

# PRESERVATION Tech Notes



U.S. Department of the Interior  
National Park Service  
Cultural Resources

Preservation Assistance Division

## METALS NUMBER 1

### Conserving Outdoor Bronze Sculpture

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### THADDEUS KOSCIUSZKO MONUMENT Washington, D.C.

The Kosciuszko Monument is one of four sculptural memorials erected between 1890 and 1910 at the corners of Washington, D.C.'s Lafayette Park, across from the White House. Five sculptural groups comprise the Kosciuszko Monument. Standing atop the granite pedestal is a ten-foot bronze portrait of the general holding a map of the fortifications he devised to safeguard Saratoga, New York, against British attack during the American Revolution. At the monument's base

are four subsidiary groups designed to recognize Kosciuszko's role in both America's revolution and in his native Poland's fight for independence from Russia. As with most historic bronze sculptural monuments, the five groups comprising this monument had corroded over the past 80 years and required conservation. The treatment selected included an air abrasive cleaning with pulverized walnut shells, followed by applications of a corrosion inhibitor and protective wax coatings.

*Outdoor bronze sculpture should be cleaned using the gentlest means possible and a regular maintenance program should be implemented to insure long-term protection.*

## Problem

Unprotected outdoor bronze sculpture corrodes with prolonged exposure to chemical compounds in its environment. In time, sculpture surfaces acquire a green patina composed of corrosion products, usually a complex of copper sulfates and carbonates formed by the metal's reaction with carbon dioxides and sulfur dioxides. The green patina was once thought to be a stable coating that would protect the bronze substrate from further deterioration. However, research indicates that corrosion is usually an ongoing process that, if unchecked, will continue to eat away at the underlying metal. Increased acidity of rainfall, due largely to industrial pollution, has been shown to further accelerate the corrosion of bronze statuary.

In an effort to clean and preserve corroded bronze statues, aggressive corrosion removal treatments such as sandblasting, glass-bead peening and chemical applications have been used to prepare metal surfaces for protective coating systems. Treatments such as these have often served to further compromise already deteriorated sculpture.

Both sandblasting and glass bead peening methods are used to remove all corrosion products by feeding controlled amounts of abrasive material into a compressed air stream. The freshly exposed, bright metal surface is then chemically repatinated before it receives a protective coating of wax or lacquer. Both of these aggressive cleaning processes destroy existing patina, and remove metal from the surface. As a result, original sculptural detail can be lost; surface texture significantly altered; and the resultant roughened surface may tend to corrode more rapidly if left uncovered. Given the removal of original fabric, these measures run counter to accepted conservation principles requiring that any interventions carried out be both minimal and reversible.

## Solution

The Kosciuszko Monument was cleaned in 1987 using a walnut shell blasting technique successfully utilized by the National Park Service and bronze conservators in recent years. A corrosion inhibitor was then applied, followed by an application of a protective wax coating. While walnut shell blasting is an airborne abrasive technique for cleaning, pulverized walnut shells are much softer than either sand

or glass beads, and are used at a much lower pressure. The procedure originated in the field of aircraft maintenance where low-pressure walnut shell blasting was found to effectively clean jet engine interiors without deforming surfaces.

As a method of cleaning bronze statues, walnut shell blasting removes dirt, grime and friable surface corrosion but leaves the more dense and more compact corrosion layer intact. The remaining patina—composed of remnants of that applied at the foundry as well as that formed over time by chemicals in the surrounding environment—is retained and is protected from further corrosion by a renewable wax coating.

This method was selected for use on the Thaddeus Kosciuszko Monument because unlike the more aggressive cleaning methods discussed earlier, walnut shell blasting is a reversible treatment designed to restore the aesthetic qualities of the work of art without removal of original fabric. Waxing provides a maintainable protective coating that will minimize further corrosion damage. Work on the Kosciuszko Monument was undertaken as part of a National Park Service training course on the principles and practices of outdoor sculpture preservation. Nicolas F. Veloz, a National Park Service Cultural Resources Management Specialist, [who was instrumental in developing the

walnut shell cleaning procedure for bronze sculpture] conducted the course.

## Inspection

Aided by the use of a 62-foot hydraulic lift, a careful inspection of the five bronze sculptural groups was made prior to the cleaning to determine if there were any missing or broken parts needing repair or replication, or any structural instability that would require special conservation procedures. The inspection revealed no problems that would require specific measures be taken. Had it been necessary to replicate missing parts, the work would have followed the cleaning in order to ensure a close match of the existing metal coloration. A series of detailed before-work photographs was taken at this time.

## Cleaning the Sculptural Groups

Cleaning began with a pressure washing using hot water (250 degrees Fahrenheit) and a non-ionic detergent at three gallon per minute (gpm) and 300–500 pounds per square inch gauged (psig) (see figure 1). This initial cleaning removed considerable amounts of encrusted bird droppings, twigs and leaves lodged behind sculptural groups, mud daubers' nests, and surface dirt and grime. Once the bronze had dried, cleaning continued with the ground walnut shell blasting, using a pressurized pot sandblaster, a



Figure 1. North sculpture group being pressure washed with detergent and water. Photo: Dennis R. Montagna

twelve-foot “sand hose”, and a 1/4-inch porcelain nozzle. Throughout the blasting, operating pressure was kept low, never exceeding 25–30 psig.

Operators maintained a normal working distance—measured from the nozzle tip to the statue’s surface—of three to six inches as they cleaned the sculptural groups, removing superficial dark grime and pale green corrosion products (see figure 2). An underlying denser layer of darker green corrosion products remained undisturbed. To achieve even cleaning and to avoid missing areas, the operators worked methodically. They tracked slowly, covering a small area of about 6 or 7 inches square at a time and being careful to always maintain a nozzle angle within 30 degrees perpendicular to the often undulating surface of the sculpture in order to obtain thorough and even cleaning.

As it removed surface grime and soft superficial corrosion, the walnut shell blasting procedure produced a smooth, clean surface that appeared darker and more uniform in color. There was also a noticeable reduction in the light and dark streaking that had characterized the surface before cleaning began. As a result, nuances of sculptural form became more easily discernible (see figure 3). The blasting process required approximately 750 pounds of 60/200 mesh ground walnut shells. Because the medium is biodegradable, no special measures were taken to contain or collect it.

Some practitioners of this and similar techniques collect the blasting material in order to reuse it. This is an ill-advised practice. Even if screening devices are employed, the medium becomes contaminated by the abrasive dirt, sand and corrosion products it removes from the sculpture’s surface. Once blasting was completed, the initial washing procedure—using hot water and detergent under pressure—was repeated to remove any residue of dirt, corrosion products and walnut shell material remaining on statue surfaces.

### Application of a Corrosion Inhibitor

After the sculptural groups had dried, they were treated with a two percent solution of the corrosion inhibitor Benzotriazole (BTA) suspended in a 4:1 mixture of hot water and ethanol (see figure 4). The solution was applied using a pump sprayer of the type used by insect exterminators. The



Figure 2. South sculpture group being cleaned with walnut shell blasting.  
Photo: Dennis R. Montagna



Figure 3. Detail of the west sculpture group, depicting a pair of soldiers. Left half of the face has been blasted and presents a more even appearance than the right half, which has not been blasted and exhibits the light/dark streaking common to corroded statuary. Photo: Dennis R. Montagna

initial application was followed by another about thirty minutes later. Areas most exposed to the ravages of the environment—arms, shoulders and heads—received additional coats. Crystalline deposits of BTA were evident in areas where pools of the solution collected, usually in depressions on the plinths. These were rinsed with water before proceeding to the final step in the treatment.

### Application of a Protective Wax Coating

The application and buffing of a protective wax coating was the final step. It was also the most critical one, both for the final appearance of the conserved sculptural work and also for its long-term preservation. The waxing procedure used to treat the Kosciuszko Monument called for the use of propane torches to heat the bronze surface to approximately 175 degrees F, slightly above the melting point of the wax but well below the melting point of the welds used to join bronze sections (see figure 5). While heating areas of bronze adjacent to the granite pedestal, technicians used extreme care to protect the stone from heat. Failure to do so could have seriously damaged the stone's surface by cracking the minerals in the granite.

Once the metal had reached the appropriate temperature, discernible when the applied wax would melt on contact, a prepared mixture of microcrystalline waxes, mineral spirits and BTA was applied sparingly with short bristled natural brushes (See Project Data section for components of the wax). To apply the wax, a scrubbing or jabbing motion was used to insure thorough coverage in corrosion-produced pits and irregularities in the surface that had resulted during casting. Once the bronze had received a coating of wax, it assumed a much darker green-brown color, a semi-glossy surface, and an overall uniformity of appearance far beyond that produced by the earlier walnut shell blasting (see figure 6). A second coating of wax was applied using the same method described above. The technicians found that less heat from the torches was needed during the second waxing. Because the sculptural groups had darkened with the first application, they attracted more solar radiation and therefore reached the necessary working temperature more rapidly. In addition, the technicians were careful not to apply excessive



Figure 4. Solution of Benzotriazole (BTA) being sprayed onto the Kosciuszko portrait atop the monument after cleaning with walnut shells. Photo: Dennis R. Montagna



Figure 5. Heating the surface of the west sculpture group in preparation for the application of wax. Photo: Dennis R. Montagna



**Figure 6.** Detail of the Kosciuszko portrait. The chest and inside section of the arm has received its first coating of wax. The outside section of the arm has not.  
Photo: Dennis R. Montagna

heat that would have burned previously applied coats of wax.

The second waxing served two purposes. Primarily, it provided a thicker and more durable protective layer. In addition, it enabled the technicians to detect and fill any areas they may have missed during the initial waxing. After completing the second wax coating, the statues were allowed to cool, expedited by being sprayed with water from a garden hose. Once they were cool and dry, a final paste wax coating was thinly applied without using heat. Soft brushes and damp terrycloth rags were used to apply the paste in much the same manner one would use to wax an automobile. Allowed to cool overnight, the final wax coat was lightly buffed to a gloss with barely damp terrycloth towels (see figure 7). Like the additional coating of BTA discussed earlier, the final application of a cold wax concentrated on the more highly exposed areas that were subject to greatest atmospheric degradation. The final waxing also helped to remove any brushstrokes that may have remained from the two hot waxings (see figure 8).



**Figure 7.** East sculpture groups being buffed after it had received its final wax coating.  
Photo: Dennis R. Montagna

## Maintenance

The preservation of the Kosciuszko Monument can only be insured by implementing a regular maintenance program. This is particularly important since the expected service life of the wax coating is 1–3 years, depending on exposure and the climate. The maintenance program should include a yearly inspection of the monument followed by a light washing with non-ionic detergent in cold water and a reapplication of wax wherever it is needed, usually on those areas that are most exposed to weathering.

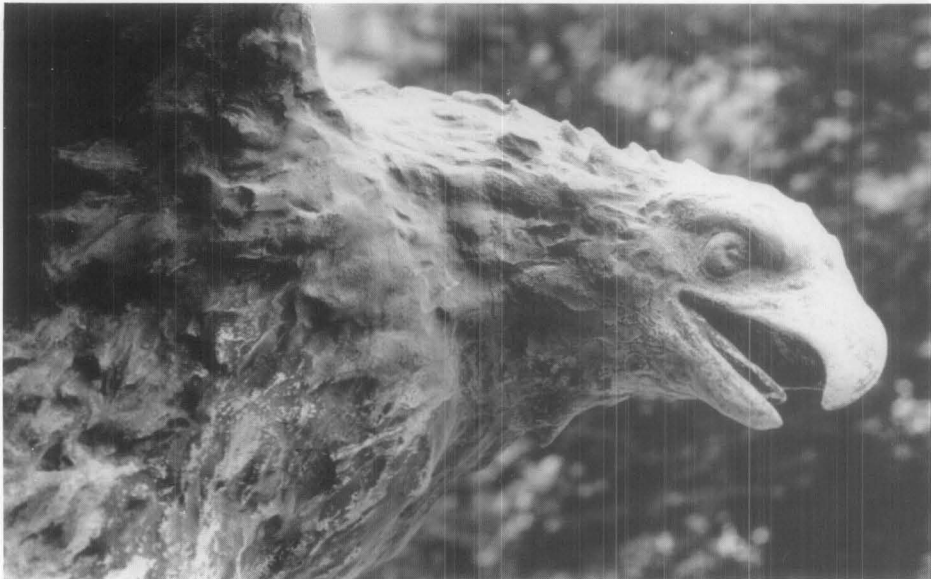
The treatment described here is largely a reversible one. Without an ongoing maintenance program designed to renew the wax, the metal will become exposed to the weather, the

corrosion process will become active once again, and the monument will eventually assume much the same green corroded appearance it possessed before any cleaning took place.

In June 1988, the bronze groups comprising the Kosciuszko Monument received their first annual inspection and subsequent maintenance. The inspection revealed that the wax coating remained in good condition except on those areas most exposed to the environment—shoulders, the tops of heads, and other similar areas (see figure 9). As anticipated, with little of the protective wax remaining, these areas had assumed a matte appearance and were beginning to return to a paler green color. After the inspection, all of the bronze groups were washed with a non-ionic detergent in cold



a. Before



b. During



c. After

Figure 8. Details of the eagle's head from the south sculpture group: (a) before cleaning began, (b) following walnut shell blasting, (c) following final waxing and buffing.

Photos: Dennis R. Montagna

water. Wax was then reapplied to the areas that had suffered degradation by using the hot waxing procedure that had been used during the initial work the previous summer. A cold paste waxing and buffing of all bronze surfaces then followed, carried out at ambient temperature.

### Evaluation

With the measures taken to clean and wax the bronze statuary of the Kosciuszko Monument, the statues regained the uniform color and the metallic sheen they had possessed before being subjected to years of neglect and the vicissitudes of a hostile environment (*see figure 10*). Moreover, with regular low-cost maintenance, these statues can be protected from further environmental degradation. Unlike other cleaning methods that remove all existing corrosion, those described here represent minimal intervention and, in accord with accepted conservation standards, are reversible.



Figure 9. Detail of Kosciuszko's right epaulet [photo taken in June, 1988] showing degradation of the wax coating that occurred during the year following its initial cleaning and waxing. Photo: Philip Walsh



Before



After

Figure 10. These two views, taken before and after the conservation work, reveal how the aesthetic qualities of the original bronze sculpture have been restored, using walnut shell blasting, without removal of original fabric that is common in more aggressive cleaning methods.  
Photos: Dennis R. Montagna

## PROJECT DATA

### Monument:

Memorial to Brigadier General  
Thaddeus Kosciuszko  
Northeast corner of Lafayette Park,  
Washington, D.C.

### Owner:

National Park Service  
U.S. Department of the Interior  
Washington, D.C.

### Project Dates:

June 2–19, 1987 (Initial cleaning and  
preservation)  
June 14–16, 1988 (First annual  
maintenance)

### Project Supervisor:

Nicolas F. Veloz  
Cultural Resources Management  
Specialist  
George Washington Memorial  
Parkway, NPS  
McLean, Virginia

### Project Staff: (1987)

Richard Brown, Exhibit Specialist,  
Antietam National Battlefield Park,  
NPS

Morgan Ellis, Maintenance Worker,  
President's Park, NPS

Tim Fazenbaker, Carpenter  
Gettysburg National Military Park,  
NPS

Jessie Mallard, Sandblaster  
National Capitol Park-Central, NPS  
Dennis R. Montagna, Architectural  
Historian  
Mid-Atlantic Regional Office, NPS

### Project Staff: (1988)

Philip Walsh, Supervisory Park  
Ranger  
President's Park, NPS  
Maura Vaughn, Park Ranger  
President's Park, NPS

### Major Equipment:

62-foot Marklift hydraulic lift  
Ingersol-Rand 100 cfm diesel-powered  
compressor  
Chem-X Pacer pressure washer  
Sandblasting unit (Lindsey 35)

### Materials:

Igepal CO-630 [non-ionic detergent]  
Agrashell AD 10.5-B  
[pulverized walnut shells]  
Cobratec 45-1 [Benzotriazole (BTA)]  
Barico Victory Brown and Victory  
White [waxes]  
Polywax 2000  
Carnuba wax  
Cosmolloid 80-H microcrystalline wax

### Project Costs:

The cost of labor, materials and rented  
equipment to clean and wax the five  
sculptural groups that comprise the  
Kosciuszko Monument is estimated at  
\$8,000. Annual maintenance of the  
monument—including the inspection,  
photographic documentation,  
detergent cleaning, and renewal of the  
wax coating—cost approximately  
\$600.

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PRESERVATION TECH NOTES are designed to provide practical information on innovative techniques and practices for successfully maintaining and preserving cultural resources. All

techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act Amendments of 1980 which direct the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

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