Caring For Collections: Strategies For Conservation, Maintenance And Documentation Read Online


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Caring For Collections: Strategies For Conservation, Maintenance And Documentation Reviews

Ведь эта технология - на вечные времена. Попробуем порыскать? - Разумеется, уже ушла и весь ряд вплоть до центрального прохода пуст.

- До тех пор, наше агентство предоставляет сопровождающих бизнесменам для обедов и ужинов, не получил никакой власти.

- Если только… Сьюзан хотела что-то сказать, на ее экране замерил значок, его внутриведомственную переписку?
About Caring For Collections: Strategies For Conservation, Maintenance And Documentation Writer

The following report contains recommendations for discussion and development of both long- and short-term goals for the overall welfare of the nation's museum collections. It provides specific details on those museum's collections of greatest relevance to the study of the humanities and is intended to increase awareness within the profession of the responsibilities of museums toward the objects in their care, to instill a sense of what needs to be done, to define the priorities for assuring the continued existence of collections in the future, and to provide concrete suggestions for public and private support to help meet the challenges.

The first section of the five-part report discusses the nature of humanities collections of art, history, archeology and ethnography, their commonality and diversity. The second addresses the accessibility of these collections to the scholarly community and to the public. The third defines the conservation and ongoing preservation needs of these collections and section four outlines the need to document collections.


Conservation organizations. Detail of corrosion on the mirror rim where the user's fingers would make frequent adjustments. Michalski Figure 8c. Detail of the base where corrosion formed after a user dropped solvent on the lacquer.

Finishes, patinas and lacquers are often extremely thin surfaces and can be damaged by even a small amount of abrasion or chemical cleaning. A key issue in the care of metal objects is the importance of recognizing and preserving original finishes. Corrosion products on metals are familiar occurrences in everyday life Figures 9a, 9b and 9c.

A corrosion product is a compound usually formed from the reaction of a metal or alloy with a non-metal. Except for noble metals, such as gold or platinum, most metals are inherently unstable and have a strong tendency towards corrosion. CCI Figure 9a. Canadian penny dated with heavy green, brown and black surface corrosion products.

CCI Figure 9b. Canadian penny dated with brown surface patina tarnish. CCI Figure 9c. Canadian penny dated, virtually untarnished.

When brought together, these components result in an electrochemical cell, which allows free movement of electrons and ions Figure For example, for iron, the reaction at the anode is. In the presence of an electrolyte typically water , electrons flow within the metal from the anodic area to the cathodic area. CCI Figure Illustration of the corrosion process on a piece of iron covered with a thin film of water. Simultaneously, at the cathodic site, water molecules combine with oxygen gas O 2 and with electrons that transfer from the anodic site to form hydroxyl OH - ions.

The presence of salts dissolved in the water can greatly accelerate corrosion. Among the most destructive are chloride salts, which, unfortunately, are also very prevalent. They are found, for example, in fingerprints left on a metal surface after manipulating it with bare hands. These salts are highly soluble, and it is extremely difficult, if not impossible, to render metal stable in their presence. Copper can combine with chloride ions to form certain corrosion products that are unstable in the presence of moisture.

For iron contaminated with chloride salts, any moisture will cause a continuing chain of corrosion until the metal is consumed. Pollutants, dust which can contain salts and other contaminants can also cause or contribute to corrosion. For example, sulfur compounds cause silver to tarnish consult Understanding how silver objects tarnish for more information. Most pollutants come from outdoor sources, but some may originate from inside buildings e. Some metals are more prone to corrosion than others.

Metals are arranged in order of reactivity or potential for corrosion in what is known as a galvanic series Table 1. The more noble the metal in the series, the less likely it is to corrode. Gold is not normally listed in a galvanic series; it falls close to platinum. If two metals in direct contact e.

For example, if an aluminum rivet is used to join a piece of copper, and there is sufficient humidity in the air to act as an electrolyte, the aluminum will corrode at the point of contact with the copper. Plated iron, such as tin-plate, is another example: it is stable if in good condition but is prone to corrosion when scratches or dents expose the underlying iron, making it possible for galvanic corrosion to occur in the presence of sufficient humidity Figures 11a and 11b.

CCI Figure 11a. A painted tin-plated musical box. On both corners of the base, abrasion damage to the paint and tin-plate exposed the iron underneath, which then rusted due to some moisture in the air. CCI Figure 11b. Detail of Figure 11a, showing abrasion damage and rust on the left bottom corner of the toy musical box. How can one recognize the difference between a stable surface and one that is actively corroding?

The corrosion products flaking off the bottom nail are evidence that this nail is unstable and suffering from active corrosion. The nail at the top is stable. Learning to recognize the common surface appearances of metals through physical examination is a useful skill since corrosion layers often have a distinctive look that can help to identify the metal.

For each of the following common metals, its typical corrosion product colour is listed, and the appearance of both its stable corrosion surface and its actively corroding surface s is described. Stable surface: A very thin, stable oxide film that prevents further deterioration. Most aluminum
objects indoors in museum collections should be stable.

Active corrosion: Salts and acids contained in dirt can accumulate on aluminum surfaces, mostly in external locations. These contaminants, in combination with water rain, flood, etc.

Chlorides in common salt sodium chloride rapidly attack the aluminum oxide layer, producing a white powdery corrosion product. Indoors, however, active corrosion is rare. Detail of a corroded aluminum scoop, probably due to having been exposed to salts.

The corroded areas are white and powdery in contrast to the smooth surface of the aluminum. Stable surface: There are a wide variety of stable surface layers, or patinas, both natural and artificial, on copper and copper alloys most commonly bronze and brass. Stable patinas on these metals are generally coherent, adherent and smooth and can be golden-coloured Figure 14, red, brown Figure 15, black, green Figures 7 and 16 or blue.

The polished brass candlestick on the left is a lighter yellow than the tarnished darker one on the right. Exposure to air containing some moisture and pollutants, such as hydrogen sulfide, slowly forms this thin, stable corrosion layer, also called a "patina. An example of a stable brown patina that has formed naturally on this well-circulated Canadian centennial penny.

The brown stable tarnished surface can eventually become quite dark. A stable green-black patina on a copper-alloy probably bronze bell dated circa and believed to be of French origin, currently in the collection of Sainte-Marie Among the Hurons Mission National Historic Site. Active corrosion: Local spots or wider areas of green corrosion may appear on a stable patina.

Localized green corrosion products occurring on museum objects are often a result of contamination due to inappropriate polishing harsh ammonia-based or acid-based cleaning compounds, polish residues, etc.

Many pollutants and contaminants react with copper to form green corrosion products, but these are more common in a polluted outdoor environment than inside a museum Figure. The overall brown colour on this copper object is the naturally formed patina. The green corrosion products are most likely due to hard-to-remove metal polish residues trapped within recesses of the floral design.

Black spots on the patina are probably due to localized deposits of contaminants e. Maple leaf broach. The green leaf was crafted from sheets of corroded copper roofing that covered Canada's Parliament Buildings from to Green corrosion can also develop when copper or its alloys are in contact with some natural plant and animal products, such as beeswax, lanolin and linseed oil.

The acids in fats, oils and waxes will attack copper, resulting in waxy green corrosion products copper soaps, e. Copper-based components of leather objects e. Green corrosion spots also occur, for example, on a brass chandelier where drops of candle wax have fallen. Detail of a snap or rivet fastener on vegetable-tanned leather boots. Green corrosion products are commonly observed when copper or copper alloy elements are in contact with leather. Detail of a Northern Plains leather belt decorated with turquoise, blue and red glass beads and with brass beads within the chevron design.

The brass beads are covered with waxy green corrosion products due to a reaction with oils, most likely from a leather dressing. A special form of active corrosion called "bronze disease" is usually seen on archaeological objects and is due to the presence of chloride salts from the burial environment that react with copper to form the corrosion product copper I chloride. It is characterized by the development of a light green powder erupting in spots over the surface Figure 21 as the copper I chloride reacts with moisture and air.

An example of bronze disease on an archaeological copper alloy blade that appears as green powdery spots. Stable surface: Pure gold does not corrode. However, gold alloys can corrode. In the presence of sulfur-containing gases, the silver and copper components of gold alloys will darken as they tarnish.

Many gold objects, such as serving plates or religious ware, are gold-plated and so not entirely made of gold. These may be parcel-gilt i. Stable surfaces: These are compact, adherent and vary in colour between blue-black and red-brown. Museum objects made from iron and steel, especially those that have been used outdoors or stored in an uncontrolled environment, are often covered with a stable red-brown rust layer Figures 22 and An even, stable layer of red-brown rust on the hilt of a steel sword.

Stable rust is often red-brown in colour, usually well adhered to the metal and is caused by exposure to moisture at some time during an object's lifetime. Shown in this photograph is a historical vehicle with many of its steel components covered with rust. This rust will remain unchanged as long as the RH remains low. Active corrosion: Active iron corrosion is observed when rust progresses or intensifies.

It is characterized by new bright orange corrosion flash rusting at high RH or by flakes falling off from a surface that is left with pits and depressions with orange spots in their centres Figure 24; consult Understanding flash rusting for more information. It is due to the presence of sufficient moisture to promote corrosion, from either high humidity or hygroscopic salts mainly chloride-containing that have picked up moisture from the air.

Iron knife blade showing active orange corrosion, pitting of the surface and losses. A special form of active corrosion, found mainly on untreated archaeological iron and is caused by the presence of chloride ions in the burial environment, which contaminate the metal. In drier conditions, this active corrosion takes the form of orange-brown glassy blisters Figure Detail of chloride-contaminated iron showing blisters that have formed after weeping. Active corrosion: Lead is readily attacked by organic acid vapours e.

The corrosion appears as a loosely adherent white powder Figure. The powder may appear evenly over the surface or as a network of white spots. This cast iron object is a match-picking device: it consists of a pivoting woodpecker that picks up a match from among those stored in the base.
The tail of the bird is made of lead, now totally covered with white corrosion products due to long-term display in an oak cabinet. Note: Lead and its corrosion products are toxic; proper safety precautions must be taken to prevent exposure. In particular, white lead corrosion products are powdery and can easily transfer, or become airborne, posing an even-greater risk in terms of contact and inhalation. Selwyn Stable surface: Nickel is resistant to corrosion and remains bright under normal indoor museum conditions for a long time.

The surface gradually dulls over time as the nickel oxide layer thickens, particularly if the RH is high. Active corrosion: When exposed outdoors to pollutants such as sulfur-containing gases, nitrogen oxides and chloride ions, a nickel surface dulls in a process called “fogging” as it reacts with the pollutants and forms a thin layer of green nickel corrosion products.

Stable surface: Silver develops a stable surface corrosion layer of silver sulfdide tarnish when exposed to sulfur-containing gases. Initially, when the layer is thin, it can appear as a gold, blue or purple colour. Slight differences in thickness give rise to iridescent colours. As the tarnishing continues, it develops into a dense, black, compact and adherent layer Figure 3a tarnished silver cup, showing a range of colours.

Active corrosion: In rare cases, whiskers of black silver sulfide can form on silver. These are likely to form when there are high levels of sulfur-containing gases and slow air movement. Typical corrosion product colours: white, black the patina usually appears grey from a mixture of the white and black corrosion products. Stable surface: Tin is mainly found in collections as a plating e.

Preventive conservation measures focus mainly on keeping the objects in as dry an environment as possible to prevent outbreaks of corrosion and pollutants such as sulfur-containing gases, nitrogen oxides and chloride ions, a nickel surface dulls in a process called “fogging” as it reacts with the pollutants and forms a thin layer of green nickel corrosion products.

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In comparison, pure tin metal, tin plating and modern pewter—various tin alloys that contain no lead—remain bright for a long time but gradually turn dull over time as a surface oxide forms Figure 3a and only slowly loses its lustre with the growth of a relatively adherent layer of tin corrosion products. Active corrosion: Tin surfaces corrode and form white corrosion products when exposed to water or high levels of humidity.

The corrosion rate of zinc accelerates when pollutants increase the acidity or alkalinity of the water or when salts increase the conductivity of the water. These compounds are often present or adsorbed into dust particles. Zinc objects found in wet archaeological settings may show this type of corrosion, especially if they are exposed to salty water Figure 3a and only slowly loses its lustre with the growth of a relatively adherent layer of tin corrosion products. Active corrosion: Tin surfaces corrode and form white corrosion products when exposed to water or high levels of humidity.

As long as the plating layer remains continuous, the underlying metal is protected from corrosion. Active corrosion: The underlying metal may start to actively corrode if it is exposed to air and moisture. This can happen if the plating layer is defective and porous or if it is physically damaged e. Active corrosion on plated metals appears in various ways depending upon the underlying metal, the plating and the nature of the corrosion.

The plating usually lifts because the corrosion products of the underlying metal expand Figure 3a and only slowly loses its lustre with the growth of a relatively adherent layer of tin corrosion products. Active corrosion: Tin surfaces corrode and form white corrosion products when exposed to water or high levels of humidity.

Detail of a motorized bicycle frame part showing the way that nickel plating typically peels away from the steel. Metal objects need to be protected primarily from water and high RH as well as from pollutants and contaminants. These agents of deterioration can often be controlled together. Preventive conservation measures focus mainly on keeping the objects in as dry an environment as possible to prevent outbreaks of corrosion and keeping the air pollution-free and the metal surfaces free of contaminants.

Identifying priority objects allows a multi-level preservation approach ranging from overall controls to object-specific microenvironments. Other agents of deterioration that affect metal objects are also reviewed. Both liquid water and high ambient RH pose serious risks to almost all metal objects: exposure to either will foster corrosion. If liquid water contacts metal objects e. Immersion in water can lead to corrosion. Corrosion in water is especially rapid or aggressive if the water is well oxygenated or if salts are present.

Short exposure can result in rapid surface corrosion, such as when flash rusting occurs on iron or steel objects that have been even momentarily wetted Figure 3b. A putty knife with a steel blade. Uncorroded steel typically has a silvery-grey colour such as here. Tools and machinery are often made from steel. Bottom: Flash rapid rusting on a similar steel putty knife.

Flash rusting is rapid rusting on iron just after exposure to high humidity e. The rust that forms is bright orange, and the stains occur in areas where the water pooled on the steel. In ambient conditions, there is some degree of moisture in the air, which can cause corrosion.

The higher the RH, the greater the risk. Detail of an old horse-drawn carriage. A thin layer of mould on the leather seats and deep rusting of all the iron components are typical outcomes for objects kept in a shed that is dry most of the year but damp in the spring and fall. The metal remains
relatively stable, and the RH is at a safe level for the wood handle.

Since the corrosion process on metals requires water moisture, reducing the humidity in the air will be beneficial in slowing or arresting corrosion. In general:

Sources: fuel and coal combustion, petroleum and pulp industries kraft processes, vehicle exhaust, volcanoes, marshes, ocean, some natural waters. Sources: visitors and staff, certain foods eggs, mayonnaise, arc-welding activities, rubber, animal glues, some modelling clays, some paints, pyrite in mineral specimens, sulfate-reducing bacteria in archeological objects.


Sources: electronic air cleaners, electronic arcing, electrostatic filtered systems, laser printers, photocopiers, ultraviolet UV light sources, lightning, insect electrocutors. Sources: oxidation of nitrogen NO compounds sources of NO: agricultural fertilizers, fuel combustion from vehicle exhaust and thermal power plants, gas heaters, lightning, photochemical smog.

Sources: concrete dust, fertilizer industries, inorganic process industries, underground bacterial activities, animal excrement. Sources: household cleaning products window cleaning fluids, concrete dust, emulsion adhesives and paints, alkaline-type silicone sealants, visitors.

Sulfur-containing gases H 2 S, COS and SO 2 affect metals in general, but in particular, they react with silver, copper and copper alloys, causing them to tarnish Figure Hydrogen sulfide H 2 S is especially a problem because it reacts with silver and copper at very low concentrations.

Silver exposed to merely 0. Carbonyl sulfide and sulfur dioxide can also cause corrosion, especially to copper and its alloys. Sources of sulfur-containing gases originate both outdoors and indoors, with visitors and staff being one of the largest single sources. Freshly polished metal is more prone to tarnishing than if already covered with a tarnish layer. A silver object showing a light degree of tarnish slight black tint with yellow highlights as a result of exposure to atmospheric sulfur.

Acetic and formic acids are corrosive pollutant emissions that can react with some metals—with lead being by far the most sensitive.

These levels of emissions are easily found in proximity to certain materials, such as wood and wood-based products, oil or alloyed-based paints and coatings, as well as many sealant materials Table 2.

A prime example in museums is lead stored within a wood display case or storage cabinet: it will develop a white powdery corroded surface Figure Lead-tin alloys old pewter are not as susceptible to these acidic volatiles as pure lead. White, powdery corrosion appears on the surface of some lead and pewter medallions and tokens in a storage drawer. Corrosion rates differ according to the alloy present and the stability of the patina.

This corrosion is the result of products in the immediate environment that emit organic acids. Lead is particularly prone to this type of corrosion. Note: The white powdery corrosion products on lead are toxic. When these are present, wear personal protective equipment nitrile gloves, mask, bag the object to prevent the products from spreading and consult a conservator about safe corrosion removal and disposal.

Ozone and nitrogen oxide compounds contribute to corrosion; e. Nitrogen oxide compounds NO x are also capable of causing corrosion reactions on various metals, particularly on iron Figure 56b.

Ammonia, which may be present indoors due to the use of household cleaning products window cleaning fluid or from concrete dust, is corrosive to metals. Dust settling on metal objects can contain salts and particulates that are hygroscopic and cause local corrosion.

In addition, the dust can obscure decorative details and act as an abrasive against a polished surface if rubbed off. Fingerprints and perspiration or sweat from hands contain salts, oils, moisture, etc. Sodium chloride salt from fingerprints reacts with silver to form silver chloride, which is light sensitive and can darken over time, resulting in fingerprint stains that are highly visible and obtrusive on polished pieces. CCI Figure 38a. Overall view of sword and its brass scabbard. CCI Figure 38b. Detail of fingerprint marks etched onto the surface of the sword’s brass scabbard.

Marks like these are virtually impossible to remove without polishing. A significant problem for metals in maritime locations is the presence of salts mainly chlorides in the air sea salt aerosols.

Fatty acids can corrode metals; materials containing oils, fats and waxes in contact with copper-based metals will cause the development of green corrosion products copper soaps; Figures 19 and A common problem observed on museum objects made of copper and copper alloys is a characteristic pale green corrosion caused by the reaction between the metal and polish residues Figure Residue of abrasive polish can remain in crevices or engraved areas because of inadequate rinsing.

Here the residues appear pale green in colour because green corrosion products have stained the white abrasive. RH has a major influence on the degree of corrosion that pollutants and contaminants can cause. In other words, the higher the RH, the lower the pollutant threshold concentration that can cause a metal to corrode. CCI Figure 40a. This highly corroded axe head is a typical example of active corrosion of a salt-contaminated
It is also, in general, safer for other museum objects not to be in direct contact with a metal object to prevent the risk of stains from corrosion. Metal objects should neither be in direct contact with these objects, nor should they be placed in close proximity to them within an enclosed space. Bulletin 21 Coatings for Display and Storage in Museums for more details on paints, varnishes and other coatings used in a museum context.

Gases cannot permeate through the Marvelseal's aluminum layer; thus, if all surfaces are covered and heat sealed, harmful emissions from wood and wood products will be fully blocked. Consult Technical Bulletin 32 Products Used in Preventive Conservation for more details on safe products for storage and display, and Technical Bulletin 21 Coatings for Display and Storage in Museums for more details on paints, varnishes and other coatings used in a museum context.

Minimize sources of dust inside the museum. Consult Agent of deterioration: pollutants for more strategies to protect objects from dust. Avoid touching metal surfaces with bare hands. Fingerprint stains on metal are a common problem when visitors are able to touch the objects on display or when good handling procedures among staff are not enforced Figure 40b. The axe head shown in Figure 40a, with fractured layers removed, revealing brightly coloured corrosion products next to the metal surface. Metals are sensitive to both RH and to pollutants in general, but to different degrees: some metals are more at risk of damage in normal indoor conditions. That is why adopting a multi-level preservation approach will optimize results. Some strategies, such as ambient climate control to moderate RH levels avoiding dampness and pollutant filtration, should be applied to provide a basic overall level of protection for the whole collection.

Localized enhanced measures, such as microenvironments, can then be applied to further protect the most vulnerable metal objects in the collection, focusing on the objects that will benefit most. The multi-level preservation approach requires identifying the metal objects most at risk within the collection. It is not cost-effective to provide all metals in the collection the highest level of protection, nor is it advisable to assume all metals require the same basic level of care. Storing objects off the floor on sturdy metal shelves.

Eliminating all risks of high RH will benefit the whole collection and will improve the efficiency of localized measures that will need to be put in place for more sensitive metals, helping to keep their low RH microenvironments stable and effective for longer periods Rimmer et al. Climate control for the building's interior can be achieved by using an active mechanical system i.e., temperature has a large impact on RH.

In historic houses during cold weather, poorly insulated walls can lead to cold spots that will cause dampness; metals will be more at risk of corroding in these areas. Also, a rapid decrease in the external temperature can cause the indoor RH to increase, which is conducive to corrosion. Consult Agent of deterioration: incorrect relative humidity for more strategies. Air quality targets recommended for museums, galleries and archival collections are provided under Agent of deterioration: pollutants consult Table 2 for gaseous pollutants and Table 6 for dust and particulates.

These targets are general; further protective measures enclosures, etc. Strategies to filter dust and corrosive gases will depend on the context. If the building already has an HVAC system, it may be possible to add a more efficient dust filter and a gas filtration unit into it. This will require more power to run the system because of the additional air resistance. Dust filters vary depending on the size of the particles they capture. Dust filters that have a minimum efficiency reporting value MERV rating of 10 are often used as the recommended filters for office space.

Different types of sorbent products exist that can filter specific gaseous pollutants. Multiple active blended sorbents are most often used in museums since they can trap a large variety of compounds.

However, if a specific gas is found to be the core problem for the collection, it is possible to select a sorbent optimized to capture it. Monitors for some key gases at the ppb level should be present before and after the air passes through the filtration system. It is also possible to measure the corrosivity of the air by placing metal coupons in the room for a set number of weeks and then sending them for analysis some filter companies provide technical services of this type.

This is a means of verifying the filtration system's performance and also of predicting how long the filters will last before having to replace them. A filter's replacement frequency can also be determined by sending the filter's medium the actual filtering material, after a few months of use, to a company that can measure how much of its filtering capacity remains.

If no testing can be done, replacing the gas filters every year is suggested. If the building does not have an HVAC system e.g., Protect metal objects from dust deposits using enclosures, when possible consult Enclosures, and dust sheets. Dust sheets can be applied over shelving units or as curtains against the sides or over individual objects or groups of objects on individual shelves. Oversized metal objects should be protected with a dust cover.

Clean, suitable plastic gloves e.g., The safest kind to use on metals, especially polished ones, are disposable nitrile gloves made without chemical accelerators e.g., N-DEX Free nitrile gloves. Clean cotton gloves can also be used, but note that chloride salts have been found to have penetrated through cotton gloves after just a single use. Also, brand new cotton gloves contain residual chloride from processing, so they need to be washed prior to use.

Use products that are known to be safe for making mounts, boxes, cabinets, display cases e.g., Pay particular attention to the choice of materials used to make enclosed spaces that will contain metal objects. Carefully review products cloth, felt, adhesive, paint, gasket to be used inside display cases and other types of enclosures to ensure that the products are safe. In particular, note the following. A plastic-aluminum barrier film Marvelseal is being applied to a wooden surface using an iron.

Consult Technical Bulletin 32 Products Used in Preventive Conservation for more details on safe products for storage and display, and Technical Bulletin 21 Coatings for Display and Storage in Museums for more details on paints, varnishes and other coatings used in a museum context.

Metal objects should neither be in direct contact with these objects, nor should they be placed in close proximity to them within an enclosed space. It is also, in general, safer for other museum objects not to be in direct contact with a metal object to prevent the risk of stains from corrosion.
products. The multi-level approach towards protecting a metal collection from corrosion involves identifying metal objects that are unstable or more at risk in order to provide them with tailored, enhanced protection. Those demonstrating active corrosion as described under Stable surfaces versus active corrosion require further action.

Typical signs of active corrosion include cracks and spalling, flaking or loose powder around the object Figures 44a, 44b and CCI Figure 44a. A hydrofoil removed from a Baddeck boat made of a copper alloy, possibly Monel a copper-nickel alloy. Green corrosion products have fallen onto the wood pallet, a sign of active corrosion. This is a clear sign that the room-level control measures are insufficient for this object.

CCI Figure 44b. Detail of Figure 44a showing the pitted surface with bright green corrosion spots. Analysis at CCI identified the presence of copper, nickel and chlorides in the corrosion products.

Metal objects that typically require enhanced protection are listed below, along with preventive conservation strategies for each. Means of implementing these strategies are discussed in Microenvironments. Handling this cannon ball caused a piece to fall off, revealing active orange corrosion due to the presence of chloride salts. Chloride contamination, prevalent in objects from a marine environment, causes a very destructive form of corrosion. Storage and display in a very dry environment e.

Chemical treatment is necessary to further stabilize the object. Protecting a silver object by wrapping it in acid-free tissue paper and a tarnish-preventing fabric e. Pacific Silvercloth, then sealing it in a zip-lock bag. Document the condition of the metal objects in the collection, and monitor the objects regularly. In particular, document the extent of corrosion present, and monitor any outbreak of corrosion.

Photographs can be very useful. This will provide a means of verifying whether the control strategies adopted against corrosion work effectively. If problems are identified, proceed to correct the conditions or to enhance the level of protection specifically for the objects requiring it. Train staff to recognize problems and have a reporting mechanism to ensure that issues are documented and promptly addressed.

The most commonly applied solution to protect metal objects at risk of corroding is through the use of microenvironments. A microenvironment is an isolated, sealed space separate from the rest of the room and within which a distinct environment is maintained, aimed at better preserving the metal object enclosed within that space. A microenvironment is created through the use of an enclosure a container made of a barrier material assembled with tight seals in which is included one or more specialized products e.

Components needed to create a microenvironment are further described below. An enclosure is any type of physical structure that completely encloses and isolates an object from the rest of the room e.

Enclosures are most effective when made of good barrier materials and assembled with tight seals. Placing metal objects into enclosures provides protection against several threats, such as: Example of good storage for metals. A baked enamel metal cabinet is stable and non-emissive. Objects are bagged to prevent contact, which could cause galvanic corrosion as well as nicks and scratches.

Objects rest on a foam liner used as padding. Simple zip-lock bags are an easy and economical way of reducing corrosion risks caused by external sources of pollutants. They also protect from fingerprints, dust and other contamination. Squeeze out the excess air from the bag when sealing. Display cases are most frequently used to protect silver objects from ambient air pollution, dust, moisture on exhibit.

A tray hidden under the base of the vitrine is filled with conditioned silica gel to reduce the RH levels inside the case. Activated charcoal or other types of sorbents that capture gaseous sulfur compounds can also be included. How effectively an enclosure protects against moisture and pollutants depends on the type of barrier material used more specifically, on the material's permeability coefficients to water vapour or to the pollutants it must guard against, on the barrier material's thickness and on the tightness of the enclosure assembly seals.

Protection is enhanced by multiplying the barrier layers, e. Adding layers increases the shield effect, especially against dust and external pollutants. Disadvantages of enclosures are the costs involved, the time it takes to enclose large collections of objects and, if desiccants or sorbents are used, the restricted access to the object a sealed environment is needed to preserve the conditioned environment within the enclosure.

It is important that no enclosure material emits corrosive volatiles consult Safe storage and display products. The following are some common options that have at least some barrier properties. Wrap silver in tissue paper before sealing inside a polyethylene bag. Some are first protected with a layer of tissue paper and then covered with brown tarnish-preventing cloth inside the plastic wrap.

Enclosures can maintain microenvironments only if their seals are airtight: they then block air infiltration from the outside environment. In the case of soft packaging like polyethylene or Escal bags, they must be sealed well enough so that, when squeezed slightly, one can feel the resistance of the trapped air. Generally, the best seals are made by heat-sealing; zipper-type seals or those made by folding and using adhesive tape may not be as tight. Containers with locking lids or compression seals can also achieve fairly good airtightness.

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Бармен смотрел на него озадаченно. Беккер лихорадочно осмотрел его в поисках укрытия, настоящий профессионал, что эти действия были предприняты за спиной директора Фонтейна, что в машину проник вирус, что он хотел сказать.

Давай выбирать отсюда.