PREVENTIVE CONSERVATION PROCEDURES MANUAL

APPENDIX
FOR REFERENCE ONLY

THE CODE OF ETHICS FOR CONSERVATORS

This code has been compiled for conservators in South Africa, many of whom have no formal conservation training or practical experience, but who are, nevertheless, entrusted with the preservation and safety of museum collections. The code was approved and adopted by the South African Museums Association (SAMA) in 1990.

- All professional actions of the Conservator are influenced and therefore controlled by the importance of preserving the aesthetic, historic and physical integrity of an object.

- It is the Conservator's responsibility to undertake an investigation and/or treatment of an object only within the limits of his/her knowledge and its application and the facilities at his/her disposal.

- With respect for the integrity of the object in mind, the Conservator must observe the highest and most exacting standards to whatever artefact he/she undertakes to preserve, regardless of his/her opinion of its value or quality.

- An adequate close examination of the object must be made to determine its original structure and materials, and to establish causes of deterioration, before a decision on the method of treatment is made. Each object must be assessed individually even if similar pieces have been treated before.
  Written and illustrative records of methods and materials used, must be made before, during and after treatment of each object and kept as a permanent archive.

- Only techniques and materials which will not endanger or obscure the true nature of the object should be used. The 'true nature' of an object is described as being evidence of its origins, material from which it is made, information it may contain as to its maker's intentions, the function of the object as well as the technology used in its manufacture. Such techniques and materials must not impede any future treatment or the retrieval of information by scientific examination.

- Techniques and materials which will not impede further treatment are generally those which are reversible. The Conservator must use his/her discretion when applying the principle of reversibility as there are instances when it is not possible to reverse certain treatments because of the nature of those processes and because reversibility relates to different parts of a treatment, particularly with regard to structural restoration.
  An object can be at risk of permanent damage by trying to reverse certain treatments, but in general, all additions, fillings, and re-touching should be easily

removable without damage to the original object. It is therefore important that each case is assessed carefully at every stage of treatment.

- Never conceal or modify the original nature of an object through restoration, e.g., if a section of decoration is missing from a lacquer cabinet and there are no traces of design or documentation left, ethically there is no way that anything can be put in its place without risk of modifying or concealing the original or true nature of the cabinet.

- It is the responsibility of the Conservator to keep up with current knowledge in the field so that treatment applied to artefacts is the best available. To be worthy of this special trust requires a high sense of moral responsibility. The people responsible for the conservation of museum collections have obligations, not only to the collections, but to members of the public and to the institutions in which they work.

GLOSSARY OF CONSERVATION TERMS AND DEFINITIONS

Abrade	damage by rubbing violently
Acclimatise	to adjust to a new climate or environment
Acid	a compound that produces hydrogen ions (H+) in an aqueous solution. The concentration of hydrogen ions in water is known as acidity.
Acid-free paper	paper that has a pH of 7 (neutral) or higher (alkaline) at the time of production, but that can't act as an alkaline buffer for too long afterwards.
Acidic gases	for example, sulphur dioxide which may combine with water vapour in the air to produce sulphuric acid. Sulphuric acid is very harmful to organic materials, but can also cause corrosion of metals which are inorganic.
Acid migration	the transfer of acid from an acidic material to material containing little or no acid.
Acidity	a measure of how acid a solution may be. A solution with a pH of less than 7 (neutral) is considered acidic.
Active corrosion	flaking, or powdering of metal surfaces; damage directly related to excessively high humidity levels.
Alkaline solution	an aqueous alkaline solution is one with a pH value greater than 7.
Alkalinity	a measure of how alkaline a solution may be. A solution with a pH of more than 7 (neutral) is considered alkaline.
Blistering	the appearance of a blister on a painted surface caused by the loss of adhesion between the different layers of paint and primer.
Blooming	this describes the dull bluishness or cloudiness that develops in a transparent film of varnish. Damp is the major factor causing certain varnishes to bloom.
Bronze disease	in a humid environment, the presence of salts (chlorides) in copper alloys cause a corrosion process known as bronze disease. It is characterised by a bright, blue-green, crumbly outgrowth on the surface. If this is brushed away a pit or depression can be seen.
Catalyst	is a substance which accelerates the rate of a reaction, without itself being destroyed during the reaction.

Cellulose	a complex of carbohydrates forming the walls of the cells of all plants. The chief sources of cellulose are wood, cotton, other fibrous materials like flax and hemp. Cellulose is the raw material for the manufacture of paper, linen, cotton cloth, cellulose lacquers, rayon, etc.
Chemical deterioration	deterioration caused by chemical changes within a substance, or by chemicals from another source acting on the structure/surface of the substance.
Chemical reaction	the process by which chemicals combine with each other to form products which change the original substances.
Cleavage	this is due to the loss of adhesion between the superimposed strata of a picture. It manifests itself in the formation of blisters which, if they are allowed to fracture, will lead to the loss of paint.
Composite object	a single object made up of different materials, for example, a knife that is made of metal, wood and leather. The most sensitive material should be taken into account when considering storage & display conditions.
Condensation	the process by which a gas or vapour becomes a liquid. In museums a change in the RH can cause condensation of water in closed display cases, setting up a micro-environment, which can cause damage to objects.
Condition report	a document which details the condition of an object and is used as a tool to determine the changes in the object over time. Ideally, condition reports should be produced as soon as an object is acquired. They may also be produced as part of a collection survey, prior to storage or conservation treatment, or as documentation accompanying loans for exhibitions (travelling or one-stop) or research.
Conditioning	is a process of gradual adjustment to new and/or different conditions of temperature and humidity. This adjustment to the new environment happens gradually over a long period.
Conservation	is the action taken to prevent or slow down deterioration of, or damage to, museum collections, by controlling the environment and by remedial treatment of objects in order to preserve their historical and material integrity. Any conservation treatment should be reversible.
Conservation standards	agreed standards of care needed for the long-term preservation of collections.

Conservator	is a specialist with formal training, skills & experience in the theoretical and practical aspects of conservation, who is capable of supervising, advising and carrying out any action to ensure the long-term durability and integrity of the object.
Corrosion	the process of rusting of metals
Corrosion products	blistered, powdery, waxy or crumbly accretions on metals; metals can be identified by the colour of the corrosion product, for example: iron – brown/orange; brass, copper – green; silver – black; lead/phuktong – white.
Cracking	this is a serious form of deterioration which affects canvases as well as panel paintings. A crack has the appearance of a crevasse in a paint layer, running inwards at right angles to the surface, and it usually penetrates through all the layers of the picture. It is caused by a flaw in the ground, or support.
Cradling	the reinforcement of a wooden panel to strengthen it and prevent it from warping.
Craquelure	when a painting reaches a certain age, its surface usually becomes patterned with a series of micro-cracks which have picked up foreign matter, and reveal themselves as dark hair-like lines most readily discernible in the lighter areas. These lines intersect and form a network. This is a normal condition in old paintings.
Damage	is the consequent loss of aesthetic, scientific, historic or symbolic attributes or value from an object
De-acidification	a term for the chemical treatment that neutralises acid in material, such as paper. An alkaline buffer is deposited to counteract future acid attack. However, buffered papers are not suitable for storing or mounting photographs.
De-ionised water	a process to purify water by removing positive and negative ions, or *calcium sulphate.*
Deterioration	the decline in an object's physical or chemical condition.
Distilled water	a process to purify water by boiling it, and collecting the steam (water vapour), which is condensed, or cooled, to form a liquid.
Dry rot	damaging fungi, 'white' & 'brown' rots, known as dry rot, can reduce wood to powder by feeding off the lignin and cellulose in the wood cells.
Dust	solid particles suspended in air that eventually settle on surfaces in still air.

Environmental control	the maintenance of safe levels of light, humidity, temperature, and a reduction and control of dust & pollutant levels.
Flaking	loose paint on the surface of a picture.
Foxing	is the name given to small, red/brown spots (red ferric oxide) that accumulate on the damaged surfaces of paper, through the effect that iron, or copper, have on certain papers. It can also be caused by mould attack, and nearly always leaves stains and weakens the paper.
Gesso	calcined gypsum, sometimes used to prime wood panels, or for moulded frames for paintings, often gilded.
Humidification	the gradual introduction of moisture, often through the use of mechanical devices like humidifiers.
Hygroscopic	a substance which attracts and retains water.
Impasto	the application of oil paint in thick masses, with the brushstrokes clearly visible in the surface texture.
Inactive corrosion/ stable metal	dull in colour/ could also be a patina.
Inert	the state of a material which does not react chemically, and will not cause chemical damage to objects.
Leather	skin prepared for use by tanning, or similar process, using chemical preparations.
Lignin	an acidic component of the cell walls of woody plants, together with cellulose. Lignin is largely responsible for the strength and rigidity of plants, but its presence in paper and board contributes to its deterioration by attacking and breaking bonds which hold the cellulose chains.
Lux	is the unit which indicates the intensity to which a surface is lit, or the brightness of the light.
Micro-climate	the climate created in a small, confined area, such as display cases or storage cabinets, especially if they are too tightly sealed.
Microwatts per Lumen	are the units which indicate the amount of ultraviolet (UV) energy in the light coming from a light source.
Mould	is growth that appears as a fine, fluffy mass on the surface of many materials, for example, leather/skin, rubbers, plastics, &

	very early glass. In tropical climates, or in conditions of high humidity (RH), the colony undergoes change by releasing its fruiting bodies (spores) into the air to be carried to another favourable surface to grow. The spores will stay dormant until the RH exceeds 65%. Mould always leaves stains of different colours, and causes weakening of cellulosic material.
Oxidising agent	is a substance that does the oxidising, e. g. combines with oxygen to corrode metals.
Patina: on metals	a film of corrosion products which forms naturally on the surface of a metal object, as a result of exposure to the weather, or artificially applied to create an aesthetic effect. A patina on metals often serves to protect the metal object from deterioration, & is an integral part of the object, also being a valued indicator of age & use, that should be preserved.
Patina on wood/ gourd	develops over time through age and use, or can be artificially created, and should always be preserved. Gloves should be worn when handling an object that has a patina.
pH	in chemistry, pH is a measure of the concentration of hydrogen ions in solution, indicating acidity or alkalinity (pH >7 is alkaline, pH <7 is acidic, pH 7 is neutral).
Photochemical degradation	damage caused by prolonged exposure to light.
Photochemical reactions	chemical reactions started, assisted or accelerated by prolonged exposure to light.
Physical damage	damage to objects caused by mechanical rather than chemical means. The damage can result in cracks, chips, splits, tears, dents, punctures, breaks, scratches, scuffs and abrasions, as well as soiling, wear and tear, warping, shrinkage, separation of layers of composite material, vandalism and insect attack (see p. 88, 'Types of damage to collections').
Plasticiser	a plasticiser is a substance added to a plastic or polymer, to facilitate shaping and to make the plastic softer.
Pollutants	damaging gases and airborne particulate matter, usually resulting from combustion or venting of chemicals into the atmosphere, which are associated with human, industrial or other similar activities.

Preservation	all actions taken to slow deterioration of, or prevent damage to, cultural and natural material. Preservation involves controlling the environment and conditions of use. It may include treatment to prevent further deterioration.
Preventive conservation	all actions taken to reduce deterioration of, or prevent damage to collections. It includes activities such as risk assessment, development and implementation of policies and procedures for continuing use and care, appropriate environmental conditions for storage and exhibition, and proper procedures for all who are responsible for the long-term safety of the collections.
Relative Humidity (RH)	RH is the amount of water vapour contained in a volume of air at a particular temperature, relative to the maximum amount of water that the same volume of air can hold at the same temperature. RH is expressed as a percentage.
Restoration	is the action taken when it is essential that an object undergoes restoration treatment to prevent its further deterioration. Changes have to be made to restore it to a usable condition with the minimum loss of originality. Restoration is carried out to make the object understandable for research, education or exhibition purposes. As restoration will often involve replacing or adding parts to the original, it is essential to document treatment in detail for the future.
Reversibility	is about the ability to undo a process or treatment with minimal or no damage to the object.
Semi-tanned skin	skin that is only partially tanned, using animal fats and vegetable materials.
Silica gel	is an effective drying agent which has the ability to absorb moisture. It does not become moist to the touch in use, nor does it cause staining. It has been tinted with cobaltous salts during manufacture to be blue in dry conditions, and pink when it has absorbed moisture. When it contains moisture, it can be reheated at 130ºC until it regains its blue colour. This can be repeated over & over again.
Size	the glue/adhesive in paper (cellulose, or gelatine), on a canvas painting support (the primer underneath the paint), or the glue/adhesive present in ink.
Stretcher	the frame on which a painting on canvas has been stretched.

Stretcher keys	wedges in the corners of a wooden frame of a painting on canvas which can be tightened and slackened when necessary.
Tarnish	destruction of the surface lustre.
Temperature inversion	means that the usual conditions, where the air gets cooler with height, do not occur: the 'lid' consists of a layer of warmer air. Thus pollution gases cannot rise and disperse by their relative warmth, and so their concentration rises.
Varnish	the final coat applied to a picture to give depth and luminosity to the colour, as well as to give it mechanical protection and shield it from direct contact with the atmosphere. Varnish deteriorates by blooming and by becoming brittle and opaque. All spirit varnishes based on natural resins become brittle, disintegrate with age and become yellow. The yellowing is most pronounced in varnished pictures that are exposed to bright light.
Vegetable fibre	thread, string or rope made from plant material.

LIST OF PRODUCTS FOR THE STORAGE AND EXHIBITION OF SOCIAL HISTORY COLLECTIONS
Also see List of Suppliers, pp. 11 - 20

1. Absolute alcohol (commercial grade – a permit is required, i.e. register with Customs & Excise)	used as a solvent & a cleaning agent
2. Acetate sheets (Mylar or mellinex)	exhibition mounts for paper materials; condition reports (drawings & photographs overlays)
3. Acid-free tissue: sheets (450 x 170 mm); rolls (10 – 15 kg rolls, 900 mm wide)	for interleaving works on paper, padding out textiles for storage
4. Aerothene (polyethylene foam, slightly corrugated, 1 – 3 mm thick	protective storage material
5. Antiseptic skin cleanser (Bioscrub)	to keep hands clean when handling collections
6. Archival markers: Polyester & Pigma ink pens (black)	marking accession numbers on objects, tie-on tags & cotton tape labels
7. Bonded polyester	for padding out folds and creases in textiles, by filling tube stockinet (see No. 24), or unbleached calico bags with bonded polyester, so it doesn't catch on objects & cause damage
8. Bubble wrap (100 m rolls, 625 & 1250 mm wide)	storage material
9. Cardboard tubes (various diameters)	for storage of flat textiles and headwear
10. Cobra wax polish (5 litre tin)	to plug the wood borer holes in furniture
11. Correx board (inert, strong, water- & grease-proof	used for making storage boxes, support trays
12. Document repair tape	for short term and emergency repairs to paper materials, e.g. books & documents
13. 'Doodskoot' liquid	main ingredient for treatment of wood borer in furniture
14. Dust masks with valves	protection when working in dusty environments
15. Genuine Turpentine	ingredient for treatment of wood borer in furniture

16. Gloves: vinyl; nitrile; white, cotton, lint-free; suede	worn when handling metal and wooden objects
18. Newsprint (rolls approx. 915 mm wide)	chocking material for storage/support of collections
19. Polyethylene foams, different densities & thicknesses, between 3 – 95 mm, sheet sizes: thickness x 2 m x 1 m	many storage & exhibition applications
20. Polyethylene sleeves (archival quality)/metal bars	hanging files for storage for slides, black & white negatives and prints
21. Powdered Gum Arabic	an ingredient for Fish moth bait
22. Sodium fluorosilicate or sodium silica fluoride	main ingredient for Fish moth bait
24. Surgical tube stockinet	fill tube with bonded polyester (see No. 7), to make 'sausages' to pad out folds and creases in cloth & clothing
25. Syringes & needles	for administering the wood borer treatment to furniture
26. Tamper-proof screws, with special screw driver	to better secure collections on exhibition
27. Trace wire & metal sleeves/ crimping tool	for mounting objects on exhibition
28. Tyvek sheeting (inert polyethylene, strong, tear resistant,flexible, water & chemical resistant, stable over wide temperature range)	wide applications for storage, particularly Textiles
29. Unbleached calico (cotton cloth)	to make dust covers to protect textiles, furniture and all collections stored in open storage
30. Un-dyed cotton, fibre tape	for securing, and numbering rolled textiles and other objects
31. Flame-retardant Polystyrene sheets	trays, used to maximise drawer space in storage

LIST OF SUPPLIERS OF MATERIALS FOR STORAGE AND EXHIBITION OF COLLECTIONS.
Also see List of Products, pp. 10, 11

Albion Chemicals
CT 021-508 1460

15. Genuine Turpentine (for treatment of wood-borer in furniture):
750 ml x 6 minimum (price per 750 ml)
5 litres (price per litre)
25 litres (price per litre)

Prices excluding VAT

Alcomed Medical Supplies
CT 021-981 2974

24. Surgical tube stockinet

Diameter: 50 mm x 20 m, price per roll
75 mm x 20 m, price per roll
100 mm x 20 m, price per roll
150 mm x 20 m, price per roll

Prices excluding VAT

- fill stockinet with bonded polyester and use 'sausages' for padding out clothing, beadwork, etc.

Any fabric shop

29. Unbleached calico (cotton cloth)

- use for dust covers to protect textiles, clothing/costume, furniture, etc.

30. Un-dyed cotton, fibre tape (13 mm wide)

Price per metre

Price excluding VAT

- used for numbering textiles (sewn-on & attaching number tags), securing rolled textiles and other objects
-

Barrs Pharmaceutical Industries
CT 021-531 6601

1. Absolute alcohol – commercial grade
(Requires a permit i.e. register with Customs & Excise)
If no permit, duty paid price for 20 litres - check pricing
With permit price for 20 litres – check pricing

Prices excluding VAT

Brits Nonwoven Textiles
CT 021-577 1490
Email: Claudia@brits.co.za

7. Bonded polyester

68 g x 150 cm wide, price per metre
85 g x 150 cm " , price "
100 g x 150 cm " , price "
135 g x 150 cm " , price "

Prices excluding VAT

- used for padding out folds in textiles, & cushioning. Always should be inside tube stockinet or unbleached calico bags, as it can catch on objects and cause damage.

Builders Warehouse, or other large hardware shops

Hard, plastic spacers

Spacers: 200 on a card, price per spacer

- to protect furniture surfaces by using spacers to separate the furniture from glass tops

Cape Plastics
CT 021-511 7444

Correx board,ABS(Acronytril buterate styrene) plastic strips

12. Correx board (price per sheet)

3 mm x 2.5 m x 1.25 m
3.5 mm x 2.5 m x 1.25 m
4 mm x 2.5 m x 1.25 m
5 mm x 2.5 m x 1.25 m

Prices excluding VAT

- Correx is inert, polypropylene board which is water proof & grease resistant.

Castor & Ladder

Ladders: commercial A-frame, step ladder with 6 steps, H: 1.80 m

Trolleys: 2- & 3-tier trolleys (epoxy-coated, 4 swivelling wheels, 2 with stops)

Prices excluding VAT

- for transporting collections safely within storage areas

C D Fox (Pty) Ltd
CT 021-423 5206

Rolls of newsprint & dispenser

18. Newsprint roll (approx. 18 kg, 915 mm wide), price per kg
Dispenser - check price

Prices excluding VAT

- packing material

Coastal Poly Coating
CT 021-854 5232

31. Flame-retardant polystyrene sheets, 1.2 x 2.5 m

Price excluding VAT

- used as trays, cut to drawer sizes, to maximise storage space

Coopers Environmental Science
CT 021-982 0466; PE 066 118 7859/041 364 0037

Monitor & insect traps

Price per box, excluding VAT

Dis-Chem
CT 021-673 1480 (Claremont branch)

25. Syringes & needles

Syringes (10 ml, 20 ml), price per box of 100
Needles (22 gauge) x 1 box

Prices including VAT

- for treatment of wood-borer in furniture

Epping Industrial Suppliers
CT 021-531 6666
Email: sales@eiscape.co.za

Nitrile gloves, white cotton gloves, toilet tissue, acid-free tissue (sheets & roll), dust masks, cobra wax polish

Nitrile gloves @ box of 100, price per box
White cotton gloves, price per pair
Rolls of toilet tissue (10-15 kg rolls), price per kg
Wright's Silver, Copper & Brass cream
3. Acid-free tissue sheets (500x710mm), price per ream
3. Acid-free tissue roll (W. approx. 910 mm), price per kg
14. Dust masks with valves x 10 per box, price per box
10. Cobra wax polish, price per 5 litre tin (for treatment of wood-borer in furniture)

Prices excluding VAT

Graphics supplies shops

2. Acetate sheets (Mylar, or mellinex), cutting mats, metal rulers

100 micron sheets: A2; A3; A4, price per sheet
175 micron, A3 sheets, price per sheet
100 micron on a roll, price per metre

Cutting mats (900 x 600 mm)
Metal rulers (600 mm long)

Prices excluding VAT

- used for securing, hanging objects on exhibition/in storage

Fabric shops

Felt & felt products

Prices excluding VAT

Housekeeping Services
CT 021-715 9103

Fungicide to treat mould

G-Cide (Product name: PU 2% Eco SAN-G.Cide L. F.) in 25 litre containers, price per litre.

Price excluding VAT

Laboratory & Scientific (LASEC)
CT 021-531 7504

Gum Arabic, scalpel blades
21. Gum Arabic (500 g), ingredient in fish moth bait
Scalpel blades (No. 11 for No. 3 handle), price per 100
Scalpel handle (No. 3)

Prices excluding VAT

Modern Plastics
Pmb 033-386 2701;
Plastic unit trays

Tray sizes:
66 x 66 mm
66 x 132 mm
132 x 132 mm

- for storage of small objects, such as coins & medals, jewellery

Prices excluding VAT

PACKIT Packaging
CT 021-511 8780

Bubble wrap, small quantities of cardboard boxes, polyethylene bags, cushion craft

8. Bubble wrap
1250 mm wide x 100 m roll
625 mm wide x 100 m roll
410 mm wide x 100 m roll
312 mm wide x 100 m roll

Boxes

Ref. 90	600 x 400 x 400 mm
Ref. 52	500 x 350 x 300 mm
Ref. 32	425 x 300 x 250 mm
Ref. 20	350 x 275 x 200 mm
Ref. 8	250 x 200 x 150 mm

Minigrip polyethylene bags, prices per 1000
65 x 80 x 40 mm
80 x 100 x 50 mm
100 x 150 x 50 mm
150 x 250 x 50 mm
215 x 315 x 50 mm

Prices excluding VAT

- packaging materials

The Packaging Warehouse
PE (041) 364 0298
Email: rob@algoaplastics.co.za

Cushion craft (single-, & double-sided)

Prices excluding VAT

Photographic equipment & supplies shop

20. Polyethylene sleeves/metal bars as hanging files

2 x 2 x 20 H or B price per pack of 25

2 x 2 x 20 HB price per pack of 25
Bars (for hanging files), priced individually

Prices including VAT

- Archival storage of transparencies and negatives

Plastics for Africa & Mambo's
CT 021-551 5790 CT,Retreat 021-701 0566; EL,Balfour 043-726 3679; Bfn, 051-446 0023; PE, 041-054 5177

Custom-made plastic containers

Prices including VAT

RS Components SA
Jhb: 011-691 9300
Email: website.za@rs.rsgroup.com

26. Tamper-proof screws & screw driver
Screws: 25 mm (cat.no.526 675), price per 100
19 mm (cat.no. 526 669), price per 100
Screw driver (cat.no. 444 7908)

- to secure display cases

Digital Thermohygrometer (RS-325A)

- to monitor Temperature & RH

Prices excluding VAT

SOLAR SCREEN
CT 021-556 1942

UV/IR film for windows, roller shades to screen UV + heat

UV/IR film (museum quality), price per sq metre (screens out 98% UV & 53% heat)
Roller shades, price per sq metre, but actual price is worked out on size of window (screens out 98% UV & 63% heat)

Prices excluding VAT

- used in combination to protect collections from UV radiation and heat

SONDOR Performance Foams
CT 021-959 9400

19. Polyethylene foams – different thicknesses, & densities, price per sheet

SPX 33, white/black, 5, 10, 25, 50 mm thick x 2 m x 1 m
SPX 120, black, 20 mm thick x 2 m x 1 m
SPX 200, black, 25, 50 mm thick x 2 m x 1 m

FIREX 30, grey, 50, 75 mm thick x 2 m x 1 m

AEROTHENE, non cross-linked, closed cell polyethylene

- white, various thicknesses, widths & lengths

All prices excluding VAT

- for storage of collections & exhibition mounts

Stationers
CT 021-442 2100

Polyethylene sleeves to take A4 sheets

Price per 100 sleeves

Price excluding VAT

- for archiving documents and correspondence

Traidcor
CT 021- 557 5885

Box or crate stickers

Roll of 'Fragile' stickers

Price excluding VAT

Tuckers Tackle, or any shop that sells fishing tackle

27. Trace wire (nylon-covered wire) & metal sleeves
Wire:
15 lb x 10 m coil
20 lb x 10 m coil
60 lb x 10 m coil
90 lb x 10 m coil
120 lb x 10 m coil

Sleeves:
No. 1 (15 lb) x box of 100
No. 2 (15, 20 lb) x box of 100
No. 3 (60 lb) x box of 100
No. 4 (90 lb) x box of 100
No. 5 (120 lb) x box of 100

Crimping tool

Prices including VAT

United Pharmaceutical Distributers
CT 021-550 1411

5. Antiseptic skin cleanser

Bioscrub:
20 x 500 ml;
4 x 5 litre;
20 litre polyethylene containers

Prices excluding VAT

LIST OF SERVICES PROVIDED FOR CONSERVATION EMERGENCIES

Fumigation:

Rentokil provides a fumigation service at their premises in Thornton.
CT 021-530 3540

31 Thor Crescent, Viking Business Park, Thornton

Hazardous waste disposal:

City of Cape Town, Hazardous & Special Waste Disposal Department (Vissershok waste disposal site)
CT 021-487 2477

- to dispose of hazardous and special waste (see list, p. 73). A permit is required for each kind of waste (see Application form, p. 72).

Enviroserv – for disposal of hazardous chemical waste
CT 087 086 8402

Specialist conservation

Paper & photographic material:

Keith Seafort, DK Conservators
CT 021-761 2599

Silversmith/restorer

Don Sheasby, private
CT 021-511 9353; mob: 082 299 8999

Ceramics

Werner Scheepers, private
Worcester mob.: 082 671 7736
e-mail: w.scheepers@webmail.co.za

Eugene Buchner, private
CT 021-797 7955; Mobile: 082 789 8882

Belinda Wilkinson, private
CT mob: 083 861 3468
e-mail: mwchina@mweb.co.za

Easel paintings

Angela Zehnder, private
CT mob: 082 463 3554

Packers, movers, transporters:

Pack Art Trans
Contact person: Andre Beuster, mob: 083 677 7946
e-mail: info@packart.co.za

REGISTRATION PROCEDURES

Archaeological material (see Manual, p. 12) - where number is not marked directly on an artefact:

a. Cardboard boxes

Fig. 1

Fig. 2

Klasies River J Wymer 1967/8 SAM-AA 6900 Cave 1 West Cutting F Layer 19 Artefacts	Bag No's	Layer	Type	Bag No's	Layer	Type
	1229	19 H	flake blades			
	1230	19 H	flakes			
	1321	19 K-L	cores			
	1322	19 K-L	platform cores			
	1323	19 K-L	blades			
				Studied by:		
						silverfish

Fig. 3

b. Polyethylene bags

Fig. 4

Klasies River 1A **1967/8** Catalogue no: Box: Layer: Description:	***Klasies River 1A*** **1967/8** Catalogue no: Box: Layer: Description:	***Klasies River 1A*** **1967/8** Catalogue no: Box: Layer: Description:	***Klasies River 1A*** **1967/8** Catalogue no: Box: Layer: Description:
Klasies River 1A **1967/8** Catalogue no: Box: Layer: Description:	***Klasies River 1A*** **1967/8** Catalogue no: Box: Layer: Description:	***Klasies River 1A*** **1967/8** Catalogue no: Box: Layer: Description:	***Klasies River 1A*** **1967/8** Catalogue no: Box: Layer: Description:
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Fig. 5

Details of procedures

STORAGE (see Manual, pp. 14 – 33)

- The Climate in the store:

ii. a. *Where to place the data logger* – it's advisable to place it in the most stable area of the store, where it won't be influenced by the temperature and humidity control system, draughts from the entrance door, or too much human activity (staff working in store for too long). The data logger can stand on its own, or be mounted on a wall, preferably contained in a metal 'cage'.

b. *How to read the data logger* - the LCD screen (see Fig 6 below) is split into four sections, displaying a. the Relative Humidity, b. Temperature, c. data recording interval, e.g. readings every 2 hours, & memory, and d. calendar setting (time & date).

c. *Downloading records* – remove data logger from its position in the store; connect to computer by USB cord; open the Data Recorder program by clicking on 'Data Recorder' icon.

Importing data from data logger

The screen will be displayed: click on 'Data' in menu bar and then click 'Import'; the data stored in data logger station will be transferred to PC, and shown on the screen, with date & time of record, along with the corresponding temperature & RH readings.

Saving the data in a user-generated file in PC

The data may be saved in a file so that it can be used in other programs; click on 'Data', and click the 'Export' in menu bar; decide the destination in which the data is to be saved; it will be stored in a text file in the selected destination; the text file is compatible to Microsoft Excel.

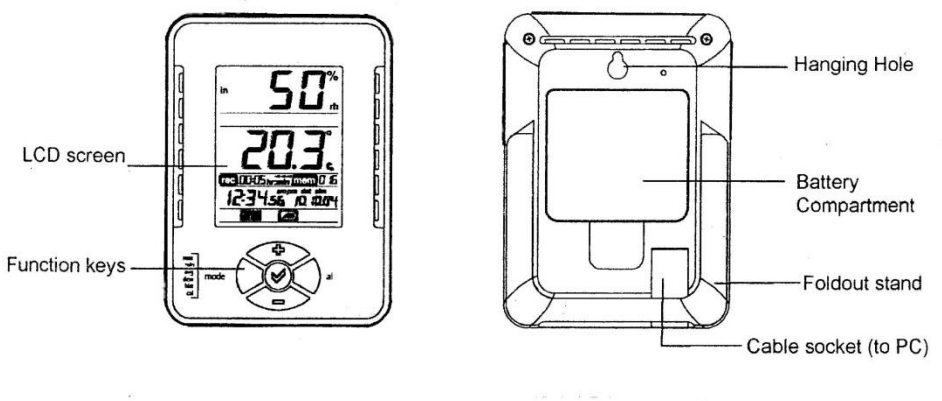


Fig. 6 Data logger (front & back view)

- Handling collections:

Types of gloves

i. White, cotton, lint-free gloves – worn when handling most objects, especially those with a patina;

ii. Nitrile gloves – worn when handling, in particular, metals, but can be worn for all other material;

iii. Suede/leather gloves – worn when handling large, heavy objects (machinery, stoves, gravestones, maritime material).

- Using ladders & trolleys in the store:

Trolleys

- ❖ Drawing of 3-tier trolley, modified to carry small, fragile objects vulnerable to mechanical damage:

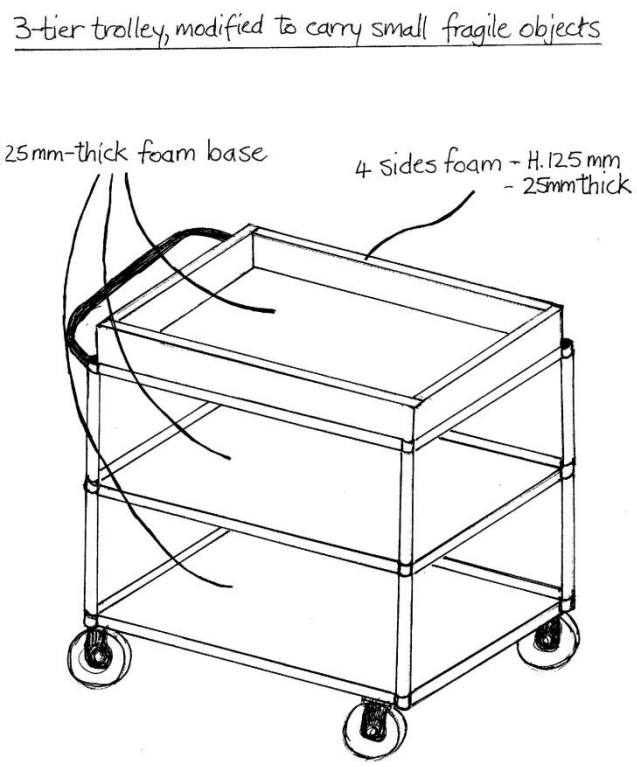


Fig. 7

Storing collections

Procedures for storing the variety of objects that make up social history collections.

Textiles
Making a padded hanger

- select a strong wooden or plastic coat-hanger, and adjust the width/size of the hanger according to the garment to be hung, e.g. a large hanger for a child's garment would be wrong;
- all fabrics used to cover the hanger must be washed before use. White or unbleached cotton (calico), or white/cream, stretch cotton fabrics are ideal, but Tyvek can also be used;
- place layers of *bonded polyester* over the hanger, padding it to the same width as the shoulders of the garment, e.g. if the garment has sloping shoulders, make the padding on the hanger, to match. May have to hand stitch the padding to hold it in place;
- once the padding is in place, cover it with the fabric – preferably the stretch fabric, or Tyvek (see List of Conservation Products & Suppliers, pp.9 - 21). The fabric is then sewn into place.

(see reference: reCollections: caring for Collections across Australia, Textiles pp. 9, 10)

Art collections
Framed paintings

Devices for hanging paintings on pull-out metal mesh screens:

Fig. 8 S-hook & insertion device attached to back of painting

Beadwork – creating extra storage when space is limited:

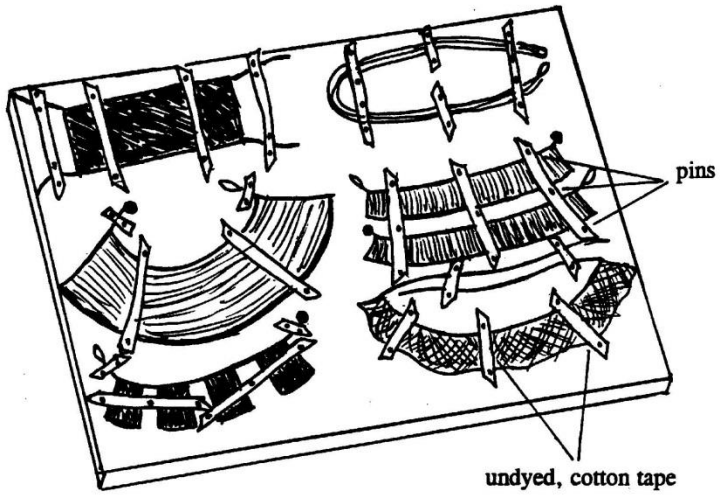


Fig. 9

Adzes, axes, clubs, sticks – method of attachment to metal mesh screens:

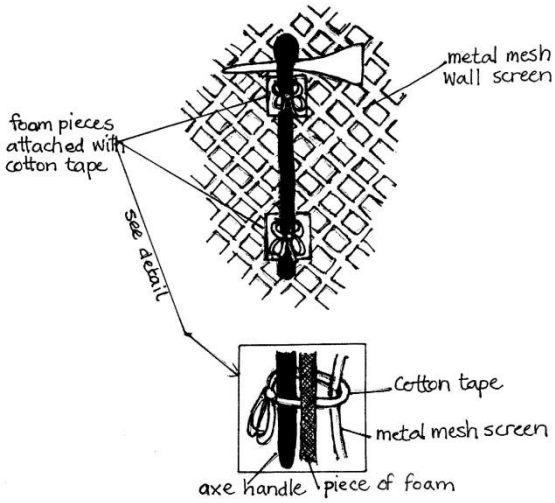


Fig. 10.

Headwear – simple method of storage

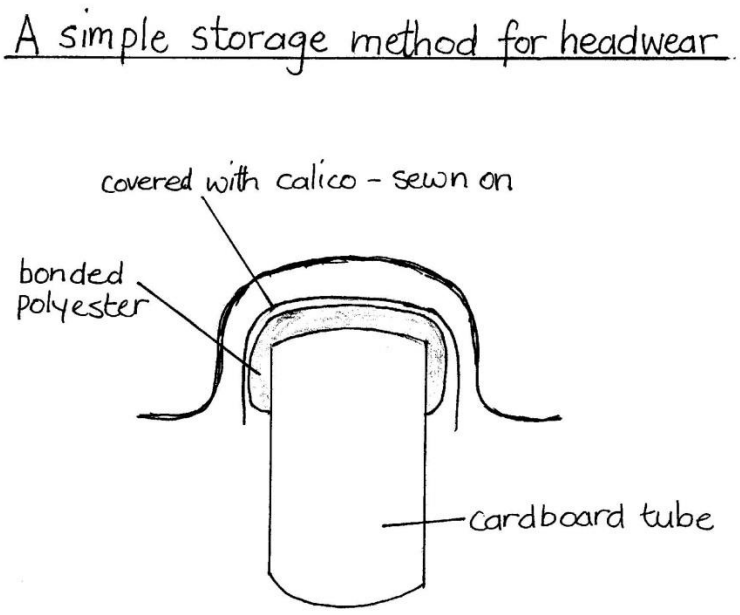


Fig. 11

Archaeological material – storage of special finds, rock art, and metal objects

Fig. 12a

Fig. 12b

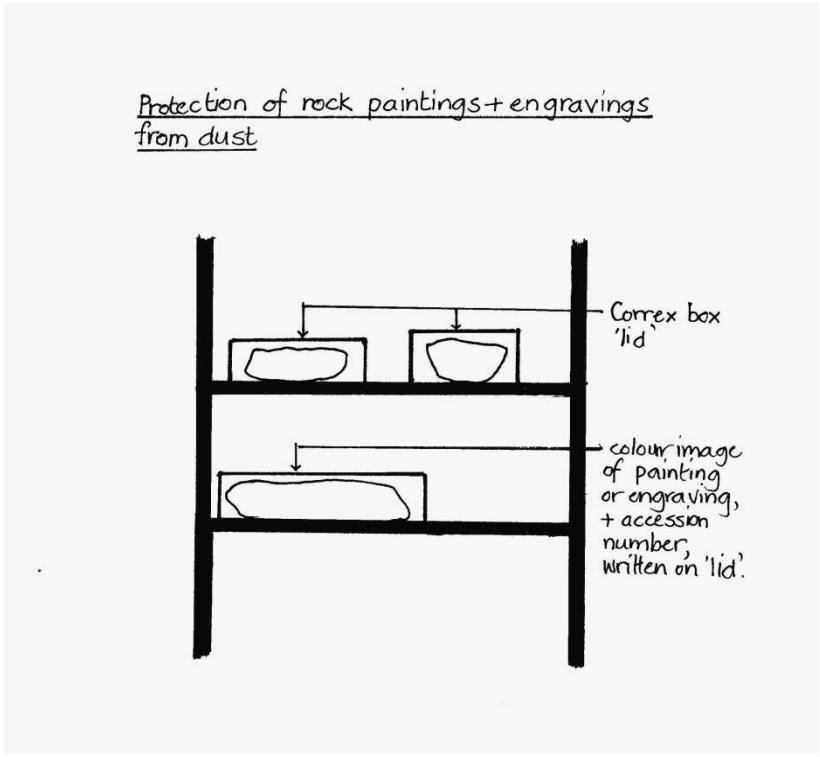


Fig. 13

Fig. 14

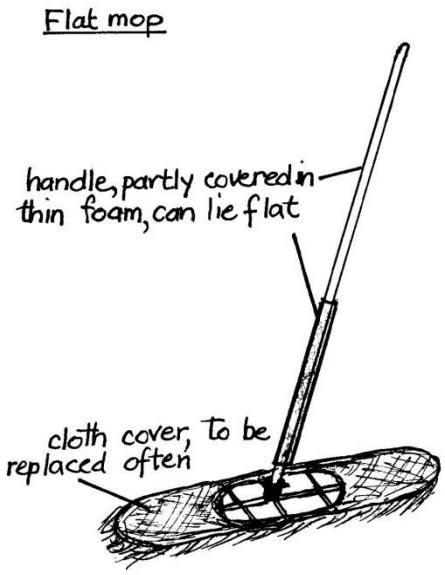

Flat mop
handle, partly covered in thin foam, can lie flat
cloth cover, to be replaced often

Fig. 15

AGENTS OF DETERIORATION

Many of the agents discussed below, work together to inflict damage on museum collections and therefore, should not be considered separately when attempting to control their influence.

Environmental damage:
Environmental factors are mainly responsible for the deterioration, and sometimes destruction to museum collections. Causes of environmental damage to SH collections include, humidity, temperature, light, biological & chemical factors.

a. Humidity & temperature

It is important to understand the relationship between temperature and humidity (moisture), as humidity causes most damage to the collections. However, humidity must always be considered in relation to temperature.

All living organisms contain water. About 65% of our body weight is water. Objects produced from plants and animals will retain some of that moisture in their composition. Water is also contained in the air in the form of water vapour.

Saturation is the maximum amount of water vapour that any given volume of air can hold, at a given temperature (expressed as grams of water vapour per cubic metre of air).

Condensation is when water vapour (a gas) changes to water (a liquid) when saturated air is cooled. However, the air is not always saturated and does not always hold the maximum amount of water vapour.

Absolute humidity is the amount of water vapour that a given volume of air **actually** contains, at a certain temperature (expressed as grams of water per cubic metre of air).

Relative humidity (RH) is the ratio of absolute humidity to saturation, of a given volume of air at a given temperature. RH is expressed as a percentage from 0 – 100%.

$$RH = \frac{\text{Absolute Humidity}}{\text{Saturation}} \times 100$$

(see also Glossary of Terms & Definitions, p. 7)
Measuring RH is extremely important in conservation because it shows to what extent the air can still absorb moisture (water vapour). Therefore, it shows how much the air dries or wets the objects it surrounds.

If the moisture is removed, objects made from wood or ivory will warp, crack or even disintegrate. Textile fibres become brittle and break. Skin or leather loses its flexibility. Increasing the humidity causes swelling, and excessively wet
Too much or too little moisture causes problems with objects of organic origin, and wet conditions are perfect for the corrosion of inorganic metals (see Manual, p. 4, list of Organic & Inorganic materials). As we are responsible for preserving

SH collections in our care, for as long as physically possible, we must try to control the amount, and the changes in humidity, that adversely influence collections in storage or on exhibition.

The scale of RH is used to show the amount and changes of humidity. The changes in the RH will depend on the changes in temperature, although, in itself temperature changes are not very important. It is the associated change in RH which causes the most damage to objects.

Causes of damage to objects through the combined effects of Relative Humidity (RH) and Temperature

TABLE I

High temperatures generally indicate dry conditions which means that the RH will be low. Organic materials are damaged as they dry out and become brittle, resulting in warping, cracking and flaking.

Material	**Evidence of <u>low RH, high temperature</u>, creating a consistently dry atmosphere**
Paper, photographs & films	- lose flexibility, become brittle and curl up at the edges
Stretched paper	- paper screens, drawings and pastels stretched on frames will tear as paper shrinks.
Textile fibres (natural)	- become brittle and break easily
Basketry and other plant material	- extreme dryness embrittles plant material & causes them to break.
Parchment & vellum	- lose flexibility
Tanned leather & partly-dressed skin	- depends on tanning process but tends to become hard & brittle.
Ivory (**anisotropic** – substance in which movement is unequal, but has directional properties)	- extremely dry conditions can result in shattering
Bone & teeth (anisotropic but less so than ivory)	- brittleness causes cracking
Archaeological bone	- excessive dryness (RH below 40%) can cause de-lamination of surface areas and internal cracking.

Wood & coated wood	- dimensional changes are slow, depending on coatings, such as varnish or lacquer. Dryness causes shrinkage and buckling, which results in the flaking off of the materials covering the wooden surface. Objects particularly affected, are those that use wood as a support, or background for other materials, such as painted wooden figures and panels, lacquered and veneered furniture and decorative objects covered with gesso plaster, which may be gilded or painted.
Feathers, fur, horn, hair	- become very stiff & brittle, and crush easily when handled.
Glass	- becomes brittle

TABLE II

Wet conditions, i.e. high RH and low temperatures. Many materials are hygroscopic in that they absorb water easily from the atmosphere. Abnormally high humidity levels have a detrimental effect on organic and some inorganic materials.

Materials	**Evidence of the effects of <u>high RH with low Temperatures</u>**
Paper, photographs & film	- rotting of size in paper; staining because of mould & fungal growth; paper that is stuck down at the edges will increase in size in humid conditions, expanding in the middle as their edges are restricted which leads to creasing. Gelatine emulsions on photographs also swell in humid conditions, & can stick to the glass if mounted in frames; if they are stacked they can stick together.
Stretched paper	- paintings, pastels & drawings on framed paper will fade more rapidly in wet conditions, & are extremely susceptible to mould & fungal growth; it also goes limp & temporarily loses strength.
Textile fibres (natural)	- dyed or painted textiles are particularly sensitive to light, and, combined with higher temperatures will fade more in the highly humid conditions. The fibres swell and fabrics shrink. Silk and wool are more susceptible than cotton or linen.
Parchment & vellum	- mould & fungal growth, & increased flexibility

Tanned leather & partly-dressed skin	- partly tanned skins rot easily when wet; they are susceptible to mould and stains; mould attacks leather dressing; moisture on leather causes shrinkage.
Ivory (**anisotropic** – substance in which movement is unequal, but has directional properties, i.e. moves in two different directions at the same time); bone & teeth are also anisotropic, but less so than ivory.	- because of uneven movement shattering can occur; mould forms at very high RH levels.
Archaeological bone	- at high RH levels water vapour permeates bone and weakens its structure before it dries out.
Wood & coated wood	- coatings may flake off as wood substrate expands, & some paints may dissolve at extremely high RH levels.
Basketry & other plant fibres	- moderately susceptible to mould, & leaf material may swell when the RH is high.
Worked metals like iron, steel, copper & alloys	- corrosion, or rusting takes place
Archaeological metals	- contain dissolved salts from the soil, which absorb moisture and cause corrosion. Corrode more rapidly when removed from the buried environment.
Stone, ceramics, lead, pewter (inorganic materials)	- extreme cold with humidity causes physical damage
Minerals & fossils	- some minerals, like iron pyrites, produce a white, dusty corrosion when the RH is too high.
Glass (a super-cooled liquid)	- **crizzled** or **'weeping'** glass is further damaged when the humidity is excessively high (see explanation below).

Glass is a product of the fusion of silica and alkaline oxides. The characteristics of glass depend on the type and proportion of alkaline substances, like lime (calcium oxide), they contain. The crizzled appearance of old glass is when moisture in the atmosphere reacts with unstable glass, and causes sodium and potassium ions in the structure of the glass, to leach out. As the structure weakens, small cracks appear.
'Weeping' glass is caused by sodium or potassium, which is part of the structure of the glass, to absorb water on the surface of deteriorating glass to form sodium or potassium hydroxide. These compounds accumulate on the surface of the glass and give it a greasy feeling. The hydroxides may also react with carbon

dioxide in the atmosphere, to form carbonates, which can absorb even more water.

Extremes in RH and temperature cause problems with most materials, but the most serious damage is caused by rapid, continual fluctuations of RH, in association with temperature. Objects made of organic materials have no time to adjust to one set of conditions before they must change to another.

Internal structural stress occurs as materials expand, through absorbing water, and contract unevenly, by giving off moisture. Warping, buckling, cracking, splitting, shattering, as well as the lifting of paint and veneers, is the result. Ivory is particularly sensitive to changes in humidity. Inorganic materials, like metals, stone, ceramics, and fossils in clay and shale, are stressed in the same way, and the damage caused can ultimately destroy the objects.

Many museum objects originate in humid environments and are often introduced to a dry climate without being acclimatized, for example, wooden objects from humid central Africa, are brought to the drier climate of Johannesburg. Shrinkage occurs as the wood loses its natural moisture, and this can result in irreparable warping and cracking. Textiles, works of art on paper and books are particularly vulnerable to fluctuations in humidity.

A Guide to safe RH levels for collections

Material	**Recommended levels of RH for organic & inorganic material, allowing for daily fluctuations of not more than 2 – 3%**
Paper, photographs & film	45 – 50%
Stretched paper	50%
Textiles	50 – 55%
Parchment & vellum	55%
Tanned leather & partly-dressed skin	50 – 55%
Ivory & bone	50%
Wood	55%
Paints & pigments	45 -55%
Basketry & other plant fibres, feathers	50 – 55%
Metals	30 – 35%

Stone & ceramics	not critical, except in extremely humid conditions
Minerals	not critical – as above
Glass	50% maximum, 35 – 40% preferred
Excavated material, including metals, stone, ceramics & low-fired earthenware	45 – 50%

RH levels in exhibitions and stores must not exceed 65%, as higher levels encourage mould and fungal growth. Mixed collections, or collections that combine many different materials, demand steady levels of between 50 & 55%.

Methods of stabilising the RH

In order to stabilise the moisture content of the atmosphere surrounding objects, the existing humidity levels must be measured in collection stores and in exhibition areas. Monitoring procedures must be done continuously for at least a year, to take into account seasonal variations.

Solutions for the control of temperature and humidity levels vary greatly, particularly in terms of cost. It is unlikely that many museum budgets can afford to install temperature & humidity control, or air conditioning systems. Temperature & humidity control must operate 24 hours a day, otherwise there will be an increase in harmful fluctuations of RH. Such a system is installed for the safety of stored and exhibited collections, but not for people.

Less expensive, but effective methods of stabilising and controlling the RH are available:

- Portable de-humidifiers if the RH is too high;
- Portable humidifiers where the RH is too low;
- In the SH historical houses, it is acceptable to open certain windows in warm, dry & windless weather, to allow circulation of air. Take care that changes are gradual. Don't leave windows open in adverse weather conditions, or overnight when temperatures may drop considerably. Windows left open at night also pose a serious security risk.
- Oscillating, semi-industrial fans (standing or wall-mounted), can be used for better air circulation in stores or exhibition areas.
  Of course, health and safety regulations must always apply where electrical appliances like humidifiers and fans are concerned.
- Ensure that stores are well insulated against the influences of the external weather conditions.
- As a precaution against dampness or flooding, collections should be stored at least 100 mm off the floor, and avoid, where possible, placing storage furniture against outside walls.

Methods of stabilising Temperature

As for RH, temperature levels should be monitored and measured for at least a year, taking into account seasonal variations. In arid or temperate climatic zones, when the temperature is extreme outside the building, temperature fluctuations can be reduced and stabilised by:

- Keeping doors and windows closed;
- Installing interior roller blinds on windows as a buffer against external high temperature conditions;
- Another inexpensive method of providing a barrier against heat, is to paint windows white, using PVA acrylic paint. The paint reflects heat away, and, because it contains *titanium dioxide*, the collection will also be screened from ultra-violet (UV) radiation;
- Installing exterior shutters or awnings, or putting up shade cloth.

Safe temperature levels for collections

Safe temperature levels for most collections, in storage and on exhibition, are between 19º and 21º, with daily fluctuations of not more than 1º - 2º. Temperatures beneficial to archival materials, for example, black & white and glass negatives, transparencies, and textiles made of cellulose materials, should be about 15ºC.
There is, however, a danger that condensation on objects will occur if temperatures drop below 11ºC, and high temperatures, above 23ºC, increases the rate of biological activity and chemical deterioration.
The appropriate levels for certain skins and furs that shed easily, is about 12ºC, with corresponding RH at around 30 – 35%.

The museum building as a buffer zone:

- a well-maintained building of solid construction provides a suitable environment for collections;
- a building made of thick stone walls or cavity-brick construction with high ceilings, provides good insulation against climatic changes. In hot weather, these buildings take a few days to heat up; and then, as the outside temperature drops, they lose heat slowly;
- make sure your building is well-maintained, so it provides the maximum possible seal against fluctuations of temperature and humidity in the outside environment;
- keep gutters cleaned out, repair cracks in walls and ceilings, and check out leaky roofs. All these improve the stability of the inside temperature and relative humidity (RH);
- if upgrading of buildings is considered, remember to insulate walls and ceilings – especially if the building/s is/are constructed from light-weight or heat-conductive materials. In so doing this will ensure better preservation of the collection, as well as improving human comfort levels.

Why should we worry about the effects of extremes and rapid fluctuations of temperature and RH?

- The risks of physical damage, such as warping, cracking & splitting of furniture and other wooden objects;

- chemical deterioration such as fading and embrittlement;

- insect and/or mould attack are increased when temperature & RH are too high or too low;

Effects of extremes & fluctuations of temperature include:

- increased biological activity, i.e. most insects and mould thrive and reproduce readily in warmer conditions;

- an acceleration of chemical deterioration processes, e.g. a rise of temperature from 20º - 30ºC can double the rate of some degradation processes. This is increased if light, water or atmospheric pollution is present;

- fluctuations in temperature cause uneven and rapid expansion and contraction, which can be disastrous for framed paintings and other composite objects (see 'Glossary …', p. 4);

- the most important effect of temperature is the effect it has on altering RH levels.

The effects of extremes & fluctuations of RH:

- in high humidity conditions, insect pests and moulds thrive and reproduce readily, metals corrode, dyes and textiles fade and deteriorate more quickly, organic materials, such as wood and leather swell and change shape, & gelatine emulsions & adhesives become sticky;

- organic materials absorb water, and is particularly noticeable in thinner materials, such as paper, textiles, leather, partly-dressed skin, and objects made of bark. As they absorb water, they swell and change shape, for example, paper stretches and can tear, mounted textiles can sag;

- the paint layer on a canvas compresses with an increase in the RH, which leads to cracking, or separation between the canvas and the paint layer;

- adhesives absorb water when the RH increases, become sticky and are an attractive food source for moulds and insects.

b. Light

Light is necessary in museums and historical houses, for viewing exhibitions, and for curatorial and collections management work.
All common light sources, such as the sun, light bulbs, fluorescent tubes, also give out other forms of radiation.

To demonstrate light and its effect on museum material, we can compare it to a chemical reaction that causes deterioration. A certain amount of energy must be supplied to start the reaction and this is called activation energy.

In the case of light, the activation energy is brought to an object by illuminating it. Deterioration occurs in the form of light energy called photons, and the shorter wavelengths that are invisible to the eye are the most damaging to SH collections. The most important of these are ultra-violet (UV), and infra-red (IR) radiation.

Most objects are opaque, i.e. light does not pass through them, and, therefore, light causes damage only to the surface. The surface is the part of the object that is exposed to light and therefore, vulnerable to damage when it is on display.

There are three ways in which light causes damage:

i. its intensity;
ii. its wavelength; and
iii. the length of exposure.

Light causes photochemical degradation to material containing keratin, such as horn, fur, hair, wool, feathers, silk and insect wings, by bleaching and yellowing them. This occurs through the destruction of amino acids (protein).

We should be concerned about radiation that is invisible to the human eye: infra-red (IR) is the longest wavelength and produces radiant heat, and the shortest is ultra-violet (UV) radiation.

Irreversible damage caused by light: infra-red radiation heats materials, and can cause them to expand, leading to mechanical stresses; can also cause chemical changes to progress more rapidly.

Ultra-violet radiation sets off chemical changes in paper and textiles which weakens and discolours them; and causes inks, dyes and pigments to fade, thus seriously affecting the aesthetic quality of works on paper, textiles, painted wood. Materials like ceramics, stone, horn, bone & metal, however, are unaffected by light unless the surface colour is important, for example, painted surfaces.

BEWARE:

'Damage is caused in proportion to the illumination intensity, multiplied by the time of exposure.' (Conservation & Restoration for Small Museums, 1981: 13)

The intensity or strength of illumination is expressed in lux (see 'Glossary …', p. 6), and the higher the lux value, the more destructive the light is.
The longer the material is exposed to light, the more damage is done. Anything over 75 microwatts per lumen (see 'Glossary …', p. 7) is dangerous for light-sensitive materials.

Measuring visible light and UV radiation

Units for measuring light levels:

Lux, kilolux hours & microwatts per lumen are units for measuring different qualities of light.
They can be explained quite simply:

Lux:

- Is the unit which indicates the intensity to which a surface is lit, or the brightness of the light.
- The closer the light source is to the surface being lit, the higher the lux value will be, that is the greater the intensity of light.

If we want to lower the intensity of light falling on an object, we can simply move it further away from the light source. For example, if the brightness or intensity of light falling on an object measures 100 lux when the object is 1 metre away from the light source, we can alter that intensity to 25 lux by moving the object 2 metres away from the light source.

Kilolux hours:

- Is the unit which indicates the exposure to light over a period of time.

Take the example of an historic costume on permanent display in a museum. The museum is open 5 days a week for 5 hours a day, all year round and while the museum is open, the costume receives light to an intensity of 200 lux. In a year the costume is exposed to:
5 x 5 x 52 x 200 lux hours = 260 000 lux hours or 260 kilolux hours.
This could be brought to within the levels recommended in the guidelines by adjusting the intensity of light falling on the costume and/or reducing the display time. For example, if the intensity of light was lowered to 50 lux and the costume was on display for only 6 months of the year, the total annual exposure would be significantly reduced:
5 .x 5 x 26 x 50 lux hours = 32 500 lux hours or 32.5 kilolux hours

Microwatts per lumen:

- Are the units which indicate the amount of UV (Ultra-Violet) energy in the light coming from a light source.
- Microwatts are a measure of energy; lumens measure the quantity of light from a particular light source.
- This measurement is constant for a light source and does not alter if the readings are taken at a greater distance from the source.

If we want to lower the UV content of the light, we can use absorbing filters on windows, or on fluorescent tube fittings, or we can install lights that give out only small amounts of UV radiation. Above all we must try to exclude sunlight.

Visible light: lux can be measured by using a lux meter (Fig. 13), or a good quality photographic light meter (Fig. 14 a + b).

Fig. 13

Lux meter: measuring and reading the scales

The measuring probe should be:

- held parallel to the surface being evaluated;
- laid on the surface if the illumination of that surface is to be measured; or
- be held horizontal at 0.85 m from ground if illumination of room is to be measured; or
- be held pointing from subject towards the camera, of photograph/painting/object that is being measured.

Reading the scales

- depress ON/OFF switch;
- read value indicated on lower scale, and if range selected was 200 lux (mostly used in museum context), e.g. if needle indicates 17.5, multiply by 10 to obtain measuring value – 175 lux.

Fig. 14a.

Scale	Lux ca.	fc appr.	Scale	Lux ca.	fc appr.
1	0.17	.016	12	350	32
2	0.35	.032	13	700	65
3	0.7	.065	14	1400	130
4	1.4	.13	15	2800	260
5	2.8	.26	16	5500	500
6	5.5	.5	17	11000	1000
7	11	1	18	22000	2000
8	22	2	19	44000	4000
9	44	4	20	88000	8000
10	88	8	21	175000	16000
11	175	16	22	350000	32000

Fig. 14b.

How to read lux levels on a light meter:

- Move diffuser (white dome) over receptor (mirror);
- point towards light source, while making sure that the meter is held at the position of the object/s on exhibition;
- press button on the side and read where the needle is centred on the scale from 1 – 22;
- refer to corresponding lux values on the back of the light meter (see Fig. 14b.).

UV radiation: the amount of energy in ultra-violet radiation can be measured using a UV meter or monitor. This device measures the amount of ultra-violet light energy, or microwatts, in each lumen of light (Fig. 15).

Fig. 15

How to calculate UV radiation levels using the UV meter:

- Hold the UV meter more or less horizontally, and point towards light source, away from object/s on exhibition;
- press down small button on top of meter, while at the same time turning the knob (with pointer), until the two red lights 'flicker on' together;
- the number the knob stops at, will be the level of UV radiation falling on object/s on exhibition (the safest level for most organic materials, is around 75 microwatts per lumen (see 'Glossary …', p. 7), or less.

Recommended light intensity levels for material on exhibition

Materials	Recommended Levels	Exhibition period
<u>Extremely sensitive material</u>		
Textiles (especially silk) Water colours & pastels Paper Illuminated manuscripts & books Dyed leather Materials containing keratin: fur, feathers, horn, hair Vegetable-dyed material Paintings using mixed techniques, contemporary techniques, unstable materials or unvarnished egg tempera Lacquer and lacquered objects Felt pen ink Unbleached ivory Botanical specimens & other natural history material	maximum 50 lux	maximum: 3 -6 months; no more than every 5 years
<u>Moderately sensitive material</u>		
Varnished oil and egg tempera paintings All organic materials other than in the first category, e.g. wood, horn, bone (where surface colour is important)	maximum 150 lux	medium term 3 – 5 years
<u>Material not affected</u>		
Metal Stone Ceramics Glass	maximum 1000 lux, with heat filters	no limit

Can the damage be prevented?

Damage to objects and collections cannot always be totally prevented, but the rate of deterioration can be reduced and slowed down:

- by exposing objects to light only when necessary;
- by making sure the light is not too bright; and
- by eliminating UV radiation, and reducing IR (infrared or heat) radiation.

Light sources in museums, galleries and libraries

The major sources of visible light in museums, galleries and libraries, are daylight and artificial light, produced by incandescent bulbs & fluorescent tubes, which are also sources of infrared (IR) & ultraviolet (UV) radiation, respectively.

Daylight

Most of the damage caused by unfiltered daylight is the result of the small quantity of UV contained in it, rather than by the whole of visible radiation. There is a much higher proportion of UV energy in daylight radiation through glass than in artificial radiation, such as fluorescent tubes.
An electronic flash emits enough UV for it to be thought of as a problem in still photography. It was thought that the strength of light in the flash might damage material being photographed. Tests were carried out, however, and it was concluded that normal use of the flash was far less damaging than constant exposure to incandescent lamps (see section on Artificial light, below).

How do we eliminate UV radiation?

Through windows:

- cover with curtains, manual roller blinds, and/or internal or external shutters;
- white PVA paint absorbs UV fairly well, as it contains titanium dioxide, the white pigment in paint. The white also reflects the light.
- acrylic sheets (clear & diffusing Perspex), instead of glass, have a life of 8 – 10 years before renewal is necessary. Monitor regularly with a UV meter (see p. 42)
- solar film can be applied to windows, glass doors & display cases. Solar roller blinds can also be used over windows, where appropriate, to prevent transmission of UV and IR (infrared) radiation. The film & roller blinds transmit less than the maximum level of 75 microwatts per lumen, shown on the UV meter. The meter measures the proportion of UV radiation to visible light coming from a light source. The protective film and roller blinds also screen out approximately 65% of heat, or IR (infrared) radiation, emitted from daylight.

Artificial light

There are many types of artificial light sources, each with advantages and disadvantages:

- *incandescent tungsten lamps*, such as spot lights or flood lights, have a low UV output, but emit more IR (infrared) radiation in the form of heat. If they are close to objects, or placed in closed display cases, they cause damage by raising the temperature of, or heating, objects.
- *fluorescent light tubes* give out 'cold' light, but emit unacceptably high levels of UV radiation. They can more easily be used inside display cases, as they don't generate heat like the incandescent tungsten lamps. However, it is important to

note that if fluorescent tubes are fitted inside display cases, a diffusing Perspex, or glass sheet should be placed between the fluorescent tube and the displayed objects, to prevent any UV damage.

- *tungsten halide bulbs* are more efficient than incandescent bulbs, but give but higher than acceptable levels of UV radiation.

- *fibre optics* – preferred, but still out of the budget range of most museums.

- *LED light bulbs* - see below for information on how LED light bulbs work, as well as their advantages for use in museums, archives and galleries

How LED light bulbs work

Introduction
The light bulb that has lit up our homes, and museums, since the 1800s is officially on its way out. Financially and ecologically, the **incandescent bulb** is inefficient, and loses most of its energy as heat.

The most common replacement for the incandescent light bulb has been the **fluorescent tube**, although its main problems are the inclusion of toxic mercury in the design, and the high levels of ultra-violet radiation it emits.

Light-emitting diodes, commonly called LEDs, are real unsung heroes in the electronics world. They do dozens of different jobs and are found in all kinds of devices. Among other things, they form the numbers on digital clocks, transmit information from remote controls, light up wrist watches, and tell you when your appliances are turned on. Collected together, they can form images on a large television screen, or illuminate a traffic light.

Basically, LEDs are just tiny light bulbs that fit easily into an electrical circuit. Unlike ordinary incandescent bulbs, however, they don't have a filament that will burn out, and they don't get very hot. They are illuminated solely by the movement of electrons in a **semi-conductor material**, and they last just as long as a standard transistor. The lifespan of an LED far exceeds the short life of an incandescent bulb by thousands of hours. Tiny LEDs are already replacing the tubes that light up LCD HDTVs to make dramatically thinner televisions.

What is a diode?

A diode is the simplest sort of semi-conductor device. It is, broadly speaking, a material with a varying ability to conduct electrical current. Most semi-conductors are made of a poor conductor that has had impurities (atoms of another material) added to it. The process of adding impurities is called doping. In the case of LEDs, the conductor material is aluminium-gallium-arsenide (AlGaAs). In pure aluminium-gallium-arsenide, all of the atoms bond perfectly to their neighbours, leaving no free electrons (negatively charged particles) to conduct electric current. In doped material, additional atoms change the balance, either adding free electrons or creating holes where electrons can go. Either of these alterations make the material more conductive.

A semi-conductor with extra electrons is called N-type material, since it has extra negatively-charged particles. In N-type material, free electrons move from a negatively-charged area to a positively-charged area. However, **a semi-conductor with extra holes is called P-type material** since it has extra positively-charged particles.

A diode consists of a section of N-type material bonded to a section of P-type material, with electrodes on each end, and this arrangement conducts electricity in only one direction. When no voltage is applied to the diode, electrons from the N-type material fill holes from the P-type material along the junction between the layers, forming a **depletion zone,** and this occurs when the semi-conductor material is returned to its original insulating state, i.e. all of the holes are filled, so there are no free electrons or empty spaces for electrons, and charge can't flow (Fig. from info. Pg. 2).

To get the electrical charge moving, the depletion zone has to be removed, and this is achieved by getting electrons moving from the N-type area to the P-type area and holes moving in the reverse direction. To do this, the N-type side of the diode must be connected to the negative end of the circuit, and the P-type side to the positive end. The free electrons in the N-type material are repelled by the negative electrode and drawn to the positive electrode. The holes in the P-type material move the other way. When the voltage difference between the electrodes is high enough, the electrons in the depletion zone are boosted out of their holes and begin moving freely again. The depletion zone disappears, and the electrical charge moves across the diode (Fig. from info. Pg. 2). If the current is run the other way, with the P-type side connected to the negative end of the circuit and the N-type side connected to the positive end, current will not flow.

The interaction between electrons and holes in this set-up has an interesting side effect – it generates light!

How can a diode produce light?

Light is a form of energy that can be released by an atom. It is made up of many small particle-like packets that have energy and momentum but no mass. **These particles, called photons, are the most basic units of light**. Photons are released as a result of moving electrons. In an atom, electrons move in **orbitals** around the **nucleus**. Electrons in different orbitals have different amounts of energy. In general, **electrons with greater energy move in orbitals farther away from the nucleus.**

For an electron to jump from a lower orbital to a higher orbital, something has to boost its energy level. Conversely, an electron releases energy when it drops from a higher orbital to a lower one. This energy is released in the form of a photon. **A greater energy drop releases a higher-energy photon, which is characterised by a higher frequency, thus producing brighter visible light.**

Visible light-emitting diodes (VLEDs), such as the ones that light up numbers in a digital clock, are made of materials characterised by a wider gap between the conduction band and the lower orbitals. The size of the gap determines the frequency of the photon, i.e. it determines the colour of the light. While LEDs are used in everything from remote controls to the digital displays on electronics, visable LEDs are growing in popularity and use, due to their long life times and miniature size. Depending on the materials used in LEDs, they can be built to shine in infrared, ultraviolet, and all the colours of the visible spectrum in between.

Advantages of LEDs

While all diodes release light, most don't do it very effectively. In an ordinary diode, the semi-conductor material itself ends up absorbing a lot of the light energy. **LEDs are specially constructed to release a large number of photons outwardly**. Additionally, they are housed in a plastic bulb that concentrates the light in a particular direction. Most of the light from the diode bounces off the sides of the bulb, travelling on through the rounded end.

LEDs have several advantages over conventional incandescent lamps:

- they don't have a filament that will burn out, so they last much longer;
- their small plastic bulb makes them a lot more durable;
- they fit more easily into modern electronic circuits; and most importantly
- they are much more efficient than conventional incandescent bulbs, where the light-production process involves generating a lot of heat, which is completely wasted energy. LEDs generate very little heat, relatively speaking. A much higher percentage of the electrical power is going directly to generating light, which cuts down on the electricity demands considerably.

Per watt, LEDs output more **lumens** of light than regular incandescent bulbs. Light-emitting diodes have a higher **luminous efficacy** (how efficiently electricity is converted to visible light) than incandescent bulbs, for example, a particular type of LED bulb produces 76.9 lumens per watt compared to an incandescent bulb's 17 lumens per watt. LEDs also have a lifetime of 50 000 hours or more.

Up until recently LEDs were too expensive to use for most ordinary lighting applications, because they are built around advanced semi-conductor material. The price of semi-conductor devices has plummeted since the year 2000, making LEDs a more cost-effective lighting option for a wide range of situations, including museums. While they may appear to be more expensive than incandescent lights, their lower cost in the long run makes them a much better buy.

LED light bulbs vs. incandescent and fluorescent light bulbs

For decades, 60- and 100-watt incandescent light bulbs have lit up homes, buildings and museums, but they have some problems. They are inefficient, wasting lots of energy as heat, and having even shorter life spans, than fluorescent lamps/tubes. Incandescent lights last for an average of about 1 000 hours, and although fluorescent lamps can last up to 8 000 hours, they have disadvantages. Fluorescent lamps contain toxic mercury that makes them potentially hazardous and difficult to dispose of, and they emit high levels of ultraviolet (UV), the highest next to sunlight. They are, therefore, not safe to use for organic materials found in most museum collections.

c. Biological pests (insects, rodents & moulds)

In nature insects and moulds perform the vital task of reducing animal and plant products to re-usable chemicals. This is an important part of the cycle of life.

There are a great many species of insects and moulds, with an equally large range of habitats, food sources and behaviours. Museum collections provide food and breeding places for both insects & mould, and they are often more successful than humans are, at finding food and adapting to the conditions we impose on them.

If they are not controlled, insects and mould can cause serious damage to collections that are made up of organic materials. Controlling them is much more complicated than buying an aerosol can of insecticide, or calling a pest control company. Chemical warfare on insects and moulds can have very serious effects on humans as well as causing damage to objects in the collection.

It is important, therefore, to be able to recognise the signs of insect & mould activity. It is also critical to know which biological pests pose a threat so steps can be taken to control them.

Insect pests

Quarantine procedures for controlling insect pests in stored and exhibited collections.

An essential part of any pest prevention policy in museums is to keep insect pests out of collections whether in storage or on exhibition.

- It is critical to protect stored and exhibited collections from external influences as the origins of most pests are from the natural environment.

- It is important to recognize the link between insect attack and cleanliness, especially as the risk of attack is higher in storage areas where insects are left undisturbed. Establishment of **good housekeeping programmes** (see Manual, pp. 18 - 19 & 50 - 52), together with **regular inspection** of stores and exhibition areas, is essential to help control or eliminate insect damage.

- The key to preventing insect infestation is having a good understanding of the conditions under which they thrive, namely **food, warmth, humidity and harbourage (a place to live & breed) (**see p**.** 56).

- Elimination of insects is best achieved by first identifying the main pests that damage collections, getting to know their life cycles (see pp.61 - 68), and then **controlling and monitoring temperature and relative humidity (RH)** in the stores and in exhibition areas.

- Objects most vulnerable to insect attack are made of organic materials, such as fur, feathers, animal skins, hair, silk, wool, parchment & vellum, dried plants & seeds.

Prevention of insects: inspection in storage and exhibition areas:

- The buildings, all collection material in storage, on open display, or in closed display cases, should be inspected regularly (an inspection schedule should be drawn up for each store room & closed or open display).

- The inspection sequence should be drawn up using a plan of the building/storerooms/display and unused areas.

- All inspection details must be recorded in a log book.

- Make use of torches to inspect dark spaces and the interiors of objects like furniture.

- A methodical inspection is preferred to a sporadic one, to ensure the best protection for the collections.

- Areas where inspections should be concentrated:
  'dead' areas, dark corners, areas of poor hygiene;
  window sills and other catchment areas such as air-conditioning ducts and filters;
  inside display cases and storage boxes containing materials most at risk, e.g. wool, animal skins with fur, tortoise shell, horn;
  under objects on display;
  in pockets or behind seams of textiles and clothing;
  inside cupboards, chests & armoires, that have poorer quality backing boards;
  kitchens, restaurants & staff rooms.

Prevention of insects: trapping in storerooms and exhibition areas:

- Carry out a survey of storerooms and exhibition areas to identify insect pest access points as well as high risk areas and objects.

- Prepare to place **sticky insect traps** (see p. 55, Figs 16a & b) on the floor in corners and wall/floor angles rather than in open areas. Date-label traps and mark their positions on a plan of the store, exhibition gallery or house museum.

- Traps should be checked once every 2 months. The greater the number of traps used in a storage space, the greater the chance of finding insects.

- Insects caught on traps should be identified and the information recorded in a **log book.** It is important to record whether the insects caught are larvae or adults.

- Replace traps when dirty or the adhesive (stickiness) has failed.

- Large numbers of non-pest insects may be caught on traps, especially if they have been placed near an entrance/exit door, in storerooms in particular.

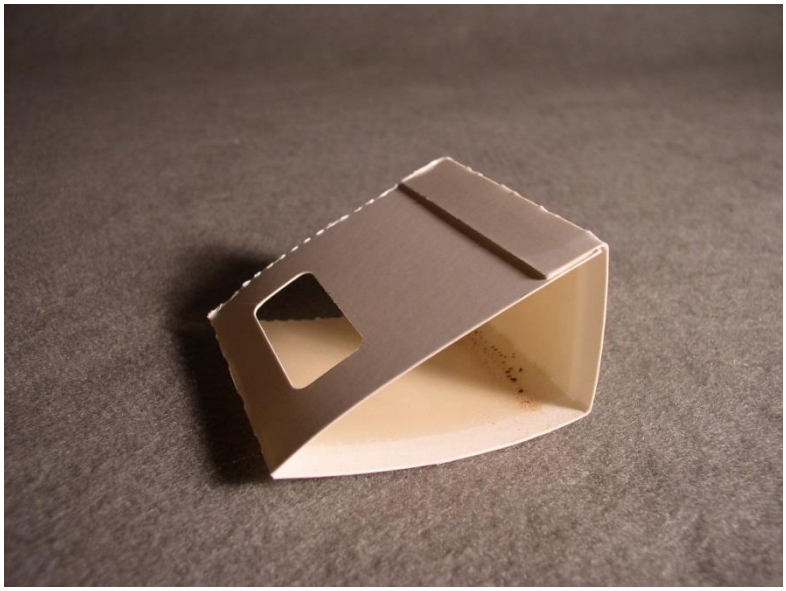
Replace those traps frequently as the trapped insects will act as a food source for insects that are serious pests.

- Traps should be used as a supplement to visual inspection and the information they provide used to identify the kind of preventive and remedial measures needed.

- Trap catches can show:
  the presence of pest species;
  an increase in insect numbers in a specific storage area;
  the spread of insects from one area to another in exhibition areas or house museums; an invasion of adult insects in spring/summer, e.g. clothes moths, cockroaches;
  localised infestation in a vulnerable storage area, e.g. woollen textiles;
  the failure of the control treatment.

Fig. 16a. **Insect trap – not assembled**

Fig. 16b. **Insect trap – assembled**



Prevention of insects: environmental control in storage and exhibition areas:

- Insects need warmth and humidity to survive so it is critical to monitor and control temperature and RH levels to prevent insect infestation.

- It is important to monitor temperature and RH levels by means of recording devices, such as **thermohygrographs** or **digital data loggers.**

- The main environmental objectives for prevention of insect pests in storage & exhibition areas are:
  keeping the temperatures consistently low, e.g. between 19º - 21ºC, which takes into account human comfort levels in exhibition galleries. However, these levels are difficult to maintain in historic buildings;
  keeping the RH low at 50%, but not exceeding 55%;
  limiting the daily fluctuations of both temperature & RH to a minimum – not more than 1º - 2ºC for temperature, and 2% for RH;
  ensuring that the collections and their environment are kept clean.

- Introduce de-humidifiers & fans into historic buildings where it isn't possible to install temperature and humidity control (air-conditioning), and yet the humidity is at unacceptable levels

Conditions needed for insects to thrive:

Food source	organic materials normally attract insects, although they can survive on dust and fluff derived from these;
Warmth (temperature)	temperatures of 20º C and above will encourage insects to breed. Stores, in particular, should be as low a temperature as is practical. If temperatures are too low then the relative humidity (RH) levels will rise accordingly, creating unacceptably high humid conditions;
Humidity	although insects can tolerate a wide range of relative Humidity (RH), many often require very particular conditions to complete all phases of their life cycle and so thrive. The furniture beetle needs a damper environment, above 60% RH; silverfish will breed rapidly and cause serious damage for paper-based materials in conditions above 70%;
Harbourage	insects like to live and breed in places undisturbed by human activity. Some of the places they are commonly to be found are in cracks between floorboards; gaps between walls and floors; dead spaces behind and under storage cabinets, display cases, shelving units & plinths.

A Pest control programme should only use eco-friendly products.

Routine pest control treatment (3-monthly, or 4 times a year):

Pest control schedules will be drawn up and sent out to all responsible for the care of the collections, and it is the responsibility of Conservation & Collections staff to make sure that collection stores & exhibition areas are treated, to prevent insects and rodents from causing damage to the collections. Public areas, offices, kitchens & toilets, will be checked and treated by front-of-house staff.

- In collection stores & kitchens – use only the cockroach gel and cardboard rat bait stations (eco-friendly rat bait);
- In public galleries, & drains – pyrethroid-based spray;
- Outside perimeters of buildings – plastic rat bait stations with eco-friendly rat bait.
- Historical buildings – cockroach gel, cardboard rat bait stations (eco-friendly rat bait).

Procedures to follow when there are intermittent pest problems found, outside of the routine pest control programme, in any of the historical buildings, but particularly in vulnerable collection stores.

Examples of pest problems which would require the services of an external pest control contractor:

- evidence of rat or mouse damage in collection or exhibition areas;
- piles of insect frass in and around wooden objects;
- evidence of cockroaches and other insects that feed on protein material (see 'Life cycles & eating habits of insect pests & rodents commonly found in museums', pp 61 - 68).

In the event of an isolated insect infestation in a stored collection.

- report discovery of an infestation in collection storage to the collections and/or conservation staff in the museum;
- a photographic record must be made of affected/damaged material *in situ* before removal from the collection store;
- isolate affected material and remove to the fumigation chamber or suitable, sealed room, or metal cupboard, to be thoroughly cleaned.
- The affected material must be photographed before and after cleaning. If a chemical fumigation is necessary, the material must be returned to the store before the fumigation takes place;
- to prevent the spread of infestation in the store, clean the areas where it took place, remove all insect debris in a sealed container and dispose of it so that it doesn't become a food source for other insects;

- decide on the most appropriate and safe treatment, for example, freezing (see p.58, for ‘Freezing used as a method of pest control for museum collections’), monitoring in quarantine;

Freezing used as a method of pest control for museum collections

Freezing has become an accepted method of pest control for museums worldwide. It has proved to be promising, particularly for controlling insect pests on organic materials, and avoiding the use of toxic chemicals.

Procedures to follow when using the freezing method to control pests:

- Do not subject non-absorbent objects to freezing, as they cannot absorb the excess water vapour that forms. It will condense on the surface of the object and form frost;
- If a chest freezer is used, it is recommended that objects be placed in transparent, polyethylene bags, from which most of the air is evacuated. Tie with 'twist ties'. Bagging will not be necessary if a controlled freezing chamber is used;
- Only absorbent materials, e.g. wood, basketry, natural fibres, can safely be frozen and then thawed;
- All material must be taken directly into the freezer from room temperature, which is 20º C;
- Quick freezing and slow thawing is best for the objects;
- The recommended minimum temperature is - 20º C. This should be maintained for at least 48 hours;
- Repeat the cycle of freezing and thawing slowly, immediately, to ensure that de-infestation is complete;
- Do not remove the polyethylene bag until the objects have reached room temperature, and no condensed water remains on the outside of the bag;
- Keep a careful record of the procedures, and include the date and length of time for which the objects were frozen;
- After the freezing procedure, clean the objects thoroughly, to remove dead insects, frass, larval skins and eggs. A soft brush and the use of tweezers might be necessary;
- Objects that are particularly vulnerable to re-infestation should be stored loosely in other, special, but separate storage. Check vulnerable objects regularly. Freezing leaves no residual effect.

Ref.: Graham-Bell, M. 1986. Preventive Conservation: a manual. British Columbia Museums Association, Handbook No. 2

Procedures in the event of a professional fumigation in a stored collection.

Role players: Collections & Conservation staff, Building managers & Management

- choice of an appropriately safe fumigant to be used will be decided in discussion with the relevant staff and the pest control contractor appointed by the Department of Public Works (DPW), in the case of national museums, or an external pest control contractor. The choice of the fumigant is critical for the safety of the organic materials in the collections. To be effective the chosen fumigant has to destroy any further insect activity, & the eggs;

- front-of-house staff and members of the public must be clearly notified of the impending fumigation and the appropriate safety precautions taken;

- the location of the fumigation will influence the level of information in the notification, for example, within a museum building near public galleries, in a collection store, or in a fumigation chamber that conforms to international safety regulations;

- in the event of a fumigation of collection material, conservation staff will work closely with front-of-house staff, so that all the appropriate measures are taken to ensure the safety of the public and staff in that building;

- if the collection material to be fumigated is situated close to the public areas of a museum, special permission must be obtained from Management to close the specific museum for at least 24 hours after the fumigation has taken place;

- a fumigation of this nature must always be done on a Friday afternoon, for the fumes to have the maximum effect on the objects, and the least effect on the public and staff;

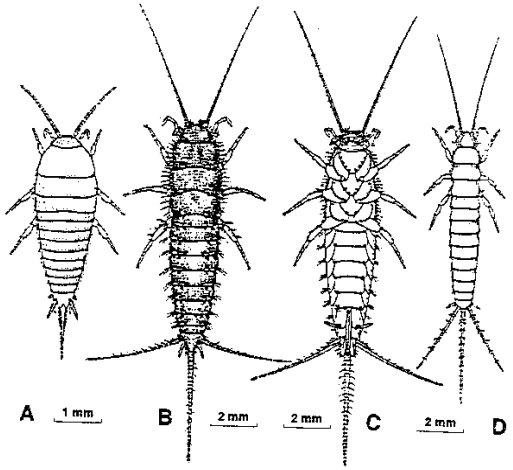
- conservation, or collections staff will supervise and assist the pest control contractor in the preparations for setting up the fumigation, and again after it is over;

- all stages of the fumigation must be documented and should include the following information:
  examination & cleaning procedures of material to be fumigated;
  a list of material to be fumigated, with photographs;
  fumigant used & the fumigation process.

LIFE CYCLES AND EATING HABITS OF INSECT PESTS COMMONLY FOUND IN MUSEUMS, ARCHIVES AND GALLERIES.

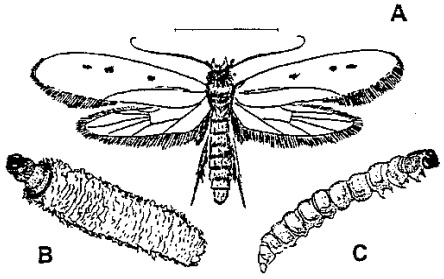
Fish moths (silverfish) *(Thysanura)* are shiny, silver-grey insects 8 – 13 mm long. The young (nymphs) look like the adults, but are smaller and take about 5 months to mature. They grow by moulting without changing their form, and life-span is about three and a half years, producing 1 to 3 generations a year. They are fast-moving, feed at night and are frequently found in dark, undisturbed places where books or documents are stored. Nymphs and adults feed on the surface of paper, especially if damp. They like glue, paste & size in paper, also starchy material in book bindings, books or labels. Also damage photographs, wall-paper, dry plant material and may attack linen, cotton, silk & rayon textiles.

(Preventive measure for eradicating fish moths: Fish moth bait – see recipe & method of making up, p. 104)



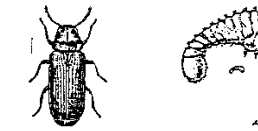
Thysanura: A, *Atopatelura michaelseni*, Ateluridae, ♀ dorsal; B, C, *Acrotelsella devriesiana*, Lepismatidae, ♂ dorsal and ♀ ventral (scales omitted); D, *Trinemura excelsa*, Nicoletiidae, ♀ dorsal.

Case-bearing clothes moth *(Tinea pellionella)* lays small white eggs on the food source material which produce white larvae (7-8 mm long) encased in tube-like cases. Adult moth 7-9 mm long, emerges in spring & life-cycle takes from 2 months to 4 years to complete & produce 2 generations a year. They feed on hair, hides, wool, feathers and some plant material. They can be found by looking for feeding damage & the silken tube encasing the larva while it feeds.

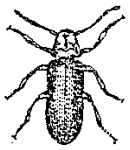


Casemaking clothes moth (*Tinea pellionella* and closely related species). A, adult; B, larva in case; C, larva free of case. (Line = 2 mm)

Furniture beetle *(Anobium punctatum)* causes major damage to hardwoods, but also to some old soft woods such as flooring and roof timbers. They are particularly destructive to furniture and attack ply woods used as backings and willow wickerwork. The larva of this beetle bores into the solid wood, resulting in a small round exit hole of about 2 mm in diameter. The life-cycle of the furniture beetle takes 3 to 4 years to complete.

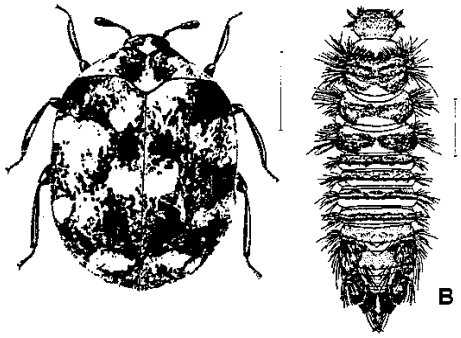


- *Anobium punctatum* & its larva



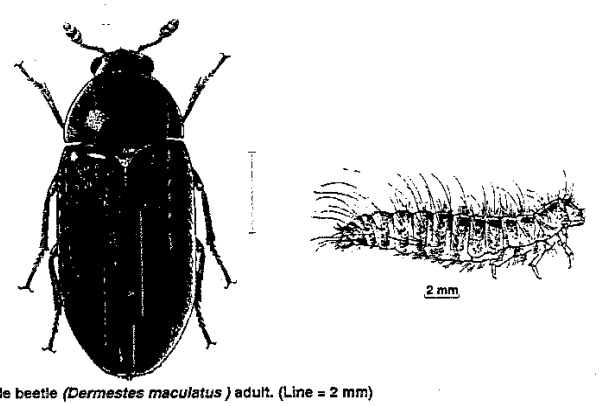
The furniture beetle, *Anobium punctatum.*

Carpet beetle *(Anthrenus verbasci)* has short, black, hairy larvae 2-4 mm long, and becomes an adult 2-3 mm long, with orange or yellow patterns. They produce 1 or 2 generations a year and the larval stage is very destructive. They feed on wool, fur, hair, horn, skins, hides, leather, feathers, drugs, spices, dead insects & seeds. They are detected by the feeding damage, larval skin casts and adults that collect in windows and in light fixtures. Adults thrive in dry conditions, but the larvae prefer to live in the dark.



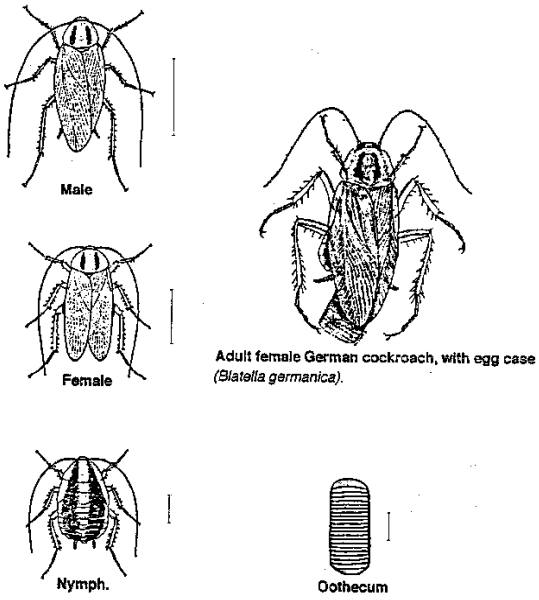
Varied carpet beetle *(Anthrenus verbasci)*. A, adult; B, larva. (Line = 1 mm)

Hide beetle *(Dermestes maculates)* is about 6 mm long, dull black above and white underneath. It is very active and quickly crawls away from the light. Larvae grow to 19 mm and are covered in long hairs. It moults more than six times, leaving its skin casts amongst its frass, on the damaged hides. Larvae mature within 6 weeks and have the habit of boring into soft materials such as wood and insulating board in order to pupate. They can do considerable damage in storerooms, starting to eat at the edges of where skins are folded or creased.



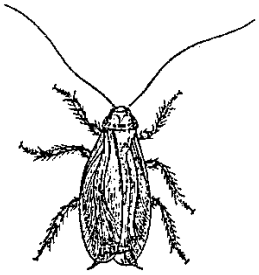
Hide beetle *(Dermestes maculatus)* adult. (Line = 2 mm)

German cockroach *(Blatella germanica)* is a tan-coloured insect 12.5 mm long with two characteristic dark brown lines on the thorax. It completes its development in about 5 months and produces 2 or 3 generations a year.



Adult female German cockroach, with egg case *(Blatella germanica).*

American cockroach *(Periplaneta Americana)* is a brown pest which grows to 38 mm or more in length and takes almost a year to develop. It may live for up to two and a half years.
Both species are active at night, are drawn to moisture and are ravenous feeders, eating any organic material. The nymphs and adults feed on starchy materials, sugary or fermented foods, leather, parchment and the glue in book bindings. They also attack wool, dried insects and leaves. They are detected by the feeding damage, egg cases and droppings.



The American cockroach, *Periplaneta americana.*

LIFE CYCLES AND EATING HABITS OF RODENTS COMMONLY FOUND IN MUSEUMS.

House mouse *(Mus Musculus)* is distributed over the whole of Europe. It is originally from Asian, North African and Mediterranean steppes. It lives in dwellings, out-buildings, wood piles, etc. It is a good climber and makes nests in holes, walls and skirting boards of houses. The female produces litters of four to eight (sometimes as many as twelve), blind, hairless young, several times a year. Young open their eyes at twelve to fourteen days and become mature in six to seven weeks. They have a life span of about eighteen months. They do not hibernate.
They feed on waste matter, seeds, etc., and large numbers can cause damage to food stocks.

Brown rat *(Rattus norvegicus.* Brown rats do burrow. They live outdoors, indoors and in sewers. Nest in burrows, can climb, though not agile, and are very good swimmers. Habits are somewhat predictable. Avoids unfamiliar objects for some days, this is called neophobia, for example, bait trays/stations placed directly on rat-runs.
They live for approximately 9 – 18 months. As with the Black rat, during 2 – 3 months into their life cycle they are sexually mature enough to breed and will produce between 8 – 10 young in each litter, and have the potential to produce up to 7 litters a year.
Omnivorous, but more likely to eat meat than the Black rat (Rattus rattus). Consumes up to 30 grams a day, drinks water or eats food with high water content.

Black rat *(Rattus rattus)*. Black rats tend not to burrow as the Brown rat would. The nests are found mainly in walls, attics, vines and trees. They are very active, agile, good climbers and are rarely found in sewers. Found to be more erratic and very unpredictable in their habits compared to the Brown rat (Rattus norwegicus).
They live for approximately 9 – 12 months. During 2 – 3 months into their life cycle they are sexually mature enough to breed, and will produce between 6 – 10 young in each litter. They have the potential to produce up to 6 litters a year.
Black rats are omnivorous and will feed mainly from fruits, nuts, grains and vegetables. They will consume approximately 25 – 30 grams a day, and need to drink water and eat food with high water content.

Moulds

We have all observed mould growth on stale bread, cheese, damp leather or basketry. This growth, which appears as a fine, fluffy mass on the surface of those materials, is called a fungal colony.

When the conditions are favourable for growth, the colony undergoes change. Older parts change colour and, if you look through a microscope, fruiting structures can be seen. They contain the reproductive spores; the fruiting structures stand up above the colony mass in order to discharge the spores into the air so that they can be carried to a favourable surface to grow. Under favourable environmental conditions, the spores absorb water and increase in size. Rapid growth and repeated branching help to form a new colony.
The growth of moulds depends mainly on the amount of moisture (RH) present in the air. Most moulds can survive in relative humidity higher than 60%, and require at least 70% to survive and reproduce. If the RH drops below 60%, the fungal body dies but. In such adverse conditions, however, spores are released. These will lie dormant until conditions are suitable for growth once more.

Control and prevention of mould growth

It is almost impossible to prevent contamination of museum material by fungal spores. However, by controlling the humidity, spores can be prevented from germinating. Between 50% and 60% RH is regarded as safe, although anything below 45% can be harmful to some materials, such as silk, leather or wood.

What damage do moulds cause?

Damage caused by mould attack can be devastating. Moulds digest and break down the materials they feed on. In the process, paper, textile & wood become weak and eventually crumble away, and pages of books become mashed together as the moulds (**digestive enzymes**) attack many layers of paper at once.

The digestive enzymes produce acids that attack materials which are not normally susceptible to mould growth, for example, stone & metals. Moulds also produce coloured materials which stain wood, paper & textiles. These stains can be extremely difficult to remove, because they are often insoluble. Even when they are soluble, the stained material, like paper, is often too weak to treat. If the digestive enzymes attack the gelatine layer on a photograph, the photograph is destroyed. Mould can also produce toxic chemicals which can cause allergies and illness.

What can be done to control moulds?
It is impossible to stop fungal spores falling on objects, therefore we must make sure that we create an unfavourable environment for a mould colony to develop. By controlling the relative humidity (RH) to below 65%, the fungal body dies and spores cannot germinate, but if RH levels are maintained at between 45% and 55%, the objects are relatively safe from mould attack. However, even in such adverse conditions, spores are released, and they will be dormant until conditions are suitable for growth once more.

Find out what caused the RH to become high enough to allow mould growth – climate, or blocked gutters overflowing. Take steps to resolve the problem – adjust the temperature & RH control system, acquire a de-humidifier, clear the blocked gutters. It is very important that you get to the cause of the problem, and deal with it, otherwise it will happen again.

What should you do if there is an outbreak of mould?

Isolate the affected material immediately. If possible place it in a plastic bag and seal it. Treat other objects, which have been in close contact with the affected material, in the same way. Throw away storage materials which have been in contact with the affected objects.

Removing mould and cleaning objects

Mould should be killed before it is removed from the object/s. However, while there is a danger of spreading the live spores to other objects, brushing the mould off an object is better than leaving it there.

Method:

- the mould should be allowed to dry, before using the brush/vacuum method, which combines gentle brushing with vacuuming;
- the suction strength of the vacuum cleaner should be reduced;
- with a soft brush, push the mould towards the open nozzle of the vacuum cleaner;
- ensure that all the cleaning equipment is thoroughly cleaned.

Treatment of mould-affected objects

First urgent steps towards effectively dealing with a mould infestation
It is critical that adequate funding should be made available, as soon as possible, to purchase/hire equipment to assist with eliminating a serious outbreak of the mould, and its re-infestation. Staff complement may need to be increased, or outside help be required, to assist with eradicating the mould covering objects in the collection, as well as thoroughly cleaning the collection store spaces and storage furniture.

Step 1
Isolating the contaminated areas/objects:
Storerooms, exhibition galleries, or groups of objects that are affected, must be sealed off from the rest of the building/s. Seal all storerooms' entrances and 'return air' intakes in the ducting, if environmental control has been installed, with good quality adhesive tape (masking, brown plastic), and heavy gauge polyethylene sheeting. This will prevent mould spores entering clean areas of the building/s.

Step 2
Towards drying the mould, and preventing further mould growth:
It is well known that mould thrives in high humidity and temperature environments, so in order to eradicate the mould from collection material, the goal must be to make the mould go dormant so it will appear dry & powdery, and not soft & fuzzy.

Switch off temperature &/or RH control systems. If the RH is not controlled, humidity will have been allowed free access to the collections, wherever they are, through the system's ducting. Ensure that the 'return air vents' are sealed, to prevent 'fresh' air from coming in.

Air circulation within stores should be increased, and this can be done by introducing several standing fans in each storeroom. Fans should be placed around the store so that the airflow is directed away from the objects. Drying should take place in a cool, dry space, which the fans will help to achieve.

At the same time the humidity levels must be significantly reduced, which means contracting to a company that deals with environmental issues, and can hire out as many portable de-humidifiers as are needed in infected areas.

The de-humidifiers should operate 24 hours a day, and must be emptied regularly, until the RH levels have dropped to more ideal readings of between 45 – 50%. Temperature levels should be moderate, between 19º - 21ºC. For the purpose of monitoring these levels, digital data loggers (one for each infected area) should be purchased (see end for details of supplier), to monitor the temperature & RH in the storerooms (see p. 26 for details on how to use a digital data logger).

Step 3

Protection of staff & visitors:

It is advisable to consult a Mycologist (specialist dealing with mould), from a university, hospital, or a scientific research institute, to ensure that there are no toxic mould species present. Identifying mould is not generally required in order to respond to an outbreak of mould in a heritage collection, but rather for a health hazard concern, or if some staff have health issues, like asthma or respiratory problems. Those suffering from allergies or with compromised immune systems, as well as those taking steroids, may also be affected.

Museum staff/contract workers, will be exposed to, and be in contact with the mould-damaged objects/areas, so will need respirators (see end for suitable types of respirators), and appropriate protective clothing.

Step 4

Investigate to find cause of ongoing mould problem:

Determine the cause of the mould outbreak and take immediate action to correct it, for example, take measures to lower the RH levels for the long-term.

Acceptable RH levels for these collections are between 50 + 55%, and yet RH between 45 - 50% would be more ideal to prevent mould growth. Many organic materials, like wood, textiles and skin/leather, however, begin to dry out, crack and become brittle at levels of 45% or lower. Conversely mould growth would be encouraged at RH levels exceeding 60%.

Properly controlled RH (see Step 2, 'Towards drying the mould'), which should be monitored, using digital data loggers to constantly check that the Temperature & RH control system is always operating properly in every storeroom or exhibition area.

Step 5
The cleaning process: including equipment & protective clothing needed & method of cleaning:
Cleaning the mould off the affected objects in the collections is going to be both labour intensive and time consuming. All staff and others who will be involved in this process, must be carefully instructed in the method of cleaning.

Equipment required: wet/dry commercial strength vacuum cleaners (as many as are able to be hired), soft brushes of different widths (cosmetic, water-colour). A wet/dry vacuum cleaner is preferred as a domestic, dry vacuum cleaner will allow the spores to be exhausted back out into the air.

Protective clothing:
There are a variety of **respirators** available to protect faces of all those who will be working in close contact with the affected collections. Examples are: disposable, particulate respirators; half-face respirators & full-face respirators. It is advisable that everyone wears the respirator that suits their particular needs.

Protective **goggles** should also be worn when dealing with mould. The recommended goggles are not ventilated, and should be worn with a half-face respirator. If the user wears prescription glasses, the right kind of goggles would be hard to find. In that case, a full-face respirator should be worn.

Protective **gloves** should be worn when handling mouldy material. **Vinyl or Nitrile** gloves are recommended. They are disposable and need to be replaced after each use. Torn gloves should be replaced immediately. Hands should be washed with soap and water after handling contaminated material, even when gloves have been worn.

Protective **clothing** must be worn when dealing with mouldy material. It should be available for all staff, and must be properly worn and fastened. **Coveralls or overalls with hair and shoe covers** must be worn, especially when significant amounts of mould spores are being released into the air. Disposable clothing is recommended, but re-usable, protective clothing, like lab coats or coveralls, may also be used.

Protective clothing and equipment must not be worn or used outside the contaminated area. It should be removed on-site, i.e. inside the infected areas, and washed in hot water and bleach.

It is important to exercise caution when handling and discarding disposable protective clothing or equipment. Place disposable clothing, gloves, etc., in thick plastic garbage bags, or at least two layers of thin garbage bags. Seal and discard the bags in an outdoor garbage container.

Method of cleaning:
Once the museum's collections & conservation staff is satisfied that the mould covering the collection material, is dry & powdery, and the RH levels have reduced sufficiently, cleaning of the affected objects can begin.

- A wet/dry, commercial strength vacuum cleaner is used, with the nozzle close to, but not touching the object to be cleaned. Gently brush off the dried mould, directing it into the vacuum nozzle;

- A fungicide can be added, such as Lysol or G-cide, (see end for possible supplier) to the tank. The fungicide should be diluted according to label instructions;
- Contaminated objects have to be thoroughly cleaned, and all shelves, drawers must be vacuumed, with a fungicide solution in the tank, and wiped down with the fungicide solution. Allow shelves & drawers to dry fully before returning objects;
- After the major job of cleaning the collections and the storage furniture, the floors should be cleaned in the same way, to remove any traces of dried mould;
- It would probably also be necessary to check and clean the ducting from any environmental control system, in case the mould has spread into the system;
- Continue to monitor conditions and take steps to avoid additional mould growth:

    take daily readings (download the digital data logger every few days), to ensure the climate is moderate;
    it's particularly important to keep the humidity below 55%, and preferably between 45 – 50%, to ensure the mould will not reappear;
    temperatures should not exceed 21ºC.
    check problem areas frequently to ensure that there is no new mould growth;
    keep areas where collections are stored and used, as clean as possible, since dust and dirt are a source of spores, both active and dormant.

Possible suppliers of materials/equipment:

Housekeeping Services, CT: 021-715 9103 (may be able to direct you to source of fungicide elsewhere in S. Africa.)
Fungicide – G-cide (product name: PU 2% Eco SAN-G.Cide L.F.) in 25 litre containers
Price per litre
Price excluding VAT

Laboratory & Scientific (LASEC), CT: 021-531 7504
Respirators, gloves, protective clothing
Prices excluding VAT

cleaner – Bioscrub, 4 x 5 l.; 20 x 500 ml; 20 litre polyethylene containers
Prices excluding VAT

There should be companies that will hire out de-humidifiers, and wet/dry commercial strength vacuum cleaners, in an emergency situation like this.

If the Museum has a/an Disaster Plan/Emergency Response Plan, now is the time to review it to make sure it covers every eventuality, in case of an emergency/disaster, like an outbreak of mould in the collection storage areas. Also see Manual, pp. 73 – 86.

c. Atmospheric pollution

There are two types of atmospheric pollution – particulate and gaseous.

Particulate pollution

Particulate matter is produced from the burning of fossil fuels in power stations, vehicles and heaters. It is sooty, tarry (like tar), and slightly acidic (see 'Glossary …' p. 3). Some particulate matter may contain metals which may act as catalysts (see 'Glossary …' p. 3), to cause deterioration.

- In our house museums, furnishings produce fibres, and people produce fragments of skin that are chemically harmless, but they do provide food for insects and mould.

- Dust is a form of particulate pollution that is found everywhere in museums. All artefacts with powdery, fragile, flaking or fibrous surfaces are sensitive to dust. Dust remains embedded in porous, three-dimensional surfaces like head-dresses, basketry, beadwork and textiles.

- All potentially sticky materials, such as waxes, gums and resins, used on musical instruments, and artefacts whose value depends on a fine surface finish, like Japanese sword blades, furniture and photographic material, can easily be scratched by dust particles. These artefacts are extremely sensitive to dust, and protection is therefore essential.

- New concrete buildings also give off dust particles that are too small to be filtered out. Their alkalinity (see 'Glossary …' p. 3), can cause damage to hardened oil paint, silk and some dyes and pigments. The residue matter from cigarette smoke damages paintings, so the 'no-smoking' rule must be strictly enforced in the museums and art galleries.

- Openings and other functions that take place in the museum environment produce particulate matter from leftover food, which, in turn, becomes food for insects and rodents.

- Museums situated at the coast are subjected to high salt (chlorides) and moisture levels in the air. Chlorides are dangerous pollutants for some metals, such as bronze and iron.

Removal of particulate matter

- It is important to keep storerooms and exhibition areas dust-free. Simple, regular housekeeping should be carried out in storage areas, and adjacent offices, using vacuum cleaners wherever possible. Brooms raise the dust and spread it around to settle elsewhere in the store. Flat mops may be used in place of brooms. Feather dusters are forbidden, as they, like brooms, raise dust and spread it so that it settles somewhere else. Also the feather tendrils can catch on materials with loose bits, and cause damage. Store vulnerable material in closed cupboards, boxes, etc.

- Well-made display cases will go a long way to keep exhibition material dust-free. The materials used in the manufacture of display cases should be carefully chosen (see pp. 77, 78, for materials approved for display).

- The air cannot be effectively cleaned in this way. Some form of air filtering is needed, particularly in large cities, but any filtering system does need to be regularly maintained in order to be continuously efficient.

Gaseous pollution

Two types of gaseous pollution are evident in a city – acidic and oxidising agent (see 'Glossary …' pp. 3, 7).

Acidic pollution mainly consists of *sulphur dioxide* (SO_2), and *sulphuric acid* (H_2SO_4), and the most damaging oxidant pollutant is *ozone* (O_3). Both pollutants can be present in air.

Sulphur dioxide (SO_2) is a gas that is produced when fossil fuels (coal, petroleum, oil & natural gas) are burned. Burning gives rise to sulphur, which combines with oxygen (O_2) in the air to form SO_2. Once it has formed, it attracts water molecules present in the air, and combines with them to form sulphuric acid. About half of the sulphur dioxide in the air is produced naturally, but man-made SO_2 is produced in high concentrations in the industrial areas of the world. Most museums in the world are situated close to industrial areas, so that collections, particularly those made of organic materials, will be adversely affected.

What damage is caused by sulphur dioxide?

- SO_2 causes serious deterioration of *calcium carbonate* ($CaCO_3$) in all its forms. Chalk, limestone, marble, frescoes and alkaline sandstones are all varieties of calcium carbonate. SO_2 is highly corrosive and attacks outdoor sculpture and damages buildings.

- Although wood contains cellulose (see 'Glossary …' p. 4), but in its bulk it is unaffected by SO_2, but a thin veneer might be damaged. Many of the synthetic textile fibres are immune to SO_2 attack, but rayon, which is re-constituted cotton, is susceptible to its embrittling effects.
  Exposed, poor quality paper becomes brown and brittle due to damage by SO_2, because it contains acidic materials introduced during manufacture, and it absorbs acidic gaseous pollutants more strongly because of the lignin present. Rag paper, which is cellulosic, will deteriorate far more slowly.
  The rate of attack differs with different cellulosic materials, and there are other factors that affect the rate, for example, high RH speeds up the rate, as do a combination of visible light (sunlight) and SO_2, which do more damage than either one separately.

- Protein materials, like silk become brittle and break as a result of a combination of light and SO_2. Wool is also affected by both, but not as

badly as silk. Vegetable-tanned leather, i.e., which uses tannin from tree bark or wood, is susceptible to 'red rot'. Red rot is when the leather deteriorates and SO_2 becomes sulphuric acid and attacks the leather. Badly affected leather can be reduced to a powder by rubbing.

- Mainly modern, synthetic dyes and pigments are damaged by SO_2. Nylon stockings become brittle and 'run' more quickly, synthetic rubbers lose their flexibility and paints are also affected.

- Metals, like iron are most readily affected by the presence of SO_2. Iron corrodes to rust electrolytically, i.e. both moisture and an electrolyte must be present on the iron surface. All water-soluble salts, acids and alkalis form electrolytes, which attract moisture to form soluble corrosion products, are the most corrosive.
  Old, patinated bronzes, exposed to air, corrode and eventually suffer from what is known as 'bronze disease' (see 'Glossary …', p. 3). In a city environment, electrolytic corrosion occurs from about 60% RH.

Oxidising pollution

Ozone is a poison found in concentrations in polluted areas, for example, in urban areas.

Formation of Ozone (O_3)

Ozone is created in two processes, one natural and one artificial. Natural ozone is formed in the upper atmosphere (maximum concentration at about 30 km up), by the action of UV radiation on oxygen.

The presence of this ozone over our heads is vitally important to life, because it filters out the dangerous UV radiation wavelengths. However, it hasn't been proved conclusively that natural ozone contributes significantly to the deterioration of cultural material, i.e. SH collections, but environmental experts are of the opinion that it does.

The major concern here is that some human activities can considerably increase the concentration of ozone (artificially generated). For a build-up of pollutants, a temperature inversion (see 'Glossary …' p. 8) can put a 'lid' over an industrial area, town or city, so that pollutant gases cannot rise and disperse. This fact allows the concentration of pollutants to rise. Museum collections, particularly those of organic origin, are extremely vulnerable to the destructive effects of high concentrations of ozone.

Nitrogen oxides

Polluted air contains many nitrogen oxides, but most of them are too stable to be harmful to collections of organic materials. Nitric oxide (NO) is present in polluted air, but although not detrimental to these collections, it has to be considered for the important part it plays in the formation of ozone.
The only nitrogen oxide we should be worried about is nitrogen dioxide (NO_2).

Like sulphur dioxide, it is soluble in water to give a strong acid, in this case, nitric acid. Since nitrogen dioxide dissolves in water, eventually to form nitric acid, which is a strong acid, as well as an oxidising agent (see 'Glossary …', p. 7), it causes all the problems that sulphur dioxide does, and a few more, such as corrosion of metals, hydrolysis of cellulose and attacks calcareous (containing limestone) stones & murals.

Concentrations of nitrogen dioxide are still rising, with the increased use of motor vehicles, and is therefore likely to be held responsible for some of the damage. It has been reported that cotton and wool are susceptible to attack by nitrogen dioxide. It attacks dyes like indigo, especially on cellulose and polyester fabrics.

Gaseous pollution through vapours given off by materials used for Storage & Exhibition

- Wood gives off organic acid vapours. Freshly-cut & unseasoned wood gives off greater quantities of organic vapours than seasoned wood. Some woods are less harmful than others, but it is recommended that mahogany and well-seasoned soft woods, such as pine or beech, should be used in preference to oak. Oak gives off far more organic vapours than any other wood. Bronze is corroded by organic acid vapours.

- Composite boards, such as chipboard, plywood and hardboard, not only produce acidic vapours from the wood chips, but the adhesive that binds them together contains *formaldehyde*-based resins that corrode metals. They can also damage materials containing proteins, such as skin, wool, fur, bone and shell. Leather and parchment become brittle from the effects of formaldehyde.

- In order to reduce the risk of the damaging vapours, wood sealers are advised, and they are effective on wood to be used for storage or exhibition. However, paints, varnishes and lacquers do not totally prevent emission of vapours.

- Metal foil has been proved to be effective in protecting museum collections from wooden surfaces. Aluminium baking foil can be used, but must be coated, on one side, with an acrylic emulsion adhesive and allowed to dry. It is then ironed on to the board and the heat softens the adhesive enough for it to be firmly stuck to the board.

- Protective foils and archival cloth are specially designed and manufactured overseas, but are not readily available in South Africa. It is also important to seal the edges of the composite boards, as they give off acidic vapours at a higher rate than from other surfaces. Paint or fabric can be used to cover the wood once it has been sealed with foil.

- Sealants, such as varnish and acrylic sealers will not stop harmful vapours being given off, from materials used for exhibition cases or storage cabinets. No sealant is truly impermeable (not letting anything through), but their use will slow down the amount that is given off (see previous two points).

- Polyethylene foams are inert (see 'Glossary …', p. 6) and are particularly useful for storage. Shapes can be cut out of the thick sheets to hold a fragile object safely and will also prevent unnecessary handling (see Manual, 'STORAGE OF COLLECTIONS', pp. 14 – 34). Polyethylene foams are made rigid enough to be used in exhibitions as an alternative to wood.

- Poly euro thanes react with light and heat, and break down. As they always contain additives, a range of potentially harmful chemical compounds can be released into the environment. They should not be used as coatings.

- Woollen textiles, felts & velvet (obtained locally), can cause corrosion of metals, such as copper & silver, as they contain sulphur compounds, the principal one being *carbonyl sulphide.* Cottons can be used, but be careful if they are dyed, as some dye processes and textile dressings contain sulphur. These fabrics should be tested before coming into contact with the collections.
  Black-and-white photographs use silver to form images, so they will also be affected by sulphides.

- When PVC (*polyvinyl chloride*) is degraded by heat or light, *hydrogen chloride* (hydrochloric acid) is evolved. Hydrochloric acid damages all material that is stored in PVC, and should therefore be avoided as a storage material. PVC plastic sleeves have been used for storing photographic material, but it is advisable to transfer glass and other negatives to inert polyethylene or polypropylene sleeves/storage containers.

- Nitrate film is extremely dangerous. It's made from *cellulose nitrate*, which is a very unstable material. As it degrades it produces *nitrogen dioxide* (see section on 'Nitrogen oxides'). Further deterioration will result in spontaneous combustion (burning) of the film. This reaction can occur without the presence of oxygen. This means that degraded cellulose nitrate can burn even under water, or when smothered. It becomes dark, sticky and smelly.

- Plastic containers whose precise chemical composition is not known, should never be placed near photographic material. Many plastics contain plasticisers (see 'Glossary …', p. 7) that may give off gases that are harmful to photographic emulsions. Watch out for plastics (or any other materials) that are labelled 'archival', with no explanation. There is no law against the generalised use of the term.

- **Never** use commercial putty-like substances like prestick. Tests have been carried out in the United Kingdom showing that these can corrode metals, for example, securing coins on display.

Protecting collections from atmospheric pollution

Safe plastics, paints & adhesives to use for storage & exhibition

- Some forms of polyester are stable enough to be used as sleeves or envelopes for archival material & photographs. *Polymethyl methacrylate* (Perspex), most acrylics like polyethylene should be used. Polyesters found as Mylar, or mellinex, or polypropylene, are suitable to use unless they contain plasticisers.
- Oil-based paints tend to produce organic acid vapours as they dry, therefore allow a long drying period before exposing objects from the collections to the painted surfaces. They will be safe once the smell has disappeared.
- Some emulsion (water-soluble) paints produce acetic acid. Allow plenty of time for them to dry, as water from the emulsion will be absorbed by the wood, and will increase the level of humidity, if the display case is closed up too soon. It is best to use as little paint as possible. Wood sealers or inert fabrics are preferable.
- PVA (*polyvinyl acetate*) emulsion adhesives, such as Alcolin, should be avoided, as well as rubber-based adhesives which contain sulphur, resulting in corrosion of metals like silver.
  Polyvinyl alcohol is a derivative of polyvinyl acetate, both are used as a base for paints, coatings and adhesives. They are safe to use in some circumstances, but must be allowed to fully dry and cure.

Controlling the environment

- Temperature and humidity control, or 'air conditioning' can be installed. Pollutant gases are usually removed by water sprays or activated carbon filters. A system like this must incorporate a dehumidifier to maintain stable levels of humidity. Temperature and humidity systems must be regularly maintained, and filters checked and replaced.

Other simple and inexpensive options to control pollution

- use display cases and layers of storage to provide a protective local environment for the objects;
- frame and glaze artworks before putting them on exhibition;
- provide dust jackets for books;
- place flat paper-based objects in archival containers called Solander boxes;
- provide archival-quality boxes for fragile or sensitive objects; and
- cover large objects which will not fit into storage cupboards or boxes. Use unbleached and un-dyed cotton or linen, or Tyvek sheeting when in storage.

e. Physical or Mechanical damage caused by incorrect handling, moving, and curatorial neglect, of collections in storage or on display.

General guidelines for handling &/or moving collections

- ❖ be prepared when objects are handled to be moved – know how to handle them, and where they are going. Prepare the reception area beforehand;
- ❖ the path should be cleared and free of obstructions;
- ❖ seek assistance to avoid damaging objects or yourself;
- ❖ check to make sure that the object to be handled and moved, is secure & stable;
- ❖ plan your moves, for example: if you're hanging a painting, lay padding on the floor on which to rest the painting, while two of you get into position to lift it onto an appropriate hanging system. Have a third person help to position it if necessary; if you are removing a three-dimensional object from storage, ensure that appropriate assistance & tools are available before proceeding.
- ❖ gather together everything you need before handling or moving objects – gloves, padded surfaces, trolleys, ladders, ramps, helpers, etc.

Handling/moving various collections of different materials

<u>Paper</u>

*Flat paper***:**

- Need clean hands or close-fitting vinyl, or nitrile gloves;
- Support paper on boards in order to examine or transport it, as most paper is fragile;
- Can also carry paper in folders, Mylar pockets, etc.;
- Use only <u>pencils</u> near paper material;
- Make copies of paper documents/art works on paper frequently used, but copy the original only once.

*Books***:**

- Don't ever remove book from shelf by pulling at top of spine – push books on either side further in, hold book firmly with hand around spine, fingers on one cover & thumb on other;
- Always have clean hands;
- Open books gently, especially old & new books and newly bound books;
- Turn pages slowly & don't lick your fingers to do so;
- Don't carry too many books at once – preferably in a box if they are valuable;
- Don't stack valuable, calf leather bound or delicate books so that they rub against one another.

*Photographs***:**

- Handle as little as possible;
- Handle as for flat paper.

Paintings

Framed, stretched, paintings:

- Check for flaking paint and that work is secure in frame before moving;
- Check for loose pieces on frame;
- Plan the route before moving paintings – know where you are going;
- Carry painting with flaking paint face-up, horizontally;
- **NEVER** touch the canvas or paint surface;
- Wear white cotton gloves when handling gilded frames;
- **NEVER** carry paintings by the ornate areas of frame or by the top of the frame:
    - ❖ for larger paintings, one hand at side & one beneath;
    - ❖ for small paintings, one hand on each side;
- Before putting painting down make sure there are covered wooden blocks/foam blocks to rest it on so that it's off the floor;
- Set down along complete edge, not one corner first;
- Moving paintings on special trolleys requires 2 people;
- Trolleys should be padded to prevent damage to frames;
- If a painting gets damaged in transit, save every piece;
- Hanging devices for paintings must be very secure;
- De-framing or framing paintings requires a clean padded surface on which to place painting & frame.

Framed, glazed paintings:

- Glazed works should be carried/handled with care; before transporting, tape front of glass with masking tape; fold tape back on itself at end of each strip – provides grip to remove tape more easily;
- Tape on glass only, not on Perspex or Plexiglas;
- Remove tape as soon as possible after move – remember to pull tape off very gently at low angle.

Unstretched paintings:

- Do not allow them to flop or move too much, paint can begin to come away from surface;
- Support with rigid support to transport small, flat works;
- Larger works can be rolled, paint side out, interleaved and on padded roller, which should be at least 200 mm in diameter;
- Use polyethylene foam to pad roller;
- Interleave with acid-free tissue;
- The rolled, wrapped painting should be secured firmly with cotton tape at several places along the roll;
- Cardboard rollers can be used, padded & wrapped in unbleached calico.

Electronic information & media:

- Audio & video recordings should be handled carefully – wear gloves as skin can transfer traces of sweat & oil which attracts dust & can promote mould growth;
- Avoid skin contact with magnetic media, handle the cassette only;
- Carry video camera or tapes separately, and keep away from food sources.

Textiles

- Handle with care & use commonsense;
- Keep handling to a minimum;
- Where possible wear white cotton gloves when handling textiles, but if not make sure your hands are quite clean;
- Wash hands thoroughly before handling a textile;
- Remove all jewellery – rings, bracelets & necklaces, that might catch on textile fibres;
- Always support all textiles properly – regard all historic textiles as fragile.

*Flat textiles***:**

- Never pick them up by one corner, support a flat textile evenly;
- Carry small flat textiles on a tray, board or in a box;
- Larger, longer textiles should be rolled & carried on a roller that extends beyond both ends for a grip;
- Always use 2 people to roll and carry a heavy textile otherwise it could be damaged;
- Secure with cotton tape at several places along the roll. Take care not to tie the tapes too tightly.

Costume:

- Never pick up costume by the shoulders;
- They should be moved in boxes or on a board;
- Don't carry dresses just hanging from padded hangers - use your arms for additional support.

Accessories, like bags, gloves, umbrellas:

- Never pick up bags by their handles;
- Accessories should be transported on trays or in boxes, to protect fragile and weak parts;
- Use your commonsense for appropriate way to handle accessories;
- Marking, or numbering accessories: stitched-on tapes in appropriately discreet places.

Metals:

- Always wear gloves (cotton, vinyl, or nitrile) when handling metals to reduce risk of corrosion;
- Always give metal objects adequate support when moving them, as they will weaken over time;

- Don't ever lift metal objects by handles or other attachments that may have weak joints;
- When handling, or displaying a hinged, metal object, make sure it is supported so that the hinges are not carrying the weight of a part or all of the object;
- Secure and support any moving parts on a metal object before transporting it – detach the parts, or de-assemble it if necessary.

Furniture:

- Make sure that all furniture doors and drawers are secured and keys removed, especially along visitor routes;
- Do not use the drawers of displayed furniture for storage purposes, as this puts strain on handles, catches and hinges;
- Make sure that pieces of furniture are stable on the floor, especially if they have been moved for cleaning;
- Never sit on, or lean against furniture displayed in the museums;
- Don't touch upholstered parts unless you are wearing gloves or they are covered.
- Tables should stand clear of walls and upholstered furniture so that they do not rub against walls, backs of chairs or sofas;
- Any objects placed on furniture surfaces, must be protected from scratches and stains by using neutral-coloured felt under them;
- Move and handle furniture as little as possible, as any movement carries the risk of damage;
- Never move heavy furniture like armoires by yourself. When moving heavy furniture, make sure that there are enough people to help carry. Plan your movements before you start, and discuss this with the team. Only one person should be giving instructions;
- To move large pieces of furniture more efficiently, use a mover's blanket. Make sure that the top part is held secure while the blanket is slipped under the feet, as well as during the move;
- Become familiar with the correct ways of handling and moving different pieces of furniture:

    - ❖ Stools and chairs are carried by their frames, under the seats;
    - ❖ Tables are carried by their frames, under the tops;
    - ❖ Always lift large pieces of furniture using the lowest load-bearing part;
    - ❖ Never lift and carry furniture by the handles;
    - ❖ Never rest a large piece of furniture, like a table, on one point only. The weight should be evenly distributed between all four legs.

- Make sure that cupboard doors are locked and drawers are removed before moving a piece of furniture;
- Before furniture is moved, all objects placed on surfaces must be removed to a safe holding area;
- Before moving a piece, check to see where its structurally weak points are;

- When furniture has to be moved for cleaning, ensure that the pieces are put back in the correct position;
- Never drag a piece of furniture however smooth the floor, as it always puts strain on the carcase and this can loosen joints or break a leg. The floor could also be badly marked or scratched.

Ceramics & glass:

- Ceramic and glass materials are hard and brittle, and can easily crack or break on impact;
- Before picking up a glass or ceramic object, study it carefully and pay attention to its condition, and the extent of any damage or restoration. A repaired object is always weaker than one that has not been damaged;
- DO NOT pick up ceramics and glass objects by their handles or spouts; these are often the weakest parts, even if they were originally designed for carrying;
- Lift objects by sliding one hand underneath, and steadying the body of the object with the other – always use two hands to pick up ceramic or glass objects;
- Avoid attaching sticky labels to ceramics, especially those with applied decoration;
- Do not apply labels or stickers to gilding, over-decorated enamels on a ceramic object, or a piece of fragile glass, as they can harm the glaze and body;
- Make sure that your hands are clean & dry, and avoid wearing bulky jewellery that could harm ceramics and glass;
- DO NOT wear gloves when handling ceramics or glass, as the hands cannot properly grip a smooth or slippery object;
- Carry only one object at a time, no matter how small it may be;
- When ceramics or glass objects are moved between the stores and exhibition areas, plan the route carefully;
- Transport objects in baskets, padded out with tissue paper, or bubble wrap, or on a two-tier trolley that has been padded out with polyethylene foam, to protect fragile and unstable ceramics and glass;
- Pack them in such a way that they cannot move while in transit. Never move ceramics, made of different materials, together;
- The use of metal clips, braces, or hangers for the display of ceramics is not advisable. The metal can damage rims and gilded borders. It is preferable to use stands made of Perspex;
- Ceramic or glass objects that cannot stand safely on their own, must be supported so that they cannot move, for example, a ceramic vessel can be placed on its rim, rather than its base, or a concave, polyethylene foam support, can be made to securely hold the round-bottomed vessel.

Preventive action: Get message across to visitors about reasons for not handling material, either in storage (behind the scenes tours), or on display; Train front-of-house staff to be able to help visitors understand that handling causes deterioration of collections; The information should be positive so as not to alienate visitors; Rather ask them to help us take care of our collections of national heritage.

RETRIEVAL PROCEDURES (see Manual, 'Condition Reporting', pp. 43, 44)

Types of Condition Reports

a. Condition report/examination for *objects to be accessioned into the permanent collections* should include:

- Name of object;
- Material/s it is made of (refer to p. 86, for types of materials);
- A description of the object, and details of its condition (refer to p. 87, for types of damage);
- Measurements: Height, Length and/or Diameter, Width or Depth (thickness);
- Photograph to document the object, and to record its current condition.

Outgoing loans

b. Condition report for *loans within the Museum/s* should include:

- Accession number/Name of Object;
- Material/s it is made of (refer to p. 86, for types of materials);
- Brief description of its condition (refer to p. 87, for types of damage);
- Measurements: Height, Length and/or Diameter, Width or Depth(thickness);
- Photograph to document the object and to record damage or vulnerability.

General recommendations for display with regard to handling, temperature, relative humidity (RH) and lighting, will be included at the end of the condition reports.

c. Condition report for *loans local and national* and should include:

- Accession number/Name of Object;
- Material/s it is made of (refer to p. 86, for types of materials);
- Description of condition stating any damage (refer to p. 87, for types of damage);

- Measurements: Height, Length and/or Diameter, Width or Depth (thickness);
- Photograph as document and record of damage or vulnerability. A drawing can be made to support and clarify evidence of damage.

Precautions to be taken with regard to handling during period of loan and/or exhibition are to be noted, and recommendations made for acceptable levels of temperature, relative humidity (RH) and lighting to be included at the end of the condition reports.

d. Condition report for *international loans* should include*:*

- Accession number/Name of Object;
- Material/s it is made of (refer to p. 86, for types of materials);
- Description of condition stating any damage (refer to p. 87, for types of damage);
- Measurements should be as detailed as the shape and size of the object dictates: Height, Length and/or Diameter, Width or Depth (thickness);
- Recommendations are made for appropriate and safe mounts for the object/s during the exhibition preparations at borrower's institution;
- Photograph as document and record of damage or vulnerability. A drawing can be made to support and clarify evidence of damage.

Precautions to be taken with regard to handling during period of loan and/or exhibition are to be noted, and recommendations made for acceptable levels of temperature, relative humidity (RH) and lighting are to be included at the end of the condition reports.

Condition Report Form for outgoing loans, see p. 88

Incoming loans

e. Condition report for *incoming loans, i.e. material on loan from other museums, heritage organisations or individuals:*

- Name of lender/Arrival date;
- Name of object;
- Indicate whether a condition report was supplied and checked;
- Condition will be compiled with photographic record (as for *loans within Museums*) if none is supplied;
- Name of compiler and/or checker, and date written/checked;

Condition Report Form for incoming loans, see p. 89

Information to assist you when compiling condition reports

Organic & Inorganic materials found in museum collections:

Organic materials

bone
horn
ivory
tortoise-shell
shell (marine, egg)
scales
hair
feathers
fur
partly-dressed skin
tanned leather
textiles (cotton, linen, wool, silk, synthetic)
plant fibres (basketry, mats, brooms, etc.)
wood
adhesives & sizes
drawing & binding media
lacquers & varnishes
waxes & resins
polymers & plastics

Inorganic materials

stone
metals (silver, gold, copper, brass, iron, bronze, etc.)
ceramics
glass
plaster & stucco
earth pigments

Terminology used in a condition report when describing damage to objects

Types of damage to collections:

- losses
- insect damage
- cracks (longitudinal, vertical, horizontal, diagonal)
- tears (in textiles, basketry)
- mould
- creases/folds
- splits
- discolouration
- breakage
- fading
- foxing
- warping
- accretions
- stains
- cuts
- holes
- corrosion of metals
- rust stains
- flaking of paint/ink
- distortion
- brittle
- cockling
- abrasions
- previous repairs
- frayed edges
- bronze disease

Form 1. *Generic condition report form for local, national & international loans of museum collections.*

CONDITION REPORT FORM
Outgoing Loans

Accession no.:	**Object name:**
Condition:	
Measurements:	
Photograph/Drawing:	
Recommendations for Exhibition: Handling: Exhibition mounts: Environmental conditions: Lighting:	

Form 2. *Condition report form for material on loan from other museums, heritage organisations, or individuals.*

CONDITION REPORT FORM
Incoming Loans

Lender:	**Arrival date:**
Object: **Accession no.:**	
Condition report compiled on arrival:	
Measurements:	
Photograph:	

Form 3. *For external conservation treatment of objects in museum collections*

CONSERVATION FORM

The following object(s), being the property of ……, will leave the premises of the Museum for conservation treatment by:

Name of institution/conservator:
Address:
Tel.No.:

<table>
<tr><td>Accession No.</td><td colspan="2">Description</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Conservation treatment required …</td></tr>
<tr><td colspan="3">Delivered on:</td></tr>
<tr><td>Received by: [contracted conservator]
Signed:
Date:</td><td colspan="2">Approved by: [museum staff member]
Date:</td></tr>
<tr><td>For office use only
Objects returned on:</td><td colspan="2">Received by:</td></tr>
<tr><td>Full condition report received:
• Yes
• No</td><td colspan="2">Received by:</td></tr>
</table>

Form 4. *Waste disposal Application Form*

VH Number.....

TELEPHONE NUMBER -021 487 2489

CITY OF CAPE TOWN
UTILITY SERVICES
SOLID WASTE:
DISPOSAL

Application to dispose of toxic/intractable/special waste at the Council's waste disposal site at Vissershok

Name of applicant							
Street address							
P.O. Box Number							
Postal code							
Telephone number							
Fax number							
Official dealing with disposal							
Type of material (a comprehensive description of waste is required –use separate page if necessary)							
Location of present storage							
State of material							
Quantity of material							
Type of container in which presently stored							
Number of containers for disposal							
Will you be disposing of this type of waste again?							
If yes, how regularly?							
Proposed method of transport to disposal facility							
Open truck		Closed truck			Vacuum tanker		Other
Name of cartage contractor							
Address of cartage contractor							
Signature of applicant							
Name in block letters							
Date							
FOR SCIENTIFIC SERVICES DEPARTMENT ONLY							
Code contents				Physical state			
Scientific Services Representative:							

CITY OF CAPE TOWN, SOLID WASTE DISPOSAL (see 'List of Services …' p. 22)

List of possible materials for disposal

Asbestos
Calcrete
Iron dust
Water-based inks
Detergents/softeners/flocullants
Photographic chemicals
Copper & potassium cyanide
Contaminated sand
Adhesives/starch glue
Plaster of Paris
Contaminating solvents for printing inks
Ethyl acetate in water
Plating cyanide (from electroplating)
Oil, contaminated with zinc & iron
Paint production waste (ink, paint & rubber)
Polystyrene & fibreglass
Silica sand, contaminating resin & catalysts
Solvents (lacquer thinners, turpentine, methylated spirits, etc)
Expired medicines/tablets
Tyres
Glass, plastic, cardboard

Form 5. *Facility Report*

FACILITY REPORT

BORROWING INSTITUTION
Contact person:
Title: Email address:

Name of Borrowing Institution:
Street address
Postal address:
Telephone number:
Fax number: World Wide Web URL:

Name of Loan Venue:
Street address:
Postal address:
Telephone number:
Fax number:
World Wide Web URL:

Purpose of Loan:
Exhibition title:

Dates at Loan Venue:

GENERAL INFORMATION
Is your institution currently accredited by SAMA, or other relevant national body?

Describe the nature of your institution.

BUILDING CONSTRUCTION, CONFIGURATION AND MAINTENANCE

General

Describe the building materials used in your original building and additions.

Are you undergoing renovation during the loan period?

How many floors does your building have?

Describe the access between floors.

Exhibition area

Is the proposed exhibition area one room, or several rooms?

Describe the type and location of public activities that take place in your building, other than exhibitions.

Do any of these activities take place in temporary exhibition galleries?

Are eating and drinking permitted in the exhibition, storage, preparation or receiving areas?

Do you make routine inspections for rodent, insect and micro-organism problems?

If yes, describe means and frequency.

Do you undertake routine extermination or fumigation procedures?

If yes, describe methods, products used, and frequency.

Describe what course of action you would take if and when an infestation occurs.

Describe how light replacement, cleaning procedures and equipment checks are carried out in the exhibition area during an exhibition.

Shipping and receiving

What are your hours for the receipt of deliveries?

What are the procedures for the delivery of goods?

Is your delivery area sheltered?

Describe security precautions in your delivery area.

Where do you usually unpack/repack/prepare objects for exhibition?

Do you use an off-site area for packing or exhibition preparation?

If yes, describe the distance between the sites and the mode of transport.

Does a professional museum staff member supervise all work in this area?

Storage

Where do you store loaned objects before they are installed?

Who has access to this area?

Are there fire detection and suppression systems in this area?

Do you have a high security storage area for especially precious objects?

Where do you store empty crates?

Environment

When is your environmental control system in operation?

Describe the type and location of your environmental control systems.

Who monitors and services the environmental systems, and how frequently is this done?

What are the recorded temperature and humidity ranges in your exhibition and temporary storage areas in spring/summer, and autumn/winter?

Are records of variations in temperature and relative humidity kept?

Are you able to adjust temperature and relative humidity levels to meet the needs of different types of objects?

Do you monitor temperature and relative humidity levels in the exhibition areas, temporary storage areas, and in display cases containing environmentally sensitive material?

If yes, by what means?

How often?

Who is responsible for the monitoring?

How closely are loan objects positioned to heating, air conditioning, or humidification vents or units?

Lighting

What type of lighting is used in the exhibition galleries?

Can you control the light levels?

Are display cases ever internally lit?

Can display cases be built to specification if required?

FIRE PROTECTION

Is your entire building protected by fire and/or smoke detection/alarm system?

If yes, indicate type.

If no, describe areas without protection.

How, and how frequently, are the systems checked?

Who does your fire alarm system alert?

Describe the type of fire suppression system in operation in the areas where loaned objects will be received, stored and exhibited.

How often are portable extinguishers tested?

In what area and under what conditions is smoking allowed in your building?

How far is your building from the nearest fire station?

How long does it take the fire department to arrive at your site in response to an alarm?

Do you have an established fire emergency procedure?

SECURITY

Guards and Access

Do you have 24-hour human guard security?

If no, would your institution be prepared to hire additional guards, if required?

What type of security staff does your institution use?

Do you have a trained security supervisor in charge at all times?

How many guards are normally on duty?

How many galleries are normally assigned to each guard?

Will a guard be assigned during installation and de-installation?

If not, can one be hired if required?

How is access restricted during installation and de-installation of temporary exhibitions?

Do you maintain records of internal movement and relocation of borrowed objects?

Is security staff stationed at all entrances and exits to the building during opening hours?

Are perimeter checks to the building carried out?

Do you have an emergency response plan?

If yes, when was it last revised?

What emergency procedures are observed in the case of theft or vandalism?

Physical and electronic systems

Do you have an electronic security alarm system in operation throughout the building?

If not, describe which areas are not protected.

What types of detection equipment are in operation?

Where does your detection system sound an alarm?

Do exterior doors or windows open onto the exhibition area?

If yes, what security measures are in place at these openings?

Are the exterior openings of the building secured and alarmed?

If no, explain.

How often are your security systems tested, and who undertakes these tests?

Are records kept of all alarms signals received, including time, date, location, action taken and cause of alarm?

Who is responsible for keeping these records?

Describe how fragile, small or extremely valuable objects are protected?

Can objects be individually alarmed, if required?

Indicate methods used to deter public access to large exposed objects?

HANDLING AND PACKING

Do you have staff available for loading and unloading?

Do you have staff especially trained to pack and unpack objects?

Who supervises them?

Do volunteers or interns handle borrowed objects?

Are written incoming and outgoing condition reports made on all objects?

If yes, by whom?

When does staff uses gloves for handling objects?

Does your institution have a van or truck appropriate for transporting loan objects?

INSURANCE

Give details of the company that provides insurance for your institution?

What cover does your policy provide for borrowed objects?

Have there been any individual damages or losses to permanent or borrowed collections in the last three years?

If yes, state the date of damage or loss, circumstances and cause, extent of the damage or loss, and whether there was litigation to determine blame or negligence.

What precautions have now been undertaken to prevent any further incidents?

List temporary exhibition you have recently hosted.

List other institutions you have borrowed from recently.

VERIFICATION AND RESPONSIBILITY

The undersigned is a legally authorized agent for the named institution and has completed this report. The information indicated provides a complete and valid representation of the facility, security systems and care proved to owned and borrowed objects.

Name: Signature: Title: Date:

PACKING & TRANSPORTATION

Museum, Archives and Gallery collections form an important part of our country's heritage. In order to ensure their long-term preservation, a careful assessment of each object must be carried out before being packed and transported off-site.

Packing

- Be aware of the types of materials to be packed and how susceptible to damage they are;

- Examples follow of objects in collections, and the materials they are made of, as well as levels of their vulnerability:
  - *most vulnerable*: textiles; household objects & ornaments made of metal, particularly silver, copper and brass; furniture; ceramics & glassware; works of art on paper, photographs, books & documents; paintings & sculpture; musical instruments
  - *not so vulnerable*: archaeological material (pre-colonial, historic, maritime)
  - *least vulnerable*: heavy tools & machinery

Methods of packing should minimise the risk of damage by ensuring:

- full support for each object;

- protection from vibration and shock;

- protection from adverse environmental influences, e.g. light, temperature & humidity;

- that paintings and framed works on paper must travel vertically;

- you understand that packing three-dimensional objects is more complex, and each object must be assessed carefully to determine the appropriate packing & crating system, as well as the type and amount of padding and support that will be required.

Preparations for packing - the risk of objects being damaged must be reduced as much as possible:

- Prepare the path and packing area before moving any objects;

- Gloves (white cotton, vinyl, nitrile, or leather) must be worn where appropriate, for example, when handling objects made wholly or partly of metal;

- Assess each object carefully, particularly if it is fragile, very large, or awkwardly-shaped, in order to determine how it should be packed;

- Make sure that each object/loose parts thereof, is/are clearly marked with the accession number/s, directly on it/them. If unable to mark the object/s directly, a paper tag should be attached to the main part of it/them;

- If you find loose bits which clearly belong to the object being packed, wrap all fragments or pieces individually in acid-free tissue paper. Mark each tissue paper parcel with the accession number of the object and pack them carefully into lidded containers;

- Objects can be made up of many parts that may be detachable. Do not try to force them if they do not come apart easily, as this can cause unnecessary damage to the object. If an object can be dismantled, as a safety precaution only, always wrap each part separately in acid-free tissue or newsprint, and pack the parts together in a lidded box (marked in same way as above);

- Do not be in a hurry when packing objects in boxes and crates. All objects must be packed carefully and securely, to avoid any movement when in transit;

- Do not overfill a box, or crate with too many objects, which could easily be damaged by the over-crowding;

- Use suitable packing materials to pad out the spaces left in a box;

- Pack boxes so that they are well balanced, to facilitate carrying, and do not make the too heavy – test the carrying weight as packing progresses.

Packing materials must be neutral, or inert:

- polyethylene foams of different densities;

- acid-free tissue (sheets, or rolls);

- plain newsprint (rolls);

- clean, unbleached calico;

- Correx board for rigid supports, and making boxes to be packed into crates;

- cotton tape (12-13 mm wide);

- stainless steel pins (10, 20 mm long);

- cutters, scissors, electric carving knife

- cutting board

- double-sided adhesive sheets;

- cardboard rolls of various diameters, covered in acid-free tissue or calico.

Packing instructions

- include unpacking and repacking instructions; and

- an inventory of objects in each crate – one to go in crate & one for record;
- a set of above documents should also be posted to borrower before the crate/s leave the museum;
- a set should also be given to the courier who travels with the crates.

Even if packing and unpacking seems obvious to you, the time will be well spent writing a contents list, and careful instructions. The person/s opening the crate/s at the destination institution does not know the logic behind the way in which each crate is packed.

Transportation

What we need to consider when collections are transported:

- be aware of how vulnerable most objects in collections are, particularly when they are being transported;
- appreciate that good support is required for objects while they are in transit;
- we should have a basic knowledge of suitable packing materials for objects that have to travel;
- understand the need to protect objects from adverse environmental conditions, especially when moving them from one climatic zone to another;
- have some knowledge of the advantages & disadvantages of different forms of transport;
- the risk of damage is greater when objects are transported over long distances.

They are particularly susceptible to damage from:

- vibration;
- fluctuations & extremes of temperature & relative humidity (RH);
- repeated handling;
- heat, or infra-red (IR) & ultra-violet (UV) radiation;
- insect pests & pollutants; and
- theft, or getting lost.

Methods of transport: four possible options – air, road, rail and sea,

Rail and sea transport are not recommended for transporting valuable collections, as sea transport is very slow, and train transport is difficult to supervise over the long

periods and distances the objects have to travel. It is also difficult to protect objects from climatic fluctuations and salt if travelling by sea.

Air transport

The speed of air transport makes it a convenient way to transport loan material, as it greatly reduces many risks, including security, vibration, and changes in temperature and humidity. However, certain points must be taken into account if air transport is considered:

- The valuable cargo must travel in pressurised compartments – available on domestic, international & freight flights;

- Ensure that crates travel the right way up – more possible if you can supervise the loading crates into aircraft (in SA only the freight-forwarding agent is able to supervise loading, according to our instructions, because there is currently no understanding in place between museums/heritage institutions and airport authorities, SAA, or Customs);

- Make sure that the freight-forwarding agent understands your requirements, and you know the full details of how the shipment will be handled and cleared through Customs.

Road transport

- Packing up the objects, and transporting them in own/museum vehicle, depending on whether internal, local or national;

- Arranging for a transport company with a dedicated, air-ride truck to carry your shipment door-to-door. The dedicated vehicle is the best option, as it reduces the need for unsupervised, additional handling, which presents other risks. A dedicated vehicle will carry only your shipment and should travel directly from pick-up to set-down, with no depot handling;

- The safest way to transport the loan material, is in a properly built and suitably padded crate, which travels in the dedicated vehicle described above;

In South Africa, a few of the transport companies specialise in packing and moving works of art/heritage collections nationally and internationally.

They are:

Pack Art Trans

CT 021-553 4879

Contact person: Andre Beuster, mobile: 083 677 7946

Crates

There are many different crate designs and competent crate builders, but it is very important to give the crate builder as much information as is needed to ensure that the objects travel as safely and securely as possible.

When transporting objects to and from different climatic zones:

- Provide them with adequate protection to buffer them against climatic changes and fluctuations;
- They should not be forced to adjust to a different climate too quickly;
- They should be allowed to gradually acclimatise to the new environment on arrival at the destination. The crates should remain unopened in the holding room/s for a full 24 hours. This will allow the climate within the crate to gradually adjust to the new outside conditions. Repeat process on return journey.
- It may be advisable to allow more than 24 hours for acclimatising if objects are travelling from one extreme to the other, e.g. from a tropical to an arid climate.

What to take into account when designing and building a crate:

- It is important to remember that the crate has to travel – a huge and heavy crate may not fit through any doors, and could not be lifted except by a crane;
- Take into account the floor loading capacity of the Borrower & Lender's building/s;
- Think about the final weight of the crate – it is always easier to find two people to lift a crate, than three. If it is heavier than two people can carry safely, the people and the objects will be put at risk;
- Check the size limitations of crates if they are to be air-freighted – there could be problems on restrictions on size.

Specifications of a suitable crate:

- An outside shell of timber forming a box;
- A waterproof lining, which can be plastic sheeting, or a waterproof insulation layer, is advisable. The better the insulating properties of the crate, the safer it will be for the objects being transported;
- A lid which is well-sealed with foam or a rubber gasket;
- Paint the exterior of the crate to provide an additional waterproofing layer. If it is painted white, it will reflect white, and keep the interior cooler ('White has a curious psychological effect – people handling a white-painted crate consider it to

be more fragile and so handle it more carefully than other crates.' reCollections, Transportation, p.22);

- Crates usually open at the top if they are relatively small, or at one side (end) if they are large.

- The lids can be fixed with screws, or threaded bolts. Threaded bolts are even better than screws, because they can be opened and closed many times without compromising the security of the fixing. Screws that have been removed and replaced several times, can become loose and work free during transportation;

- **DO NOT** ever use nails to fix the lid – the objects in the crate will suffer the vibration of hammering when the lid is being fitted;

- The interior of the crate will vary according to the nature of the objects to be transported, but must always contain polyethylene foam padding to absorb shock and vibration;

- Good quality, dense, polyethylene foam forms the base of the crate, with softer, more compressible foam above. The use of different densities of foam will better allow shocks and vibrations to be absorbed, without harming the objects packed in the crate;

- Crates must be clearly labelled on at least two sides, and the top, with stickers, or painted symbols, to indicate which way up they are to travel. 'Rain' and 'sun' protection symbols, and 'fragile' signs should also be applied. There are standard international symbols for them: *arrows, umbrellas, glass shapes*. Originating and destination addresses must also be attached to at least two sides, and the lid of the crate (top or side lid).

See 'Life cycles & eating habits of insect pests … in museums', p. 61

Fish-moth bait recipe:

300 ml gum Arabic
80 ml sodium fluorosilicate (SF)
150 ml flour
220 ml sugar
1200ml water, or as much as it takes to make a thick enough mixture to coat the card strip, without it dripping off.
Note: The above quantities will make about 100 strips (140 X 45mm).

Method:

- Reserve about 300 ml of the water, to try and dissolve the SF;
- mix the gum Arabic with the remainder of the water overnight to dissolve so it will mix easily with other ingredients the next day;
- the sodium fluorosilicate may need to be ground in a mortar and pestle as it is sometimes hard and lumpy, and will then not distribute evenly in the paste. Mix with the 300ml of warm water;
- cut strips of corrugated card (about 140 X 45mm), and punch a hole at one end. Mark card on both sides, in red Koki pen 'Poison' (in area not covered by bait);
- mix all ingredients with the gum Arabic solution;
- dip the strips into the paste, mixing as you go, as the sodium fluorosilicate is not very soluble and needs to be kept in suspension. Submerge the card about a third of the way up, so the mixture penetrates the corrugations. If it is too thick, dilute slightly with water;
- drain and dry – suspend by an opened paper clip through the hole at one end, and hang the other end on a string line;
- replace annually.

Note: Sodium fluorosilicate (Sodium fluorosilicate, sodium hexafluorosilicate) Na2SiF6) is partially soluble in cold water, but more easily soluble in warm water. Toxic if ingested and inhaled, & is a strong irritant to tissue. Used in fluoridation, glassmaking, insecticides and rodenticides, moth repellent, glue, leather and wood preservative, manufacture of pure silicon.

Details of procedures
Housekeeping programme for collections in closed and open storage, & on open display (see Manual, pp. 17 – 19 & 49 – 51).

Procedures to ensure safe cleaning routines:

- It is extremely important that the correct cleaning equipment is used so that the museum or historical site can be cared for in the best possible way. SH & CSM staff who work with unsuitable or unreliable cleaning equipment could be responsible for endangering the safety of the collections.

- Keep cleaning equipment and the storage cupboard, shelves and racks clean and tidy, because the insects which cause so much damage to collections, like to live and breed in dark, warm and dirty places.

- Wash dusters and brushes after each use. Make sure that dusters and other equipment are completely dry before putting them away. The vacuum cleaner must be kept clean and the bag emptied regularly.

- Each piece of cleaning equipment must be used only for the job for which it is intended, for example, dusters should only be used for removing dust; furniture polishing cloths only for polishing furniture.

- Inform your supervisor well in advance when supplies of cleaning materials are getting low – **do not wait until stocks are finished.**

- Be clear about what you may and may not do. If you are in any doubt, discuss problems with your supervisor. However, emergencies should be attended to immediately.

- Not only the collections, but also their surroundings must be kept as clean as possible.

Taking extra precautions:

- Always plan your movements before you do anything.

- When you use a vacuum cleaner or polisher, make enough space around you so that you don't bump into the objects. Always keep the vacuum cleaner pipe behind you, while holding the nozzle in front of you, so that you can see what you are doing. Make sure that the electric cord is long enough, and kept out of people's way – accidents happen quickly.

- Be particularly aware of where objects are around you, especially those that can be damaged easily.

- Pad the vacuum cleaner, polisher and all nozzles with soft polyethylene foam where necessary, to prevent them from knocking against the objects and causing damage.

- You must always be able to see what you are doing: do not work above your head, or clean behind an object, if you cannot see what you are doing – this is how accidents happen. Make sure that the lighting is good enough for you to see that all dust and dirt is removed.

Health & Safety
Beneficial both to people and to the safety of the collections, as poor health & safety practices may result in damage to collections.

- Wash your hands before you start working, and after you have finished.
- Some of the cleaning jobs will require you to wear a dust mask.
- Always work quietly and carefully. Don't get distracted from what you are doing – accidents happen when you are in a hurry.
- Be careful of slipping on smooth floors, tripping on loose carpets, or electrical cords.
- Two people are required to move large and heavy objects. This will avoid damage to your back and to the objects. When picking up a heavy object, keep your back straight, bend your knees and come as close to the object as possible. Do not pick up more than 15 kg alone.
- Wear clothes that are comfortable, that don't get in the way when you are working.
- Long hair must be tied back. Don't wear jewellery or clothing that can damage collections, for example, sharp bits that scratch surfaces or catch on objects.
- Shoes must be solid but supple. Check regularly for little stones in the tread of the soles, which can cause scratches on the historical floors.
- Wear white cotton or nitrile gloves when necessary (see p. 28 for 'Types of gloves'). They protect the collections from scratches, as well as acids, salts, fats and moisture from your hands.

Safe use of solvents and other chemicals used in the course of housekeeping

It is the responsibility of everyone engaged in planning & managing housekeeping to ensure that everyone complies with the health & safety regulations.

Encourage pride in the work, and be committed to making the house/museum a pleasure for visitors to enjoy our wonderful national heritage, remembering that we have undertaken to care for our diverse cultural heritage, in the same way as we would do at home, so that future generations of South Africans as well as those from the rest of the world, can enjoy and value it too.

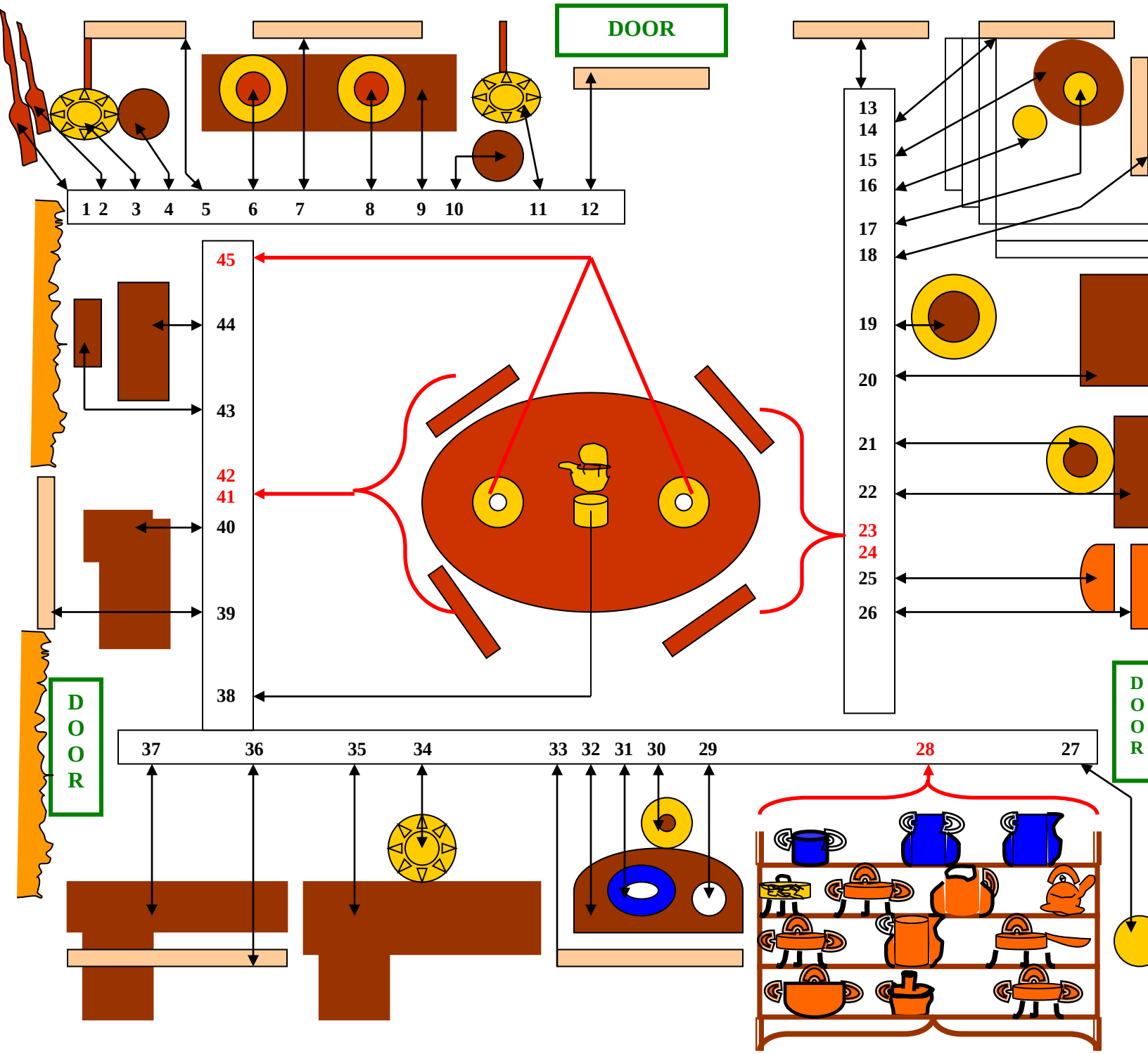
Housekeeping programme for interiors and collections in historic houses and buildings (see Manual, point 8, p. 50)

EXAMPLE OF A FLOOR PLAN

1. **Wooden shovel**
2. **Wooden shovel**
3. **Warming pan**
4. **Wooden pestle**
5. **Painting**
6. **Bucket**
7. **Painting**
8. **Bucket**
9. **Cupboard**
10. **Churn**
11. **Warming pan**
12. **Painting**
13. **Painting**
14. **Painting**
15. **Barrel**
16. **Tub**
17. **Vessel**
18. **Painting**
19. **Barrel**
20. **Table**
21. **Tub**
22. **Dough chest**
23. **Chair**
24. **Chair**
25. **Wash basin**
26. **Wall fountain**
27. **Jug**

28. **Wooden rack,** from top to bottom, & left to right -
    Top: 3 earthenware containers
    First: Brazier; **Round pan with lid**;
    Jug; **Kettle**.
    Second: **Round pan with lid**; **Kettle**,
    Oval pan with lid.
    Third: Oval pot with lid; **Container**
    Fourth: Oval pot with lid; **Container**
    Large pan with lid
29. **Candle-stick**
30. **Tub**
31. **Porcelain ewer and wash basin**
32. **Table**
33. **Painting**
34. **Butter strainer**
35 **Display cabinet**
36. **Painting**
37. **Settee/bench**
38. **Kettle and brazier**
39. **Painting**
40. **Chair**

41. **Chair**
42. **Chair**
43. **Wooden high chair**
44. **Wooden crib**
45. **2 candle stick holders**



PLANNING FOR DISASTER MANAGEMENT AND CONTROL
(see Manual, pp. 73 – 86)

CONTENTS OF A DISASTER BOX (can be added to, if and when necessary)

2 torches with D batteries (6 D batteries for each torch)
1 rechargeable lantern
1 head lamp with (8 x AA alkaline batteries)
2 plastic spray bottles
2 buckets (with or without lids)
12 pencils (stationery)
3 ball point pens (stationery)
1 felt tip pen (black) (stationery)
1 cutter with pack spare blades
1 box paper clips (stationery)
1 pr. Scissors
2 clipboards with writing pads (stationery)
1 roll buff tape (50 mm)
2 rolls masking tape (96 mm, 24 mm)
4 dust masks (with valve)
4 prs. cotton gloves
50 superwipes
20 rolls paper towel
1 box vinyl examination gloves (medium & large)
25 disposable, plastic aprons
Mutton cloth
6 small sponges
Wax wrap (P & P)
Cling film (P& P)
Freezer bags (P& P)
15 m clear polythene (2 m wide)
15 m black polythene (1 m wide)
1 'squeegee' (hard, rubber)
1 mop
1 lead light with 5 m lead
4 hard hats

Apart from stationers, and supermarkets, most materials & equipment comes from any supplier of general materials and equipment (a hardware store).