# NATIONAL MUSEUMS LIVERPOOL

**ENVIRONMENTAL GUIDELINES FOR COLLECTIONS**

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**National Museums Liverpool**

**Environmental Management Policy and Guidelines for Collections**

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**1. Introduction**

**Securing** **and safeguarding** **our collections** to a basic level of care and maintenance is one of National Museums Liverpool’s primary priorities. This document sets out guidelines for the different environmental factors that affect the preservation of collections on display and in store.

The guidelines have been developed for use by project teams (including both internal staff and external consultants), curators, conservators, registrars and Estates Management staff, to provide a reference for new developments, loans and requests for information.

The guidelines should be applied within a broader framework of managing the risks to the collections, so that risks are identified for specific collections and display or storage environments.

These guidelines will be regularly reviewed and updated to take account of the latest research findings on the effect of environment on museum collections. They have been updated to reflect the new environmental guidelines for cultural collections developed by the British Standards Institute, PAS 198:2012 *Specification for managing environmental conditions for cultural collections*.

**2. Energy Consumption and Sustainability**

In the past, environmental control systems in museums have frequently been based on providing ideal conditions for collections, particularly in temporary exhibition spaces, where loaned items have to meet strict environmental criteria. This has resulted in the use of close control air-conditioning systems (e.g. in the Temporary Exhibition Suite at the Walker), that have high energy consumption and are expensive to operate.

NML adopts the following low energy strategy to provide appropriate environmental conditions for collections.

**2.1 Low energy strategy at NML**

NML’s commitment to sustainable environmental control stands alongside our responsibility to safeguard our collections and provide comfortable viewing conditions for visitors.

NML’s environmental guidelines were revised in 2008 to support the reduction of our carbon footprint, and to reflect changes to national and international guidelines for hygroscopic materials proposed by the National Museums Directors’ Conference, and presented to the Bizot Group in 2008.

NML is committed to finding alternatives to air-conditioning where possible, and to operate existing environmental control systems in such a way that minimises energy consumption.

We aim to achieve effective environmental control for our collections through passive control measures, such as:

 High thermal insulation

 Low air leakage

 Maximising buffering effect of buildings

 Natural ventilation systems

 Use of absorbing materials to control pollution

 Airtight display cases

 Microclimate boxes

 Glazed and backed paintings

Where air conditioning and mechanical ventilation systems are in use, and an alternative passive control system is not currently feasible, we aim to minimise energy consumption through the following measures:

 Seasonal adjustments to controls

 Upper and lower RH limits rather than set points

 Overnight shutdown if environmental parameters not breached

NML’s Green Policy (drafted 2010) further strengthens our commitment to:

* *Implementing energy saving measures; working towards the use of passive and low energy systems wherever practicable.*

**3. Environmental Monitoring**

Ongoing monitoring of the environment is essential to alert us to potentially damaging conditions, and is a standard requirement for accreditation of museums and designated archives (MLA Accreditation Standard 2004).

* NML upgraded its environmental monitoring system in 2013 to the *Eltek Darca Heritage* networked radio telemetric system. This includes sensors for the ongoing monitoring of temperature, relative humidity, visible light and ultraviolet radiation, as well as flood detection cables and low temperature sensors for freezers.
* Nominated representatives from NML’s venues are responsible for the basic maintenance of the monitors on the *Eltek Darca Heritage* monitoring system, and ensuring that signals are reliable, batteries changed, and any issues identified and addressed.
* Archiving of recorded monitoring data is important for understanding historic conditions in which collections have been stored.
* Stand-alone dataloggers are used to provide short-term information, for example for external loans or exhibitions.
* All new developments for collections areas should include budgetary provision for environmental monitoring.
* Sensors for monitoring relative humidity (RH) and temperature should be independent of any building management system.
* NML has a regular programme of calibration of monitoring sensors every two years, as a minimum.
* Other environmental factors, e.g. vibration, gaseous pollutants, dust, can be monitored in specific circumstances. See sections below for guidelines on control of these factors.

**4. Climate control – Relative Humidity (RH) and temperature**

Many materials are affected by relative humidity and temperature, either through too high or too low relative humidity or temperatures, or through too great a change in relative humidity. In defining acceptable ranges of temperature and humidity, consideration should be given to the sensitivities of the collections and their current and past display or storage environment, as well as the significance of the collections.

* For most hygroscopic collections on display or in store, an acceptable range of relative humidity is 40-60%, unless the collections are acclimatised to a different range of relative humidity.
* Certain hygroscopic materials (eg panel paintings, parchment, vellum) are more sensitive and require specific, tight RH control.
* Specific collections: eg. metals, unstable glass, photographic materials, have different requirements, and these are provided for by separate storage areas or microclimates in the display area.
* Changes in relative humidity should not be greater than ± 5% in any 24 hour period.
* The temperature should be stable, and in the range of 18ºC to 25ºC in gallery areas. Lower temperatures are acceptable (and often preferable) in storage areas.
* Environmental control methods should be designed to eliminate any risk of condensation on collections, or within the fabric of NML’s buildings,
* No water-carrying pipework should run through or over collections areas.

These guidelines are consistent with initiatives by the National Museums Directors’ Conference and presented to the Bizot Group in 2008 to broaden museum environmental conditions in an era of energy constraint. Further to this, PAS 198:2012 *Specification for managing environmental conditions for cultural collections* emphasises the importance of considering the significance of the collections, and their expected lifespans, when setting environmental conditions. The above recommendations provide a guideline, and may not be appropriate in all instances.

In order to minimise energy demand, passive, low-energy methods of environmental control should be implemented in preference to air-conditioning.

**5. Airborne pollutants**

Airborne pollutants that can adversely affect museum collections include pollutant gases generated both externally (e.g. from traffic or industry) and internally (e.g. by display materials, visitors, cleaning products), and particles from a wide range of sources (e.g. construction activity, visitors, vehicle exhaust, sea salt aerosol).

# 5.1 External pollutants

Externally-generated pollutants include gaseous pollutants, such as sulfur dioxide, nitrous oxides and hydrogen sulfide, and particulates from vehicle exhausts.

* Controls should be in place to exclude externally-generated pollutants from collections areas.
* The use of the building envelope and design should be the primary control method. Where possible, passive control measures, such as limiting natural ventilation, locating sensitive objects away from entrances and windows, and deposition of pollutants onto absorbent surfaces, should be used. These methods, combined with air tight showcases and other enclosures, can be effective and energy-efficient methods for controlling pollutant levels.
* Where HVAC (heating, ventilation and air conditioning) are installed, appropriate filters should be incorporated to control particulates to an agreed level and remove pollutant gases. Specifications for filters will depend on the location of the building, air intake ratio and collections to be stored or displayed.

# 5.2 Internal pollutants

Internally-generated pollutants are those from construction and display case materials, visitors, or certain types of collections. They include organic acids (acetic acid and formic acid) given off by wood and wood-products, hydrogen sulphide from degrading organic matter such as wool, dust from visitors or construction work, and volatile organic compounds (VOCs) from paints, varnishes and adhesives.

High concentrations of internally-generated pollutants can build up very quickly in enclosed spaces, and cause rapid deterioration of objects. The following control measures are implemented to safeguard collections from exposure to internally-generated pollutants:

* Materials used in close proximity with collections should be selected from approved lists, or tested by NML’s Conservation Science Department prior to use (see below 5.2.1).
* Paints and varnishes should be allowed to dry / off-gas for the times specified in NML’s painting policy (see below 5.2.2)
* Specific measures should be incorporated into all contracts for work that is likely to generate dust in collections areas (see below 5.2.3)

# 5.2.1 Materials

* Gallery and case fabrication materials should not release dust or acidic vapours into the environment. Inert materials should be selected as far as possible, for example:

 Glass

 Metal

 Perpsex

 Acid free / archival paper and card

 Unbleached / undyed cotton

 Approved acid-free silicone

* Water-based emulsion paints with low or minimal VOCs are the most appropriate paints for use in galleries
* Sufficient drying time should be allowed for paints, varnishes and sealants to prevent any residual volatile compounds from affecting collections. (see NML’s paintings policy 4.2.2 below).
* NML’s Conservation Science Department evaluates materials to be used in galleries and display cases, and where necessary, tests them to determine their suitability. Samples should be submitted using the Materials Testing Request form (attached – Appendix 1), together with relevant information on the product details and supplier and product health and safety data sheets. The testing process can take up to 9 weeks, so materials should be submitted for testing as early as possible.
* Up to date lists of materials that have been tested and approved for use are available from NML’s Conservation Science Department.

**5.2.2 Painting policy**

Paints (including water-based paints), varnishes, adhesives and other materials used in gallery refurbishment give off volatile compounds that can damage museum objects. The harmful effects of organic acids and other vapours are widely reported, particularly on metal artefacts, photographs, calcium-based materials, and cellulosic materials.

* Water-based paints with low VOC’s should be used in all where collections will be stored and displayed. Collections should be removed from areas before they are painted, unless otherwise agreed with the relevant conservation section.
* Sufficient drying time should be allowed to ensure the concentration of volatile compounds has levelled off before collections are installed into refurbished painted spaces. Guidelines for drying times to be allowed before collections are installed are given below:

Plaster work 8 weeks

Adhesives (includes carpets, linoleum, vinyl flooring) 4 weeks

Solvent-based paints and varnishes 4 weeks

Water-based emulsion paints 1 week

Non solvent based sealants/finishes for wooden floors 1 week

Display cases to be vented with doors open 2 weeks

**5.2.3 Protection of collections from dust**

* Contractors should take all necessary measures to ensure that dust does not infiltrate collections areas.
* Temporary screens should be erected as a barrier between construction areas and collections areas. The screens should be appropriate to the scale of the work and risk to collections, and should be agreed in advance with NML. Screens should be checked regularly when work is ongoing to ensure that they remain intact and dustproof.
* Contractors should limit the creation of dust by using dust extraction facilities in plant and hand tools wherever possible.
* Contractors should undertake a full clean of all areas on completion.
* Any work likely to generate dust within collections areas should be notified to the relevant conservation and curatorial departments in advance, so that collections can be moved or protected.

**6. Display Cases**

In many galleries, the display case is the primary method of protecting the collections on display. NML’s display case policy, and performance specification for display cases should be consulted for detailed information on case design and use. Fundamental principles are listed here:

* All materials used in case construction should be inert. See also section on materials testing and approval.
* In general, cases should be as airtight as possible, unless specified otherwise.
* New cases are tested by Conservation Science to ensure that they conform with the airtightness specification agreed in the case contract.
* Cases must provide adequate access for the installation of objects.
* Access to case facilities – eg. Lighting, alarms, environmental control – should be possible without disturbing the display space.

**7. Integrated Pest Management**

Integrated pest management involves an over-arching approach to detecting and identifying pests through monitoring, modifying the environment to discourage pests, and developing sustainable control methods that minimise the use of insecticides. This approach involves all NML staff in different capacities. NML has an Integrated Pest Management Policy, updated in 2014. Details of the policy are found in the IPM handbook (2010). Some basic requirements are listed below:

* The coordination of NML’s Integrated Pest Management is undertaken by the IPM Co-ordinators, with the assistance of nominated staff for each venue. The IPM Co-ordinators as at May 2014 are the Head of Zoology and the Senior Organics Conservator. The IPM Co-ordinators and Entomology curators advise on the safe monitoring and control of insects which can damage collections (eg carpet beetle, biscuit beetle, moth).
* All new items entering NML must be quarantined, inspected and decontaminated if necessary, before being placed within or close to collection storage or display areas
* All organic material moved between stores should be checked for infestation, and quarantined or frozen if necessary.
* Training in awareness of pests is important for all NML staff
* Vermin and nuisance insect pests (wasps, ants, cockroaches, flies) should be notified to Estates Management
* Food and drink should only be consumed, stored, prepared and disposed of in designated areas

**8. Light and UV radiation**

**8.1 Control of visible light**

Light is essential for the display of collections, but light and UV radiation cause irreversible damage to some objects. For objects sensitive to light, the selection of appropriate light levels is a balance between aesthetics and visual access, and an acceptable degree of change.

Light falling on an object (or illuminance) is measured in **lux**. The dose of light received is a product of light intensity (lux) and time (hours), so that decisions on how an object is illuminated on display should take account of both the light levels and the duration of display time. This can be expressed as lux hours, or more practically millions of lux hours / mega lux hours (**Mlx h**).

Objects can be categorised into 3 types, depending on their sensitivity to light: highly light sensitive, moderately light sensitive, and no sensitivity to light. The table below gives examples of these broad categories, and the recommended light exposure to reduce damage to an agreed level.

|  |  |  |
| --- | --- | --- |
| **Highly light sensitive**ISO Blue wool 4 and below | **Moderately light sensitive**ISO Blue wool 5 and above | **No sensitivity to light** |
| Watercolours, photographs, textiles, fur, feathers, natural history specimens, parchment, books, painted leather and wood | Easel paintings, furniture, ivory, bone, wood, leather | Stone, glass, metal, ceramics |
| 50 lux for 20% of time. ie 1 year in every 5 years, 2 years in 10, or 10 years in 50 | 200 lux unlimited duration or 0.6 Mlx h per year. | 300 lux unlimited duration |

* These recommendations are based on an acceptable fading rate of 1 Perceptible Change in 50 years.
* The highly light sensitive category includes materials with a range of light sensitivities from ISO 1 to 4. Where there is specific information available on rates of fading, recommendations may vary i.e. exposure may be limited to less than 50 lux for 20% of the time for very vulnerable objects, or increased for less sensitive objects. The relevant conservation section will advise.
* Sensitive objects should be kept in the dark when not on display
* Since the light damage is a function of both the light intensity and the time illuminated, display requirements for highly light sensitive objects should stipulate the length of time the object will be on display as well as the level of illumination (lux).
* Where natural light is the primary source of lighting in the gallery, light levels for moderately sensitive objects can be calculated on a total annual exposure of 0.6 Mlx h, since the illumination will vary according to the time of day and year. Natural light is generally unsuitable for displaying highly light sensitive objects, as it is difficult to maintain stable light at low levels.
* An ongoing log of light exposure should be recorded for objects that are highly light sensitive.
* The Colour Rendering Index (CRI) of light sources should be a minimum of 85.

**8.2 Control of UV radiation**

Ultraviolet (UV) radiation is extremely damaging to organic materials, and since it cannot be detected by the human eye, it has no role in the viewing of objects. UV radiation should be eliminated from light sources as far as possible. This is achieved by incorporating UV screens into glazing units, applying UV screening films to windows, and ensuring that artificial light sources include UV filters.

* Daylight should be filtered so that relative to the transmission at 550nm, 0% is transmitted at 300nm, <1% at 320nm and 380nm, and <50% at 400nm.
* When new window films are applied, a sample of the batch used should be tested to check that the UV screen is effective to the above specification. Films should be checked annually, and replaced when the proportion of UV exceeds 75 μW/lumen
* Sources of artificial light should be filtered to reduce the UV content to <10μW/lumen.

**9. Vibration**

Vibration can cause damage to collections in various ways, such as dislodging loose paint fragments, or opening old repairs. More catastrophically, vibration can cause objects to “walk” and potentially fall off glass shelves, or can cause old fixings to loosen and paintings to fall off walls. Damage from vibration is extremely difficult to predict, as it depends on the frequency of vibration, and on the size and shape of objects.

* Consideration should be given to the mounts and fixings for collections in galleries with solid floors.
* Cases and shelves should be designed to prevent vibration being transmitted to objects
* Display drawers should incorporate appropriate vibration dampening mechanisms

During building works, the following measures should be incorporated into the project planning and contracts to protect collections from vibration:

* Notice should be given to the relevant Collections Management department of activities that are likely to cause vibration above background levels in a collections area. Sufficient time should be allowed to plan preventative measures eg. relocating collections or reviewing working methods.
* Provision should be made in the project budget for vibration monitoring during works likely to generate vibration.
* Tests should be carried out using actual tools in advance of major works to determine levels of vibration in collections areas. Contractors should use non percussive methods where possible.
* Contractors can be asked to stop work immediately if vibration levels are found to exceed agreed limits.