

Relative Humidity and Temperature

What is relative humidity?

The amount of moisture that can be held in a given volume of air will change depending upon the air's temperature. That is, the hotter the air, the more moisture the air can retain. Similarly as it gets colder, the air can hold less moisture which is why a room may feel damp if there is a sudden drop in temperature. Relative humidity is the amount of moisture held in air of a given temperature relative to the absolute amount of moisture air can hold at that temperature and is expressed as a percentage.

Damage caused by relative humidity

Much of the damage caused by relative humidity occurs because of fluctuations in relative humidity. As the humidity levels fluctuate, organic materials such as wood and ivory will take in and give off moisture. As moisture is taken in, the item will swell and as moisture is given off, the item will shrink. Generally this is not too much of a problem, if the item is made in one piece of one material. However, more often than not collection items are made of composite materials which swell at different rates hence the cycles of swelling and contracting lead to splits and cracks, glues giving way, paintings warping and veneers popping off.

High humidity will lead to mould growth, corrosion of metals, cockling of paper and encourages insect activity. Low humidity will lead to the drying out, shrinkage and splitting of organic materials (such as bark, ivory, wood and leather).

While temperature is generally not considered as much of a problem extremes of temperature can also cause problems. Warm temperatures will often increase insect activity and can also lead to the softening of resins and adhesives which will in turn lead to sticky surface and warping materials. Freezing temperatures can cause problems with glass and paint surfaces.

Fact Sheet

Vulnerability of materials to temperature and Relative Humidity

Environmental factor	Vulnerable material	Type of damage
Fluctuating relative humidity (sharp changes of more than 20% in 24 hours or less)	Any composite material including <ul style="list-style-type: none">• Paintings on stretchers/strainers• Furniture• Bone handled cutlery• Bark paintings• Musical instruments• Masks with applied decoration	Warping, splits and cracks, glues giving way, paint and veneers popping off.
High relative humidity (constantly above 65% RH)	<ul style="list-style-type: none">• Metal items• Organic material (such as wood, leather, bone)• Items with a high salt level (such as some archaeological pieces and maritime collections)• Paper• Photographs	Mould growth, corrosion, increased insect activity, growth of salt crystals, cockling of paper, softening of the emulsion layer of photographs
Low relative humidity (constantly below 35% RH)	<ul style="list-style-type: none">• Organic material (such as wood leather bone)• Photographs• Bark paintings• Items which have adhesive repairs	Desiccation of organic material and photographic emulsions, splitting and distortion of bark paintings, shrinkage of some adhesives leading to failure of previous repairs.
High temperature	<ul style="list-style-type: none">• Plastics and rubber• Materials using resins and waxes• Items which have adhesive repairs• Organic material	Increased insect activity, accelerated degradation of plastics and rubber items, softening of resins and waxes leading to stickiness and distortion, slumping of adhesive repairs.
Low temperature (below freezing)	<ul style="list-style-type: none">• Glass• Paintings on canvas• Resins	Embrittlement and increased fragility of glass, resins and paint surfaces.

Fact Sheet

Reducing risks

There are two approaches to controlling temperature and relative humidity-mechanical and passive. Mechanical involves the use of airconditioners which control both the temperature and relative humidity. Such a system is both expensive and complicated to install and maintain. It needs to be on twenty four hours a day. All too often fluctuating relative humidity is caused by inappropriate airconditioning (such as a system which only controls temperature) or systems which are only on during opening hours. This is not to say that airconditioning should never be used, simply that its ongoing maintenance needs to be considered from the outset.

A passive system will take advantage of the building's structure, including siting, sun movement, insulation, materials used in the building, overhangs and shutters to control the building's environment.

Controlling the environment immediately surrounding vulnerable objects are another way that cost effective environmental control can be provided.

- Buffering materials such as silica gel or Artsorb can be placed in display cases to control relative humidity (remember this will need to be changed from time to time).
- Mountboards for paper objects on display and backboards used with framed works will provide further buffering for such items.
- Wrapping items in store in acid free tissue or using acid free card in storage boxes will also provide further buffering.
- Washed cotton or linen can be used in storage or display situations as a buffering material
- Try to avoid placing collection items on exterior walls either for storage or display. The difference in temperature between the outside and inside of the building can lead to a build up of moisture on the inside of the wall which may transfer directly to the collection item.