environmental conditions should be effected slowly and gradually, which is why we need to allow the works time to acclimate to the new exhibition environment. We must also consider that the works may not always come from the same place. We therefore need to know the original circumstances of every piece in order to design a customised acclimation process for each particular case. Designing an exhibition in a location with a Mediterranean climate is very different from designing a winter show in a Nordic country. Determining the right parameters for each exhibition venue is a complicated task in which several variables must be taken into account. Nevertheless, most conservators agree on a series of general values: the recommended level of relative humidity is between 45 and 60% (in other words, an average of 50–55% with a permissible fluctuation of +-5%), while the recommended room temperature is an average of 18°C with fluctuations of +-2°C.

Table 21: Benchmark parameters for temperature and relative humidity when exhibiting works on paper

Temperature	Relative humidity
18–20°C.	50–55%.

When dealing with works that require special conditions outside the benchmark ranges, special display systems must be provided (cases with independent climate control or additional regulating devices).

Box 11: Considerations regarding temperature and humidity

- To strike a balance between the work's conservation requirements and human comfort levels.
- To provide an acclimation period for the work between the archive and the exhibition venue.
- To consider the conditions at each work's place of origin.
- To consider the climate of the location where the exhibition will be held.
- If necessary, to provide special cases to regulate temperature and humidity levels for individual works.

2.2.2. **Air quality.** In the first chapter of this guide, we discussed the importance of good ventilation in storage areas to prevent the build-up of dust, volatile gases and pollutant particulates. As we saw, HVAC systems include a ventilation system responsible for filtering internal and external airborne pollutants.

All of the rules and recommendations for storage rooms also apply to exhibition spaces, but in the latter we have to consider an additional element: the pollutant effect of visitors, whose body heat causes the room temperature to rise and whose movements generate airflow and currents that cause dust to circulate through the air. Consequently, large numbers of visitors must be controlled as they represent a source of pollution in exhibitions.

2.2.3. **Lighting.** Lighting is one of the key factors that allow a work to be properly appreciated in an exhibition. However, according to many conservation professionals, it is also one of the most problematic, primarily because it requires finding a compromise between acceptable levels for preserving the work (light is a very powerful agent of deterioration), viewing the work and guaranteeing the comfort of the audiences who view it.

Some of the factors we must consider when trying to decide how to light works on paper are:

- The light source.
- The light intensity.
- Ultraviolet and infrared radiation.
- The exposure time.
- The correct location of light sources.
- The distance between light source and object.

Light sources may be natural or artificial, and we can combine both to achieve the most suitable lighting for the exhibition discourse. However, in order to also consider what is best for the work from a conservation perspective, we must take the following steps:

a) If the room is exposed to natural light, we must protect all means of entry with UV filtering materials, such as special curtains that attenuate and diffuse beams of light, or block those openings by creating structures that prevent sunlight from falling directly on the works. In the case of works on paper, given their sensitivity and high vulnerability to light, we strongly advise against using any exhibition room with a source of natural light. Works on paper can generally tolerate a maximum light level of 70 lux, free of ultraviolet and infrared radiation, though this may vary from case to case. Therefore, any opening that allows sunlight into the room must be carefully protected and controlled, and we also need to consider where light will fall, as the trajectory of the solar cycle changes throughout the year.
b) In the case of venues with artificial lighting, the market offers a wide variety of lamps and light fixtures, and we must choose the ones that best meet the conservation requirements of our works—today there are many fluorescent, LED and halogen lamps that have virtually no emission in the ultraviolet and infrared spectra.

With regard to light intensity, we know that its deteriorating power depends on one intrinsic factor—its spectral composition—and two extrinsic factors—the composition of the illuminated material and the accumulative nature of the effects of light. This means that light intensity and exposure

time have a reciprocal influence on deterioration: exposing an object to 40 lux for 300 hours has the same effect as exposing it to 12,000 lux for one hour. Therefore, spectral composition, exposure time, intensity and the composition of the object must all be taken into account when determining the most appropriate lighting system. With regard to spectral composition, we know that visible light is harmful from a conservation perspective, but so are infrared and ultraviolet rays: infrared light has thermal effects that trigger physical and chemical reactions and ultraviolet light causes chemical reactions and colour degradation. The latest studies have established four levels of protection according to the degree of sensitivity to light:

- No sensitivity.
- Low sensitivity.
- Medium sensitivity.
- High sensitivity.

Works on paper—whether they are drawings, prints, photographs or other media—are, as we know, particularly fragile and therefore fall under the "high sensitivity" category.

The lux is the unit of measurement for light intensity. When mounting an exhibition, we can use the parameters shown in Table 22 as benchmarks.

The values listed on Table 22 clearly indicate that works on paper should be exposed to light for short periods of time, as luminous radiation is undoubtedly one of the worst enemies of paper.

If the light source is artificial, lighting possibilities will depend on the existing electrical installations and the characteristics of the works we are exhibiting. In any case, we can offer a series of considerations to bear in mind:

Firstly, we must study and determine where the light sources should be located and the angle at which light should fall on each work to avoid shadows or glare that might impede proper appreciation of the piece. Secondly, we need to calculate the distance carefully, as every light source is also a source of heat and, if situated too close to a work, can have the undesirable effect of causing the piece's temperature to rise. On the other hand, if it is too far away the work may be difficult to see, as light intensity is inversely proportional to the square of the distance between source and object.

Table 22: Recommended light intensity levels

Sensitivity level	Materials	Light intensity	Cumulative intensity*	Annual maximum**
High sensitivity.	Felt-tip and regular pen ink, anilines, plant lakes, synthetic lakes, shellac-based dyes, paper-tinting dyes, severely degraded paper, 19th-century photographs, salted paper, albumen paper, etc., as well as colour photographs with "color" in their brand name (Kodacolor, Fujicolor, etc.).	40 lux.	400 lux/day.	32,000 lux/year.
Medium sensitivity.	Colour photographs with "chrome" in their brand name (Kodachrome, Fujichrome, etc.), prints, drawings, watercolours and gouaches.	50 lux.	500 lux/day.	40,000 lux/year.
Low sensitivity.	Pastels, acrylics, charcoal, Conté crayon, chalk, plaster or gesso, temperas, oils, rag paper and modern archive-quality black and white photographs.	70 lux maximum.	700 lux/day.	56,000 lux/year.

* 10 hours/day.
** 80 days (approximately three months of exhibition per year).

Another factor to bear in mind is that an illuminated object may serve as a source of reflected light. In the case of works on paper this is an interesting possibility, as we can use devices like display cases with sloping surfaces as indirect light sources to reflect the direct illumination of other works.

2.3. Social conditions

2.3.1. **The human factor.** The ultimate goal of any exhibition is quite simple: to make a work of art available to the public. In order to achieve this goal, we must strike a balance between the best possible conditions for both the works and the visiting public. In other words, we need to create conditions of public access and visibility that are compatible with the need

to preserve and safeguard the works. However, in order to achieve exactly the right kind of balance, we must always be aware that human beings represent a major risk to the works on display.

People create hazardous situations in an exhibition by introducing certain factors which can be classified as avoidable or unavoidable, depending on the degree of personal volition involved. Table 23 lists these factors and their possible solutions.

Table 23: Risks posed by visitors to an exhibition

	Factor	Solution
Avoidable.	Vandalism. Theft and burglary. Terrorism.	Human and mechanical surveillance. Access control. Specific protection for cultural assets on display. Security plans. Passive protection (cases, burglar-proof glass, etc.).
Unavoidable.	Changes in environmental conditions caused by human presence (rising temperature and decreasing relative humidity).	Controlling the number of visitors. Keeping the HVAC system in perfect working order.
	Dust dislodged by people moving about the room.	Cleaning the exhibition space carefully and frequently. Smooth flooring that doesn't attract particles. Keeping air filters in the HVAC system in perfect working order.
	Introduction of insects, germs and other harmful airborne substances.	Cleaning the exhibition space carefully and frequently. Keeping the space well-insulated. Keeping air filters in the HVAC system in perfect working order.
	Involuntary accidents.	Carefully planning the distribution of the works and furniture. Security plans.

2.3.2. Protective security measures. Security is a fundamental part of conservation. Institutions that host public exhibitions are required to comply with all current legislation regarding safety and emergency evacuation plans. They must also guarantee the safety of the heritage in their care by using all technical and human resources at their disposal. Consequently, in addition to fire-prevention and intruder/theft-detection systems, such institutions also need to establish a system of human surveillance, to control access to the exhibition halls and the number of people permitted inside, and to devise training plans for all employees involved in the exhibition.

Exhibiting works should never be incompatible with the goal of caring for and preserving them for future generations. In an exhibition venue we can have up to four different levels of protection against avoidable human factors, which, after all, are the only ones we can actually do something about. The display systems themselves, such as frames or cases, are considered the first security level. Physical and visual barriers comprise the second level. On the third level we have electronic devices. And the fourth level is human surveillance. All of these elements serve to dissuade and discourage what we might call antisocial acts.

Table 24: Security levels and protection systems in an exhibition venue

Level	System	Protection
1.	Frames and cases.	Environmental and tactile. Direct protection of the work.
2.	Physical (ropes) and visual barriers (floor tape and different coloured flooring). "Do not touch" signs.	Visual. Marks minimum distance from works. Indirect protection of the work.
3.	Electronic devices (anti-theft and barrier systems).	Audible. Marks minimum distance from works. Indirect protection of the work.
4.	Human surveillance.	Visual and audible. Marks minimum distance from works. Indirect protection of the work.

Something else we need to consider is the degree of access we should allow in each area while the works are being mounted (access for external personnel, controlling entry/exit of materials, controlling movements of cultural assets, etc.).

3. PRESENTING AND MOUNTING WORKS

Mounting an exhibition is one of the most critical moments for the works from a conservation perspective. The convergence of countless different tasks in this hectic work period, when the entire exhibition design finally takes shape, makes it a particularly hazardous situation for cultural assets.

All guidelines regarding the handling and installation of the works must be strictly observed when mounting and setting up the works. Security measures should also be very tight.

3.1. Preparing the space.

Before mounting a work, the venue must be fully prepared and the distribution plan finalised. All equipment and furnishings required for the exhibition should also be built or installed. In order to have a perfectly prepared venue, all outfitting work (painting, carpentry, electrical installations, etc.) must be finished well in advance of the works' arrival, giving the space sufficient time to dry and be cleared of any lingering substances or odours (like wet paint or pollutant fumes) that might harm the works. Moreover, any paint, varnish or material that might come in contact with the works should be highly stable, with a chemical composition that does not pose a threat to the works.

Table 25: Advisable and inadvisable paints and varnishes

Can be used	To be avoided
Acrylic emulsion paints for interior and exterior.	Alkyd paints.
Acrylic urethane paints.	Oil-based paints.
Polyurethane-based liquid plastic paints.	Latex varnishes.
Vinyl acrylic paints.	Anti-corrosive paints.

From a conservation perspective, it is important to create a spatial distribution that allows foot traffic to flow smoothly through the space, preventing congestion or overcrowding in areas near vulnerable works.

In this preinstallation phase, we must begin to monitor temperature and relative humidity levels to ensure that the works will find themselves in the right environmental conditions—logically, the same conditions required for their exhibition—when they enter the exhibition space. In addition to the HVAC system, we must check that the security, lighting, fire-prevention, and all other, systems are working properly and ready to receive the works in the exhibition venue. During this period, it is important to monitor environmental conditions to make sure that the works are acclimating correctly and not suffering any alterations.

Finally, we must check the venue to ensure that all tools and machinery have been removed, and have the room methodically and thoroughly cleaned so that the exhibition space is fully prepared to receive the works.

Box 12: Aspects to bear in mind when preparing the exhibition venue

- Completion of all outfitting and preparations before the works' arrival.
- Suitable spatial distribution favouring the smooth flow of foot traffic.
- Use of chemically stable materials that will not harm works.
- Correct functioning of all systems affecting conservation of the works (HVAC, security, lighting, audiovisuals, etc.).
- Thorough cleaning of the venue once all preparations are complete and before the works' arrival.
- Removal of all machinery, tools and unnecessary equipment used to prepare the venue.

3.2. Equipment and furnishings. In most cases, the equipment and furnishings required for the exhibition are prepared at the same time as the exhibition space itself. In addition to the exhibition furnishings, we will need several auxiliary elements for the setup process: a clean, spacious, well-lit area and a work table large enough to handle and examine the objects in good security and lighting conditions, with enough room to spread out the works and attach mounting elements like mats and frames.

Most works on paper are framed for exhibition, although display cases are also frequently used. Although the use of display cases has occasionally been questioned, as some feel that they distract from the works themselves, they are often necessary for conservation purposes as they provide excellent physical protection against shocks and vibrations and are efficient barriers against environmental agents and dust. Display cases also allow us to create different microclimates in a single space that can be efficiently monitored by environmental control systems. In this respect,

cases can serve as both viewing and preservation devices. However, a display case is only useful if it meets the necessary requirements. In fact, if the interior conditions are less than adequate, display cases can actually do more harm than good. For example, high relative humidity inside a display case can stimulate biological activity, or incorrect lighting that causes the internal temperature to rise can reduce relative humidity, again stimulating biological activity. It is important to remember that, whenever possible, display cases should be illuminated from the outside, as an interior light source can cause heat to build up inside the display case. If lighting is built into the display case, as with many of the models on the market today, the light source must be in a separate space from the work and the case must have a built-in ventilation system.

Box 13: Requirements of a display case for exhibiting works on paper

- Made of stable, suitable materials.
- Dimensions suited to the size of the objects.
- Easy to access.
- Airtight.
- Stable.
- Secure.

Another question we must consider when building display cases is their composition. It is important to remember that display cases contain a limited amount of air, so the effects of any unstable materials or pollutant, harmful substances can multiply dramatically in such a reduced space. Therefore, before placing a work on paper inside a display case we must be absolutely certain that the case has no unstable components and that the stability of the work is guaranteed.

There are many different types of display cases made of various materials. Although no product is totally inert, we should bear in mind that metal structures must have anti-corrosive treatments and only safety glass should be used. There are many types of safety glass with additional features on the market today, such as anti-glare or bullet-proof glass. Table 26 describes the properties of different materials we may use to build and prepare a display case suited to our exhibition requirements.

Finally, two other things to consider regarding display cases are the characteristics of the interior materials and objects used as supports or anchoring elements, and the requirements of the materials used to seal

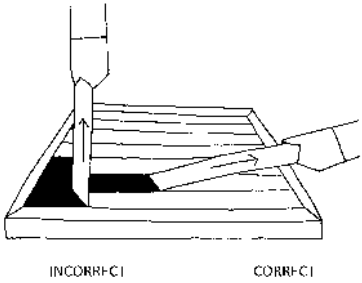
Table 26: Materials used to build furnishings and display cases for exhibiting works on paper

	Advantages	Disadvantages
Wood.	Easy to work with and inexpensive.	Hygroscopic material that gives off volatile organic compounds and may attract insects.
Metal.	Highly stable, especially anodised aluminium and stainless steel.	Expensive and hard to work with. Risk of corrosion.
Glass.	Inert. Excellent visibility. Scratch-resistant. Anti-static. Relatively impermeable to damp.	Fragile. Heavy. Risk of breakage.
Plexiglas.	Easy to work with. Good visibility. Resistant to impact and chemical substances. Lightweight. Stable. Easy to work with in terms of dimensions.	Scratches easily. Permeable to damp. Larger panes tend to warp if they aren't thick enough.
Polycarbonate.	Very resistant (200 times more than glass). Very lightweight. Low thermal conductivity. Highly shock-absorbent.	Scratches easily. Less transparent than Plexiglas. Hard to work with. Joints are hard to smooth and disguise.

the case. In both cases, guaranteeing chemical stability and the safety of the work we intend to protect should be the top priority.

3.3. **Preparing the work and meeting its needs.** Once we have established all the right conditions in terms of space, furnishings and environmental circumstances, we are ready to receive the works.

When they arrive at the venue, we must give them time to acclimate. This should be done gradually to avoid undesirable sudden changes in temperature and relative humidity, and ideally the works should not be removed from their packaging until at least 24 hours after arrival. The unpacking process, usually performed by personnel from the transport and installation companies, should be done according to the spatial distribution of the display units, without handling the works any more than necessary and taking special precautions with the most delicate pieces.[1] The unpacking should be done in a separate area within the exhibition hall where the works will finally be installed. This unpacking space must be carefully chosen so that the process can proceed smoothly. It should be a space large enough to hold all crates and boxes, with an ample work area where the pieces can be unpacked and examined, and close enough to the exit so that the removal of the empty crates does not interfere with the installation process. Normally, unless the work is very small or several works have arrived at once, the crate will be laid horizontally on the floor and opened. Crates containing several works should be marked to indicate whether they should be opened from the top or the side. At this point in the process, it is vital to have a work table at hand so that we can place the work there once it has been removed from the crate and proceed to remove the packaging. If the works are framed and protected, we will need to remove the protective elements very carefully, moving parallel—never perpendicular—to the surface of the work. If the crate or package is very small, we can open it on top of the table.



Removing protection tape from framed works with protective glazing

[1] See Section 7 in Chapter 2 of this guide.

This process must be done in the presence of a conservator-restorer who, before any handling operation commences, will visually examine both the front and back of the work and prepare a report, known as the "condition report", describing the current condition of the piece. This is a key moment, for careful examination under good light can provide us with valuable information about the work's condition and any deterioration it may have suffered. At this point, we must make some critical decisions, such as whether or not the work is in suitable condition to be exhibited, or the most appropriate type of frame to use depending on the work's condition.

Box 14: Technical factors that may affect the exhibition setup process

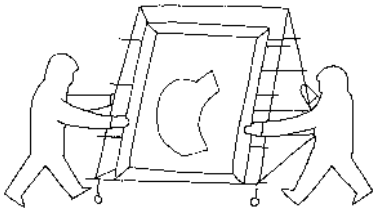
- Condition of the support.
- Condition of the emulsion or graphic media used.
- Type of media (impasto, collage, pastels, etc.).
- Technical specifications of the support (thickness, thinness, good or poor quality, etc.).
- Structural problems related to the possible deterioration of materials (e.g. materials not well adhered to the support).
- Format (small, large, loose leaves, fragmented pieces, etc.).

The entire mounting and setup process is usually documented in a photographic report. However, when dealing with works on paper we must be particularly careful about overexposure to flash photography.

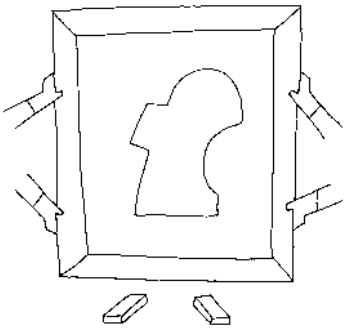
Bearing in mind the guidelines and principles of handling discussed in Section 2.4 of Chapter 2, summarised in Box 7 (General guidelines for handling works on paper), we can now proceed to distribute the works in the exhibition halls. If the works need to be leaned against the wall and rested on the floor during this installation phase, they must be placed on anti-slip insulation foam. Another important point to remember is the need for a qualified member of the staff to supervise all movements of works and ensure that there are enough people to carry out these tasks according to the procedures established and using the system most suited to the format and weight of the works.

3.4. Mounting process and methods.

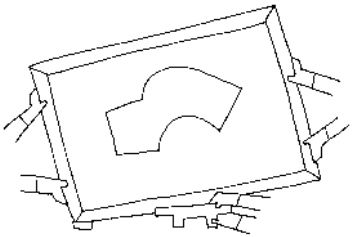
Once the work has been deemed ready for exhibition, we must provide it with a suitable support. A support may be required for various reasons: to facilitate handling, due to structural needs (if the object is in an advanced state of deterioration), or for exhibition purposes. In this section we will only address the latter case.



Moving a medium/large-format work on an A-frame cart



Medium/large-format framed work carried by two persons prior to mounting



Moving a large-format work on a wheeled cart

Mounting and framing a work makes it easier to handle and exhibit, but it also creates a microclimate that preserves the work from light and other harmful environmental factors, in addition to keeping it in an acid-free environment. As readers may have deduced from the previous sections, some works may already be mounted when they arrive at the venue. In such cases, the type of mount we encounter will tell us about the condition of the work and how it should be handled. At this stage, we can decide whether to keep this mount or adapt it to our exhibition requirements.

If we decide to create a new mount, it must be designed to preserve the original structure of the object and absorb shock. Before deciding which is the most suitable type of mount for the work in question, we must consider a number of factors related to the history and aesthetic features of the work.

For example, is it a unique piece or one of a series? Do both sides need to be visible? Are there inscriptions?

Table 27: Historical and aesthetic factors to be considered when mounting works on paper and their consequences

Factors	Consequences
Unique or serial nature of the work.	
Part of a series.	Requires careful control to ensure the homogeneity of the series. Works from the same series can be mounted in a mat with several windows.
Special mounting requirements that must be respected (e.g. artist's specifications or predetermined mounts).	Maintain the original mount, even if it is not the most suitable from a conservation perspective.
Presence of structural features that must be visible (e.g. deckle edges).	Windows must be sized accordingly.
Both sides of the work must be visible.	Use a mat with front and back windows so both sides are visible.
Iconic, frequently exhibited works.	Conservation folder.

In Chapter 1 of this guide, we saw how works in storage should be protected. One of the options was to store works individually in conservation folders with windows or mats that allow the works to be framed and exhibited without removing that protective layer. A mat folder is a type of folder consisting of two sheets of stiff card joined along one side and with an opening or window through which we can see the work. Some of these folders have a third sheet that serves to protect the work while in storage but can be folded over when we want to exhibit the work, thereby protecting the back of the piece. When we frame the work, the mat will serve as a buffer between the work and the transparent sheet of protective material.

Just as most institutions outsource the transport of artworks, so is framing and matting usually done by outside experts who have all the necessary tools (mat cutters, machines for creating bevelled window edges, etc.) to perform a task that requires great skill and precision. Outsourcing this job will also save us the hassle of finding storage

space for the equipment and materials used in the process, which, as they come into direct contact with the works, must also be kept in strictly monitored conservation conditions.

There are a number of factors and requirements to be considered when deciding how to present a work in order to achieve our ultimate aim of conservation and simplify what is already a very complicated process.

Table 28: Technical factors to be considered when mounting a work

Factors	Alternatives	Advantages	Disadvantages
Window size.	Larger than the work.	Allows us to view the entire piece.	The work must be anchored at various non-visible points.
	Smaller than the work.	The work is anchored more securely to the support.	Areas not exposed to light may age differently. Risk of warping due to stress caused by mat pressure.
Number of windows.	One.	For individual works. The conservation folder can be used in the mount.	
	Diptychs and polyptychs.	For aesthetically or conceptually related works.	May give rise to differences if the grouping is a one-time occurrence and the works are part of a larger series/collection. Makes it harder to handle each work individually.
Standardised mat sizes/formats.		Simplifies storage and framing.	Uniformity.*
Format dimensions.	Establish minimum security formats (no less than 30 x 40 cm).		
	Exhibit in display case.	Very small works.	
Physical-chemical properties of the card.			

* It may also be a positive factor.

The original work can be attached to the support in different ways. The most widely used method is by means of hinges, small pieces of paper that attach the work to the support base using adhesives. Another common method is to use mounting corners or strips, which hold the work to the support without the need to apply any type of adhesive directly.

Each system has its advantages and disadvantages, which are addressed in Table 29.

Table 29: Systems for securing the work to the support

Direct systems (hinges)		Indirect systems (corners/edge strips)	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Secure anchoring. Hinges are made of Japanese paper of a suitable weight and cut to the appropriate size for each work.	Hinges act on the original, which is attached directly to the support.	They eliminate the need to directly handle the original. Rapid dismount. Ideal for museums that rotate their exhibits frequently. These systems are transparent, as they are made of Mylar film, and come in a wide variety of models and sizes.	Less secure anchoring than direct systems.

Our choice of system must be based on the degree to which it fulfils the following requirements:

- Efficient, secure anchoring.
- Does not damage the work.
- Does not mark/stain the work.
- Chemically stable.
- Reversible adhesive.

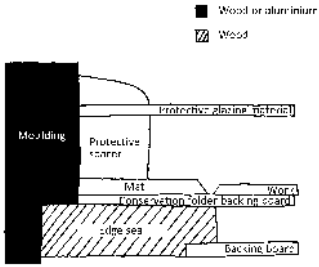
Once the works on paper have been secured to a secondary support, if they are to be displayed vertically we must proceed to frame them. The framing process is very important, as a frame is both a conservation system—it serves as a protective barrier against light, climate conditions and pollutants—and a display device. The frame allows us to protect the

work, but it will also determine how the work is presented and made available to the public.

At this point it is important to determine the measurements, materials and components of the frame, as well as how each of the parts should be distanced from each other and from the work itself. As we can see in the illustration, the work is only in direct contact with the conservation folder and does not touch any part of the frame.

We must consider every part of the frame and its materials:

- Moulding.
- Protective front panel.
- Backing board.
- Sealing materials.
- Hanging fixtures.



Side view of framing elements for a work on paper

At smaller institutions, framing is often outsourced, though this does not relieve us of the responsibility to ensure that all materials used meet a number of stringent requirements: they must be suitable for properly preserving the work and the professionals at the framing company must handle the work properly—in other words, always with the front facing up, in the prescribed position, and laying the work on a table protected from possible vibrations by a cushioning material such as thin foam.

Table 30 shows some of the recommended materials for manufacturing the different parts of a frame.

Table 30: Recommended materials for the different parts of a frame

Part	Material	Advantages
Moulding.	Wood or aluminium.	Chemically stable. Lightweight. Mass-produced in different shapes and colours.
Protective front panel.	Conservation-grade acrylic sheets.	It filters virtually all UV rays.
Backing board.	Corrugated conservation mounting board or Plexiglas.	Lightweight. Inert and sufficiently rigid.
Sealing materials.	Paper adhesive tape with aluminium base.	
Hanging and security fixtures.	Different models in stainless steel.	Chemically stable.

Nowadays, square section frames are used for works on paper and photographs. Their measurements are usually dictated by the dimensions of the mat or conservation folder. Many frames are also fitted with tiny sensors that provide readings on the temperature and relative humidity levels to which the work is exposed.

Although the majority of works on paper are hung vertically on the wall, in some cases—when the work is very small, bound or part of an album, or very fragile—they are presented horizontally or on a sloping surface in display cases or frames. These exhibition conditions have their own set of requirements. For example, all materials and elements used in the interior of the display cases must be inert, and the works must not rest directly on the case but against a secondary support (such as a conservation folder or conservation-grade backing board of smaller dimensions that, in addition to serving as a buffer between the work and the case, visually elevates the object). Also, as we near the end of the mounting process, we must check to make sure that the display cases are perfectly sealed and that their preventive conservation systems are working properly.

Works are usually arranged in halls according to the criteria established by the exhibition curators, which may be historical, aesthetic, conceptual,

chronological, etc. However, from a conservation perspective we must also bear in mind a few guidelines:

- Try to group works with similar environmental needs in a homogeneous space.
- Keep works away from windows, pipes, draughts and heat sources.
- Leave enough space around the works so that visitors do not crowd around them.

As we finish mounting and installing the different works, we must remain aware of the need to protect them from luminous radiation throughout the process. To this end, works are usually protected by special light-blocking cloths until the exhibition is ready to open. In order for emergency lighting or low lights to affect them as little as possible during closing hours, we should try to keep the works in total darkness at such times.

Finally, conservation work must be continued for the duration of the exhibition with a series of periodic inspections following certain control procedures to monitor any incidents that may affect the condition of the works on display.

4. DISMOUNTING AND REPACKING

When the exhibition closes it is time to dismount the works, a process that must be planned and carried out with the same methodical care applied to each of the preceding tasks. It is important to have a clear idea of the order in which the dismounting process will be performed. In this final stage, it is once again absolutely vital for a conservator-restorer to be present, supervising every step of the dismounting, repacking and loading processes carried out by personnel from the installation company. This conservator-restorer will be responsible for documenting and drawing up a condition report for each of the works before they are repacked. This report requires the same analysis as the one performed when the work arrived at the exhibition venue. There may be two separate documents (incoming and outgoing condition reports) or a single condition report reflecting the inspections carried out on two different dates (arrival and departure). The information contained in this report is of vital importance as it provides a record of:

- The effects of the exhibition period on the work.
- The work's condition on leaving the institution.

Works should be repacked according to the same guidelines provided for packing in Chapter 2 of this guide. Like packing, repacking should be done in a safe, secure, clean, well-lit place with environmental conditions similar to those of the space where the object was located during the exhibition. If the work has not suffered any changes and the risk assessment has not detected any alterations, it should be repacked using the original packaging. If one of these factors has changed, the packing method will need to be re-evaluated. If the packaging was damaged en route to the venue, it must be replaced by identical or equivalent materials.

To minimise risk, all guidelines regarding the handling and installation of the works must be strictly observed, and security measures should be tight at all times.

Regardless of the type of work (photographs, drawings, prints, etc.), once the objects reach their destination they must be removed from their frames and stored in a suitable manner and location.

After every work in the exhibition has been repacked and loaded, we must proceed to take down all the display elements (cases, panels, etc.) in order to bring the entire process to a close.

APPENDIX

DETERIORATION TABLES

Table 1: Deterioration caused by temperature	
Low temperatures.	Risk of condensation due to sharp fluctuations.
Cold materials suddenly exposed to human comfort temperatures (e.g. 18°C).	Condensation of water particles on the cold surface, forming water droplets.
Temperatures between 16 and 30°C.	Allows insects to thrive.
Temperatures above 23°C.	Increases chemical activity. Stimulates metabolic development of microorganisms.
Temperatures above 40°C.	Photographs become permanently brittle. Loss of flexibility.

Table 2: Deterioration caused by relative humidity	
Fluctuating relative humidity.	Causes tension and warping in photographs.
Very low relative humidity.	Cracks gelatin in photographs. May cause delamination in photographs. Risk of works sustaining scratches or cracking when handled. Binders dry out, causing delamination of the paint layers.
Relative humidity above 30%.	Dries out hygroscopic materials. Brittleness.
Relative humidity above 65%.	Promotes microorganism development and colonisation.
Relative humidity above 70%.	Promotes the appearance of insects and mould/mildew.
Relative humidity above 75%.	Signs of deterioration increase noticeably.
Relative humidity above 85%.	Promotes the appearance of bacteria.

Table 2: Deterioration caused by relative humidity (cont.)	
High relative humidity.	Stimulates the metabolic development of harmful organisms in storage spaces. Causes paper hydrolysis. Causes paper acidification. Causes paper yellowing. Fades images (in photographs). Causes gelatin to soften and adhere to adjacent surfaces (in photographs).

Table 3: Deterioration caused by luminous radiation	
Ultraviolet radiation.	Causes paper yellowing.
Prolonged exposure to light.	Alters the colours and causes images to fade.

Table 4: Deterioration caused by pollutants	
Exposure to dust. Absence of protective enclosure material.	Grime.
Urban pollution.	Colour alteration in watercolours.

Table 5: Deterioration caused by insects	
Cockroaches.	Irregular areas of surface erosion.
Silverfish.	Irregular areas of surface erosion (smaller than those caused by cockroaches).
Woodworm, moths and beetles.	Circular tunnels, generally extending from the outer edges to the centre.
Termites.	Deep crater-like holes and irregular areas of erosion from the edges to the centre. Potentially very destructive.
Booklice.	Small surface abrasions with irregular lines.

Table 6: Deterioration caused by people	
Handling without gloves.	Fingerprints.
Eating or drinking in storage areas.	Grease or food stains.
Incorrect handling or absence of protective enclosure material.	Scratches, wrinkles, folds, damaged edges, etc.
Incorrect organisation, handling or framing.	Yellow stains, adhesive traces, rust from staples or paperclips, holes, rubber band marks, etc.
Careless handling and incorrect cleaning.	Abrasion or loss of the drawing or emulsion.
Acts of violence, wars and vandalism.	Destruction and loss of documentation, scattering of the works, fragmentation, breakage and dissociation of sets/collections.

Table 7: Deterioration caused by inherent vices	
Colour alterations.	Caused by unstable dyes/pigments.
Yellowing and brittleness.	Caused by poor-quality paper.
Foxing (spotted ochre-coloured discolouration).	Caused by metal impurities in the paper (though some believe it to be caused by bacteria).

Table 8: Deterioration caused by incorrect photographic processing	
Inadequate washing.	General yellowing.
Improper fixing.	Brown or purple stains in blank areas and along the edges.

Table 9: Deterioration caused by natural disasters	
Fire.	Smoke damage, burns, soot stains, charring, melting and total disintegration.
Flooding.	Wetness, stains, water rings, grime and invasion of microorganisms.
Hurricanes, tornadoes, etc.	Chaos and disorder, scattering of documentation, losses, breakage, warping and fragmentation of sets/collections.

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