

## **The Museum Environment**

### **What do we mean by “ the museum environment” ?**

These are the conditions in which museum collections are displayed / stored / used. They include temperature, relative humidity, light, pollution and pests.

### **Why monitor the environment ?**

Unsuitable environmental conditions can be damaging to museum objects and costly to the museum. By monitoring environmental conditions, problems can be identified and addressed through a variety of environmental controls.

Environmental monitoring is also now a requirement of the Accreditation Scheme for Museums in the United Kingdom under section 4.5 “Actions to minimise the risk of damage to and deterioration of the collection”.

### **How can environmental conditions affect your collections ?**

#### **Relative Humidity (RH)**

Organic objects contain moisture and this tries to remain in equilibrium with the surrounding RH. Therefore if RH around the collections is low, organic (animal or vegetable derived) objects lose moisture, can become dry and brittle and can crack. If the surrounding RH is higher than the moisture levels in the collections, the objects absorb moisture and can swell and become damp. Metals can corrode, and mould, mildew and insect pests can become a problem. RH also aggravates fading and other decay processes. Fluctuating RH can cause objects to crack, split and warp.

#### **Temperature**

This directly affects RH and so can aggravate damage by that means. An increase in temperature also speeds up the rate of decay of objects. In some cases high temperatures can soften materials and low temperatures can cause them to become brittle.

#### **Light**

This can cause fading, bleaching, discolouration and brittleness in some materials and physically weaken others. The two types of light which should be controlled in museums are Ultra Violet (UV) and visible.

#### **Pests**

Animal or insect pests can feed directly on objects or on the dirt around them. They cause damage by eating the objects themselves or through staining caused by their secretions. Moulds and fungi can also stain and etch into the surface of objects. Some pests can pose a health risk to people.

## Pollution

Gaseous pollutants, including organic acids, sulphur dioxide, nitrogen oxides and ozone, can cause bleaching, discolouration and weakening of a variety of materials. Particulate pollution (dust) can become embedded in the object's surface, cause abrasion and wear, attract moisture, act as a food source for pests and be visually disfiguring. Liquids such as sweat can also cause problems such as dirt, corrosion and chemical weakening of materials.

## **Identifying your museum's environmental requirements and recommended guidelines.**

Monitoring is only useful when you know what conditions you want to achieve. Section 4.5 c of Museum Accreditation Scheme states that the museum should "determine the level of control of the environment ... which it wishes to achieve". Often environmental conditions are a compromise because unless you have only one type of object / collection then invariably optimum conditions for all the different materials in your collections are not going to be met. This is why we recommend a broad band or range of RH within which you should try to remain for the majority of the time. It is generally better to keep conditions stable, i.e. not moving up or down too much, rather than trying to keep all the different parts of your collections at different specific RH's. Some collections such as archaeological metals will benefit from specific controls to prevent serious decay and the advice of a conservator regarding collections requiring more specific environmental conditions would be beneficial.

### **(Relative Humidity) RH**

Usual recommendations are to maintain as stable an RH as possible within a 20% band. This allows for annual seasonal changes in humidity and the needs of a mixed collection. Commonly used bands are 40% – 60% or 45% – 65%, however, current thinking is that collections are more robust than often thought and provided conditions don't change rapidly, a band as wide as 40 – 65 %RH is fine. RH should not exceed 65% as mould, mildew and pests are more likely to occur. Choose the band which you are most likely to be able to meet (this can be reviewed annually). Also consider the needs of your collections, but either of these bands should be suitable for mixed collections. Some collections, such as archaeological metals, may require more tightly controlled relative humidities.

### **Temperature**

Museums are generally heated to human comfort levels of around 17 – 21°C. Stores can be kept at lower temperatures to slow down degradation of objects (say around 10 – 15°C). Overall then, a museum should try to maintain temperatures between 10 – 21°C. It is important to maintain stable temperatures rather than allowing them to fluctuate, as this causes greater damage to the collections. Some collections, such as photographic collections, will really benefit from lower temperatures.

### **Light**

There are two types of light which need to be monitored: **ultra violet (UV)** and **visible**.

UV is high-energy radiation and is unnecessary for human viewing of objects. It should not exceed 75 microwatts per lumen and should preferably be eliminated completely.

Visible light levels for light sensitive objects including watercolours, textiles, paper, photographs and plastics should not exceed 50 - 80 lux. For less sensitive objects such as oil paintings, wood, ceramics, metals, glass etc., 200 to 250 lux is recommended. These light levels will not prevent damage to objects, they are merely the commonly accepted levels of damage.

Although materials such as ceramic, glass and metals can safely be lit to higher levels, brighter areas in museums make areas with lower light levels seem even darker and should be avoided.

These levels should be maintained in display areas, but for stores, light levels, when not in use, should be zero. It is also necessary to ensure that lighting meets legally required levels in work areas.

### **Pollution**

There is no one recommended level for pollutants in museums, each one having its own recommended levels. It is also more difficult and expensive to monitor gaseous pollutants. Staff should be aware that they can originate from varied sources including traffic emissions, the museum building itself, the collections, storage and display materials, staff and visitors.

### **What environmental conditions does my museum require ?**

- What type of collections do you have ? Are they mixed general collections eg social history or are they sensitive collections requiring more specific conditions eg archaeological metalwork?
- Where are they housed ? Eg a damp barn or a warm store?
- Most museums will be able to use the recommended guidelines above.

### **Monitoring environmental conditions**

- Buy the best equipment you can afford, preferably that which provides a continuous record of conditions rather than spot readings.
- Chose equipment carefully and look after it.
- The type of equipment you choose will be affected by the building layout, staff, security, finances, collections etc.
- Ensure that you are familiar with the advantages and disadvantages of the various pieces of equipment before buying. Don't forget that monitoring equipment can be added to over a number of months or years so make sure that you plan ahead and that any new equipment is compatible with existing items.
- Decide upon the frequency at which results are recorded and try to maintain a regular logging programme using trained staff and volunteers.

- Use equipment in a suitable place within the recording location. Do not place it close to sources of light and heat, or near air conditioning, humidifiers / dehumidifiers, air vents, doors or windows etc or where it is susceptible to theft, vandalism or physical damage.

## **Choosing environmental monitoring equipment**

Museums should purchase equipment that will enable them to monitor light levels (at least visible light and if possible also ultra violet light), temperature, humidity and pests. The complexity, price and usefulness of this equipment varies. There is a variety of equipment ranging in price and complexity and these are detailed below:

1. Cheapest methods are those that do not provide accurate, quantifiable readings which can be recorded and compared (e.g. ISO blue wool card, humidity strips).
2. Readings taken by equipment such as sling hygrometers, dial hygrometers or electronic hand held readers are recorded by staff at the moment of reading and are called spot readings. These will generally not be taken at night or when the museum is closed and so an accurate pattern of conditions is not built up. For example, the effect of the heating being switched off at night can't be monitored.
3. Some equipment such as electronic data loggers and radio telemetry systems take spot readings i.e. they record conditions at pre-set intervals, but they continuously record these spot readings to produce charts.
4. Other equipment will monitor and record continuously, such as recording thermohygrographs.

Try to buy at least some equipment from groups 3 or 4, to provide a continuous record of environmental conditions. It not only gives a more accurate picture, but also takes up less staff time with monitoring. This can be supplemented by spot reading equipment (group 2) in areas which are not being continuously monitored.

## **Hidden extras**

The initial purchase price of equipment is not the only cost. You will need to also think about ongoing costs such as those linked to:

- Recalibration: equipment needed for you to do it yourselves or sending equipment away for recalibration.
- Replacement: For eg batteries, extra wicks for sling hygrometers, sticky traps, charts & pens for recording thermohygrographs etc.
- Repair and maintenance: Check guarantee periods and conditions and costs.
- Training: Necessary to enable competent use of equipment and interpretation of results.
- Equipment: With computerised equipment, ensure the compatibility of hardware and software. Ask about future upgrades to software purchases. Telemetry systems should include an external sensor.

## General guidelines for equipment

- Read instructions and follow them carefully.
- Store equipment in the boxes provided when not in use, or in a clean secure area.
- Clean, maintain and re-calibrate equipment regularly.
- Train staff to use equipment correctly.
- Keep receipts and contracts safe. Note when guarantee periods finish and the terms of any contracts (with some computerised systems, firms will include maintenance, repair, recalibration and training for set periods after the purchase date).
- If storing equipment, remove batteries to prevent them leaking and causing damage.

## A basic monitoring kit

- Temperature and humidity: Continuously recording equipment such as recording thermohygrographs is preferable. Buy sufficient to monitor galleries and stores. These can be cheaply recalibrated with sling hygrometers or (more expensively) with hand held electronic readers which themselves need checking with recalibration salts. Electronic dataloggers are now a similar price to thermohygrographs but most require a computer to download them. Some types can be recalibrated by yourselves, but others may have to be returned to the manufacturers for recalibration.

This equipment can be supplemented with spot readings from dial hygrometers or from sling hygrometers or hand held electronic readers (which may have already been purchased to recalibrate other equipment).

- Light : Visible light levels change with the plane of the object and the distance from light sources. Every time an object is moved or a lamp angle is altered, readings will differ, so a museum should purchase a light (lux) meter and check levels regularly. UV meters are expensive and once an area has been checked, needs only to be re-checked if new sources of light are admitted or for museums with uncovered windows etc which have no UV filtering film on them.
- Pests: All museums should purchase sufficient sticky traps to lay one or two in each room and replace them when full or no longer sticky. Results from the trapping programme should be logged and acted upon.
- Pollution: Although pollution monitoring is recommended, for museums with limited funding, it is at the bottom of the monitoring equipment list. If you are worried that items are being damaged by pollutants then dosimeters, passive samplers or some sensors for telemetry systems can monitor certain pollutant gases. Simple cards for monitoring dust accumulation can be simply made by taking a piece of card and painting half white and half black or using a piece of clear glass. Place around the museum and check regularly to find the pattern and rate of dust accumulation.

## Hints and tips for using environmental monitoring equipment

Below are some guidelines for ensuring correct use of the more common pieces of monitoring equipment but it cannot be stressed too strongly, that the instructions which accompany the equipment must be carefully read before using it:

### Lux meter / light meter

- Chose a suitable scale on the equipment.
- Hold the sensor in the plane of the object and facing away from it.
- Don't stand in the path of the light source as this will affect the reading.
- Recalibrate it annually, preferably at a NAMAS laboratory (National Measurement Accreditation Service of the National Physical Laboratory).

### UV meter

- Check that when held near a 60watt tungsten light bulb, it reads 75 mw/l (close curtains and switch off all other lights before doing this). It should be recalibrated if this reading is not around 75 mw/l.

### Recording thermohygrograph

- Don't knock it or move it unnecessarily – change the charts *in situ*.
- Check calibration regularly and also after it has been moved as well as on receipt of the equipment from the manufacture upon purchase.
- Change the charts when they are complete.
- Ensure that the correct chart is being used for the chosen recording period.
- Ensure that the pens have not dried out.
- Write on the charts themselves, the recording location and the dates on which recording started and stopped.
- Check that the drum is rotating and ensure that it is replaced correctly after changing charts.
- Wind up clockwork thermohygrographs regularly.
- Ensure the hair is taut and clean it periodically by brushing lightly with a soft brush (recalibrate after doing this).
- If a battery driven thermohygrograph is not in use, remove batteries to prevent acid leaks from causing damage to the equipment.

### Sling Hygrometers

- Whirl at arm's length to prevent heat and humidity from operator affecting readings.
- Take readings until two consecutive ones are the same.
- Read wet bulb first.
- Don't put fingers near or over the ends of the thermometers when taking readings.

- Keep wicks / sleeves clean.
- Ensure that the wick / sleeve is wet.
- Use only distilled or deionised water.

### **Electronic readers**

- Ensure batteries are working.
- Keep the probes dry and clean.
- Recalibrate regularly against recalibration salts.

### **Pests**

- Check traps regularly, record results and if necessary replace them

### **Interpreting the results of environmental monitoring**

It is not enough to merely collect the results of environmental monitoring. If the monitoring programme is to be of any use, the results must be regularly examined, interpreted and where necessary acted upon. It is useful to monitor external temperature and humidity so that internal conditions can be compared to them. This will help to show how conditions within the building react to changes in the external environment.

The environmental policy will define acceptable environmental conditions within the museum and staff must be familiar with these in order to interpret fully the results of a monitoring programme.

In order to eliminate problems which may arise due to staff recording spot reading results in different ways, the museum should design simple recording sheets. In order to maintain good records, which can be compared over the long term, the information from recording sheets should be transferred to an annual standard chart or datasheet or plotted as a graph. Keep records of visitor numbers, external weather conditions and anything else which may affect conditions such as switching on air conditioning or heating apparatus, opening blinds or curtains etc., as these will help you to more correctly interpret the data.

Keep plans of the museum, on which are drawn the locations of pest monitoring traps and on which can also be drawn, the locations of any other environmental monitoring equipment. The environmental monitoring programme itself should be regularly reviewed. Look at:

- What you are monitoring and why?
- How much data you want to collect and why?
- Is the data being correctly collected and interpreted?
- Is the equipment regularly maintained and suitable for your purposes?
- Have staff been fully trained in the use of the equipment?
- Has the museum allowed for the costs involved in using and maintaining the equipment?
- Are you acting upon the results of the monitoring?

## Controlling the environment

This can be very difficult. It is imperative that wherever possible the actual causes of the environmental problems are identified and this is why it is important to monitor the environment and interpret the results. It is pointless buying a dehumidifier if the humidity is only too high because the gutters leak when it rains for example – the gutter should be fixed. There is often no one simple solution and in some cases, financial restraints prevent adequate environmental control, but the following are some ways in which conditions can be controlled, mitigated or prevented:

### Temperature

- Keep doors and windows closed.
- Keep heating levels stable.
- If possible try to choose a heating system which can be controlled 24 hours a day.
- Create a double entrance lobby.
- Lag pipes and insulate roofs.
- Board up windows and insulate between window and board.
- If possible move collections so that sensitive items are in the environmentally better areas.
- Chose lamps which do not give out heat .

### Relative Humidity

- Well sealed doors and windows
- Maintenance programme for building to ensure roofs and gutters etc are in good repair
- Don't place collections in basements of damp buildings / those with no damp proofing
- Air conditioning if well chosen may help, but if badly chosen it can create more problems
- Humidistats can be used on heaters instead of thermostats
- Humidifiers and dehumidifiers – mostly only really effective in sealed areas/rooms
- Silica gel for smaller containers
- Try to avoid using stores as office areas, staff rooms etc.
- Provide area for wet coats etc away from collections
- Increasing the temperature may lower RH, but high temperatures are also damaging.

### Pests

- Quarantine area separate from collections
- Check all incoming items for pests
- Treat any items which may be infested
- Implement an integrated pest management programme
- Don't allow food in collection areas
- Maintain a good cleaning and housekeeping regime
- Doormat at front door
- Do not use food, plant, woollen or felt materials in displays or stores
- Be aware that foodstuffs being accessioned to the collections may cause problems later
- Keep flowers and pot plants out of museum

### Pollution

- Close doors and windows and ensure well sealed

- Good front door mat to collect dust
- Choose display and storage furniture which is inert
- Be aware that the collections themselves can give off pollutants
- Clean newly accessioned items
- Good housekeeping programme
- Vacuum floors wherever possible to remove dust (sweeping re-circulates dust)
- No smoking policy in museum
- Site any photocopiers away from collections
- Air conditioning with filters

### Light

- Remove daylight by covering or boarding up windows or using blinds to control (please note that vertical blinds are not suitable for this as they let too much light through).
- Neutral density film on windows cuts down daylight by varying degrees.
- Ultra violet films, varnishes, glass and acrylic sheets are available for doors, windows and lamps to reduce / eliminate UV light (does not eliminate visible light)
- Check the number and wattage of lamps in the museum – reducing one or both will cut down light levels
- Check the Ultra Violet emission of lamps in catalogues or with manufacturers before buying
- Position lamps carefully avoiding “hot spots”
- The plastic covers provided for fluorescent lamps often have built in UV filters so don’t leave them off
- Switch off lamps when collection areas or stores not in use
- Use dimmer switches to control light levels
- Cover very sensitive objects with curtains that the public have to move to view object
- Put up notice explaining why light levels are low to reduce complaints by public
- Automatic switches can be used so lights come on only when someone enters that space

### **Summary**

- Draw up an environmental policy which sets out aims and clearly defined parameters.
- Chose environmental monitoring equipment carefully.
- Always read equipment instructions and ensure all relevant staff receive training in its use.
- Maintain equipment and recalibrate it regularly.
- Record and interpret the results of monitoring and act upon them if necessary.
- Review the environmental policy on a regular basis.
- Seek to identify causes of environmental problems not just deal with the symptoms.

## **Recommended publications**

May Cassar

### **Environmental Management – guidelines for museums and galleries**

Published by Routledge at £76.00

Garry Thomson

### **The Museum Environment**

Published by Butterworth Heinemann at £40.00

David Pinniger

### **Pest management: A Practical Guide**

Published by Collections Link at £ 20.00

Can be ordered from the [www.collectionslink.org](http://www.collectionslink.org) website

Pamela B Hatchfield

### **Pollutants in the Museum Environment: Practical Strategies for Problem Solving in Design, Exhibition & Storage**

Published by Archetype Publications Ltd at £ 35.00

**The Collections Link website** has a wealth of free, downloadable information for museums on every museum subject area including the environment. This has all been vetted and meets the recommended guidelines for museums in the UK. It can be found at [www.collectionslink.org](http://www.collectionslink.org). The section for the environment can be found by selecting, on the menu on the left hand side of the home page, the section “environment” which is under the heading “How do I care for my collection?”

Available as free downloads from the internet:

### **Benchmarks in Collections Care Implemented Pest Management**

Both on the MLA website under publications

[www.mla.gov.uk](http://www.mla.gov.uk)

### **Preventive Conservation by Fergus Read**

On the Meaco website under “practical”

[www.meaco.com](http://www.meaco.com)

Free wall chart “**Insect Pests found in Historic Houses & Museums**” can be obtained from :  
English Heritage, Customer Services Dept, PO Box 569, Swindon SN2 2YP.

Tel: 0870 333 1181 [www.english-heritage.org.uk](http://www.english-heritage.org.uk)