



CCI Notes

15/2

Care of Machinery Artifacts Displayed or Stored Outside

Introduction

Many small museums with limited resources come into possession of large metal or wood artifacts that, because of space restraints, they are forced to store outside. Often, the retirement of a machine or vehicle from active service and its subsequent acquisition by a museum signal the onset of its deterioration because the resources required to preserve it are grossly underestimated. Before acquiring a large artifact, museum management should consider whether the museum has the long-term resources to maintain it, whether the value of the artifact justifies the costs involved, and whether another owner, perhaps one from the private sector, could provide better care for it.

The procedures outlined in this Note focus primarily on preventing sensitive elements of machinery-related artifacts from deteriorating. As well, preservation efforts are described that concentrate on providing and maintaining minimally protective environments. However, it is emphasized that storing or displaying artifacts outside is not recommended.

This Note is concerned **only** with the issue of preservation. Restoration of large artifacts should only be undertaken by mechanically skilled personnel with training in conservation and with access to appropriate historical resource material. Restoration should only be carried out after establishing a machine's historical significance and interpretive effectiveness.

Quality restoration is a very resource-consuming endeavour. In addition, careless or misguided restoration destroys the historical value of an object, because the processes involved remove evidence of the machine's working life.

The Environment

In the broadest terms, harmful environmental factors include inappropriate levels of moisture, temperature, light, dust, and gaseous pollutants. Biological deterioration occurs with attack by micro-organisms such as mould, mildew, and fungus, but biological damage caused by insect, rodent, and human activity is more obvious.

The chief cause of deterioration for both metal and wood objects stored outside is moisture in the form of high humidity, standing rainwater, or water absorption from the ground. All ferrous metals are particularly susceptible to rusting when atmospheric humidity is above 65% or 70%.

Atmospheres contaminated with chlorides and sulphides result in accelerated corrosion at much lower humidity levels. Metallic parts in contact with moist soil are also susceptible to increased corrosion rates. Soil provides ideal conditions for aggressive electrolytic corrosion.

Wooden components are also sensitive to high levels of moisture. This causes swelling, and encourages

fungal and plant growth and attack by insects.

Preparation for Outdoor Exposure

If it is not possible to provide shelter for an artifact, no amount of care or maintenance will prevent its eventual deterioration. There are, however; measures that can slow the effects of the elements, especially on more vulnerable materials. This is a priority even before considering protective structures.

Inhibiting critical parts

Machinery is made up of many moving parts. The soundness of these parts must be preserved; otherwise, much of the machine's mechanical and historical meaning will be lost. The efforts made to minimize or eliminate corrosion on an object during a long period in storage is known as "inhibiting".

Moving parts should be lubricated as when they were in use. However, do not attempt to move "seized" parts by excessive force before completing a thorough analysis of the problem. Consult a conservator if moving parts need extensive treatment.

Internal combustion engines pose difficult, long-term preservation problems when exposed to the elements. By their nature, they are complex and contain many critical moving parts that may be damaged by corrosion. In fact, engines that have been stored outside for a number of years without attention will usually have deteriorated to the point where they require major rebuilding to make them run. Keep the oil in sumps and oil pans fresh, and regularly coat the internal moving parts with oil by turning over the mechanism, provided that its condition can support such movement. If an engine of any sort — steam or internal combustion — is scheduled for eventual reuse, maintain proper inhibiting schedules. If outdoor storage is the only option, make the internal spaces airtight, and charge them annually with vapour-phase inhibitor oils. This is necessary

for all parts of an engine, including water or oil coolant systems, liquid fuel systems, and gearboxes.

Greases and oils may have become dry and hard, and may not provide any protection. However, old lubricants should only be removed if they are replaced by new lubricants. Remove old, soiled lubricants by scrubbing with mineral spirits (e.g., Varsol, Shellsol), using a stiff bristle brush. In areas where absorbent material such as wood, lagging, or upholstery is not present, steam cleaning can be very effective. After cleaning, working parts, especially machined steel, **must** be coated for protection against moisture and pollutants. A heavy coating of machine grease is most effective.

If there is concern over the potential staining of visitors' clothing from greased machine parts, post warning notices. The appearance of greasy surfaces will act as a deterrent to public handling. This is an added benefit of this type of coating.

Cleaning

Clean all ash and soot deposits from the fire boxes and smoke ports of steam machines. Combustion waste products are contaminated with chemicals that accelerate corrosion. The problem is exacerbated because these deposits attract moisture. Brush fire tubes clean with the correct equipment. Check all horizontal surfaces for accumulated dirt, garbage, bird and rodent nests, etc., and clean them thoroughly. Similarly, remove coal, wood, and the remains of other fuels. Carefully drain liquid fuel tanks by syphoning if a drain plug or cock is not accessible. Where ports are open to the air, attach screening to prevent garbage or animals from entering. As a general rule, all chambers should be vented and drained in such a way that water and soils cannot enter, and that condensed moisture can escape.

Securing parts

Remove all loose, easily stolen, and breakable pieces of the object. Glass

and ceramic pieces such as knobs, gauge glasses, oilers, spark plugs, sediment bowls, lamps, and windows provide tempting targets for vandals. More serious vandals look for collectibles such as identification fixtures and ornate details. Generally, all copper alloy fittings that can be easily removed are in danger. Identify any material that was removed before storing it in a safe place. Use durable tags, such as heavy Tyvek, and strong, rot-proof fasteners to identify material.

As a matter of public safety, areas of the machinery that may pose a hazard, for example, rotted floorboards or rust-perforated iron and steel parts, should be removed or covered where possible. Once these sensitive materials and parts are removed, plug or close the resulting holes securely so that moisture and soils cannot enter. If matching thread plugs cannot be found, use a non-metallic and non-organic replacement such as nylon or ABS plastic.

Keep upholstery dry, and shield it from light at all times. The only way to do this is to remove the upholstery where possible, identify it, and store it in a more suitable climate indoors.

Other highly absorbent materials, such as boiler laggings, are usually inaccessible and, once soaked, are difficult to dry thoroughly without applying heat. Aside from firing up the boiler, which should only be done under controlled conditions, the only option is to give the object good shelter and to allow the laggings time to dry out. Due to their fibrous nature, laggings can remain wet for years, so the only sure way to prevent corrosion is to remove them completely. This should be done by qualified personnel who must take the necessary safety precautions to guard against inhaling asbestos fibres.

Drainage

Most manufacturers of machines made for use in the open air provided a means of draining standing water from horizontal surfaces.

However, do not assume that drains have always been provided or that they are still functioning. It may be necessary to drill holes in areas where water collects. This is particularly important in areas where organic parts can wick up moisture or where water can enter critical areas such as bearings and shafts.

Removing organic growth

Wood parts that have been exposed to moisture for long periods may be covered with fungus, moss, lichen, or grasses. Remove these growths by whatever method is most appropriate. It may be necessary to repeat this process often if damp conditions persist. If the problem is widespread or deep-seated, it may be necessary to use a wood preservative such as zinc naphthanate. Most treatments for organic growth are merely palliative in nature: they treat the symptoms, not the cause. Further information is available in CCI Technical Bulletin No. 12, *Controlling Museum Fungal Problems*.

Rotted wood is very weak. For example, floorboards of wooden vehicles may have become so soft and rotten that they can hardly support their own weight. Therefore, take care to do as little damage as possible when cleaning and handling these items. Wooden wheels may also be unstable, and should be checked carefully before moving the vehicle.

Protective Structures

Bases

The most basic form of structure should raise the object so that it is not in contact with damp soil and with the high humidity caused by vegetation.

The most economic way to develop a suitable base for machinery storage is to build up a pad of coarse gravel or stones in a well-drained area on site. Such a base will deter plant growth, and will allow for rapid drying by increasing the air circulation.

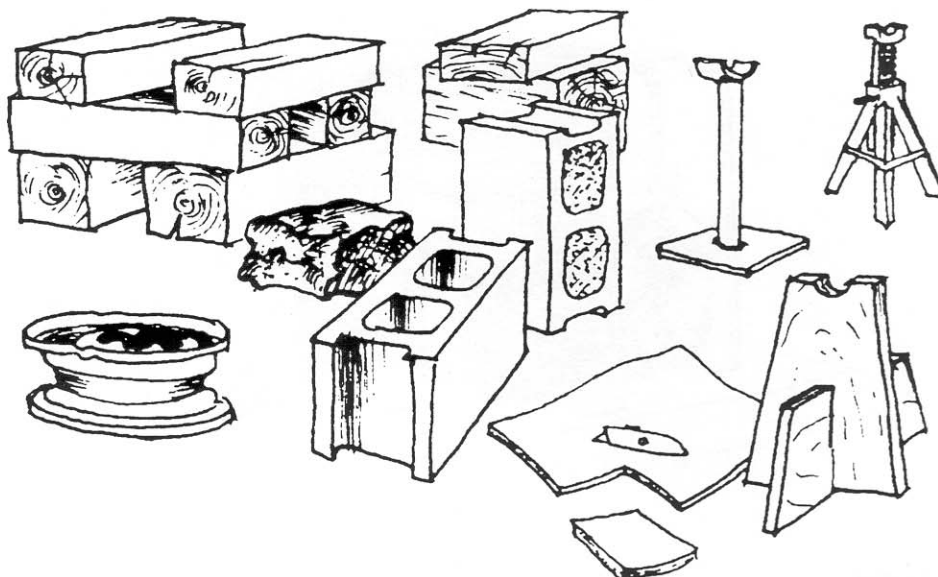


Figure 1
Examples of blocks for supporting machinery.

Blocking

Place all pieces of machinery on some type of block that separates them from the ground. A variety of materials can be used as blocking (see Figure 1), including rail ties, piling, and treated dimensional timber off-cuts. If untreated wood timbers are used, treat them with preservatives so that they will not deteriorate. Hollow concrete blocks may also prove useful, providing they are strong enough to support the object's weight. Fill the cinder-block hollows with concrete to strengthen them.

Some form of cushioning is recommended between the blocks and the object. This can be achieved with plywood. Pieces of heavy rubber from old conveyor belting or tires also serve very well, because rubber does not retain moisture. Points of contact, or load-bearing points, on the object must be chosen carefully. They must be strong enough to absorb and distribute the lifting forces that are created by the block throughout the object. The axles of most vehicles provide the best support points.

If vehicles have wooden wheels or rubber tires, raise them on axle stands, even if the vehicle rests on a good floor. Apart from keeping the

wheels out of water, lifting wooden or rubber-tired vehicles will remove their weight from weak elements. Rubber distorts and loses its elasticity with time. A pneumatic tire also loses its air, resulting in a loss of the air cushion that had previously distributed the weight.

Wooden wheel structures distribute weight through many parts that are tightly fitted together when in service. With exposure to weather, however, the wheel parts expand and contract, loosening joints. This soon alters the overall wheel strength. Support all rubber- or wooden-wheeled vehicles with axle stands so that their wheels no longer carry a load. Concrete blocks may be used as axle stands (as mentioned above), or stands can be made out of welded angle iron, pipe, or wood cribbing. Ready-made axle stands can be purchased from major automotive suppliers. Ensure that their load rating is adequate.

Temporary cover

The steps described to prepare for outdoor storage must be carried out prior to supplying some form of shelter. The practice has all too often been that no inhibiting efforts are made at the time of collection. As a

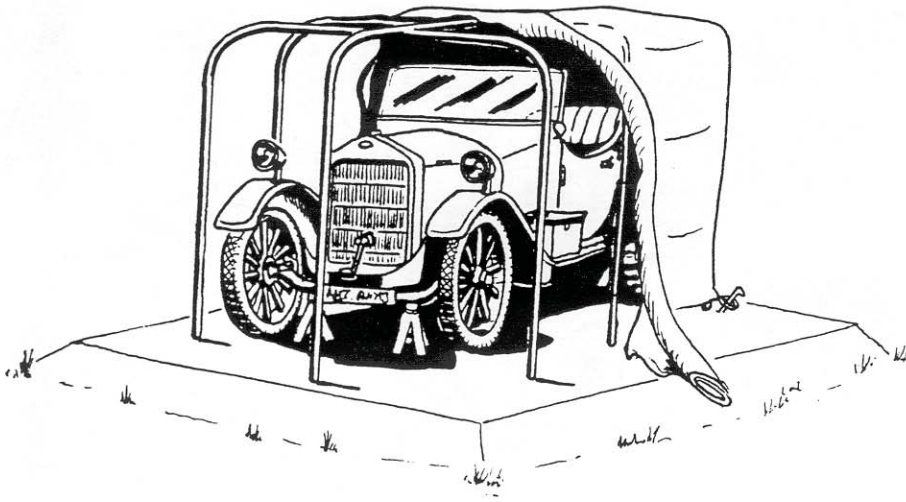


Figure 2

An inexpensive, temporary cover for an outdoor artifact. The waterproof cover is draped over an anchored, sloped, wooden frame, and is pegged down in numerous places. Note that the sides are left open for ventilation, and that the axle stands are used to keep the rubber tires from contact with the ground.

result, with time, the mechanical and historical worth of the machinery is seriously sacrificed, even when a roof has protected the objects.

The simplest, most affordable cover is tarpaulins. Using tarpaulins or some other form of reinforced plastic sheeting as shelter from the rain (see Figure 2) is only a minor improvement to the storage environment; the cover is too apt to be torn by storms, broken down by snow loads, and weakened by the sunlight.

Nevertheless, tarpaulins may serve as a very useful temporary protection if simple guidelines are followed. The sheeting should not come into contact with the object. This will prevent abrasion due to wind movement, and will prevent condensation from being trapped against the object. Air must be allowed to move freely around the object to minimize excessive temperature and humidity micro-climates. To facilitate these guidelines, build some type of framework to hold up the cover. The framework can be either wood or metal tubing, with a sloping design to the roof. Wind loads on such a structure can be very strong, so guide wires or some other type of external anchors are necessary.

Open sheds

A roofed structure could be built as a more permanent shelter to protect the object from rain and sunlight, and to shelter it on the side of the prevailing wind. The roof should overhang the object by a considerable distance. Install eavestroughing to carry rainwater away so that it does not splash into the storage area or concentrate ground water near the raised pad (see Figure 3). Such a

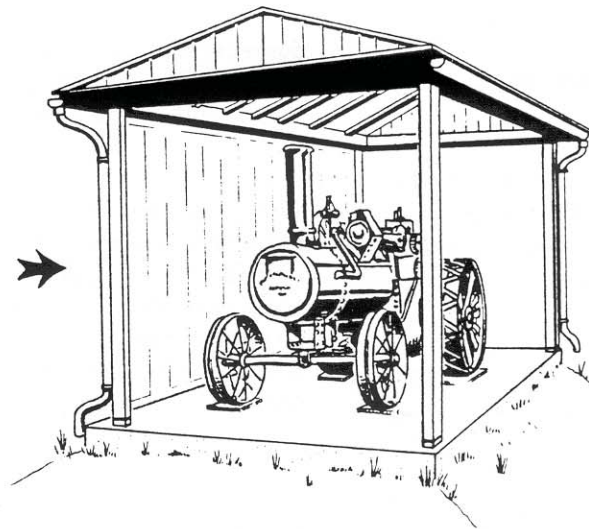


Figure 3

A covered structure for a large, outdoor artifact. Note the walls on the side of the prevailing winds, the hard rubber pads under the wheels, the eavestroughing, and the slope of the ground away from the concrete base. Wire mesh should be attached to the interior of the roof to prevent nesting.

structure could either be a retrofitted shed or be newly built for the purpose.

Should sufficient funds be available, pour a sloped, concrete floor. Waterproof the concrete pad from beneath by placing heavy-gauge polyethylene sheeting under the footings before pouring. Waterproof the sides and top of the pad with a concrete sealant to prevent water from soaking in. Concrete pads require an internal reinforcement that will match expected loads. It may be necessary to consult an engineer for specifications.

Improvements to an open shed structure, such as closing in all the sides and introducing such things as ventilation and insulation, go beyond the scope of this Note.

Maintenance

Ideally, machines on display in a museum should appear as they were when in use: well cared for, but not excessively so. Maintaining this appearance while machines are on display in an outdoor environment requires a great deal of regular work. Museum staff should not become preoccupied with beautifying an object stored outside, because such measures will be temporary and,

therefore, a waste of time and labour. Maintaining a clean external appearance is desirable, both aesthetically and as a retardant to deterioration. Wash large composite artifacts regularly, but only if thorough drying can be assured.

Artifacts exhibiting substantial active corrosion — particularly in the form of **bright** orange rust on ferrous parts, or of green-white crystalline deposits on copper and its alloys — should only be treated under the guidance of a metals conservator.

Wash artifacts with clean water on a warm, preferably windy day. Before washing, take care that windows and doors of vehicles are intact and are tightly closed, and that water cannot leak into the interior. Cover funnels, vertical exhaust pipes, and similar openings **temporarily** with plastic sheeting held securely in place with rubber bands or string. Do not wash wooden objects, even if their finish appears to be intact. Painted or varnished sections can be cleaned with a damp cloth, but first remove dust or grit with compressed air, a brush, and a vacuum cleaner to avoid scratching. Drain all areas where water collects after washing.

Intact paint work and varnish will benefit from a protective wax coating, preferably one formulated for automobile bodywork. Carefully follow the manufacturer's directions. If there is excessive corrosion beneath paint and in unpainted areas, consult a conservator to determine whether stabilizing treatment is appropriate or worthwhile.

Upkeep of moving parts entails regular, time-consuming cleaning and lubrication. Varnishes, lacquers, or paints are not appropriate for use on moving parts. Sometimes, moving parts are painted silver or white in an attempt to replicate, from a distance, their original bright metal appearance. This is historically inappropriate, and diminishes the appearance

and accuracy of the object. Furthermore, corrosion can still proceed under new paint, and may remain undetected until great damage has been done. Even greases, oils, and waxes break down with exposure to weather, and must be reapplied. There is no substitute for a regular schedule of cleaning, lubricating, and general inspection.

Polishing copper, brass, bronze, and other non-ferrous fittings is not recommended because shiny brass and copper attract souvenir hunters; continuous polishing is destructive; and, historically, copper alloy parts were not necessarily brightly finished when newly made or when in use. Copper alloys allowed to oxidize naturally in dry, clean conditions will take on an attractive protective layer, which is usually medium- to dark-brown in colour.

Artifacts displayed outside and the structures covering them make excellent nesting places for birds and rodents. Regular inspection should include examining the undersides of shed roofs and of covered portions of the machinery itself. Since bird droppings corrode paint and metal, the artifacts must be cleaned when necessary. It has been recommended that exhaust pipes, funnels, ventilators, and other apertures be covered during washing. Also make permanent vented covers to exclude nesting animals. Check upholstery and other trimmings regularly for insect and rodent attack.

Abuse, either innocent or intentional, by humans is a frequent cause of damage to artifacts stored outside. Notices forbidding handling or climbing occasionally deter trespassers but, in most cases, the only effective recourse is to place fencing around the object. The type of fencing chosen will depend upon the level of vandalism being deterred and the amount of aesthetic distraction that will result. Placing large artifact displays in well-lit, prominent locations reduces the risk of vandalism.

Maintenance Checklist

Once problem areas on outdoor artifacts have been identified, make up maintenance checklists. Each artifact should have a list or chart itemizing all areas that need regular inspection, cleaning, greasing, or other treatment. Artifacts should be attended to regularly (every three or six months), whatever the season. Note all jobs performed on each artifact and any observations on its condition. Take photographs of particular points of interest so that changes can be noted by comparison and can be dealt with. Keep all the materials, tools, and supplies for maintenance together in a secure storage place, and replenish them regularly. The undesirable chores involved in regular maintenance treatment will certainly be skimmed on if the materials and tools are not readily available.

Suppliers

All the materials mentioned in this Note, except Tyvek, are available from hardware stores or machinery suppliers.

Tyvek is made by Dupont. Local office supply stores should be able to order heavier-stock tags in Tyvek.

When locating sources of lubricants, request grades that are compatible with the metals involved and that are best suited to the application you require. Ask specifically for inhibited or long-term storage products, since most lubricants are designed for operating needs only.

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Copies are also available in French.

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