



Best Practice Recommendations for Cleaning Government Issued Headstones¹

This document was developed as general guidance for the cleaning of government issued headstones based on research undertaken by the National Park Service National Center for Preservation Technology and Training and funded by the Department of Veterans Affairs National Cemetery Administration. Recommendations are intended to be used by cemetery directors, operations staff, foremen, maintenance staff, contractors and headquarters staff. The document focuses on general cleaning and regular maintenance of marble headstones that are soiled from dirt and biological growth. Recommendations do not address cleaning needs from unusual events such as removal of road tar, mower scars, vandalism, or other accidental damage. Cleaning recommendations for other stone types such as granite, sandstone, or limestone are not presented here.

One of the critical components of maintaining the appearance of a national cemetery is the cleaning of headstones. Many of the more than 3 million gravesites in 131 national cemeteries are historic headstones and markers which should be protected and treasured. Also, today's new headstone will be tomorrow's historic grave marker.

Headstone cleaning must take into consideration the operational standards set forth by the National Cemetery Administration. [1] The following standards are among those designated for headstones:

- Headstones, markers, and niche covers are clean, free of debris and objectionable accumulations.
- Headstones, markers, and niche covers are not damaged by cemetery operations (e.g., interment, grounds maintenance, headstone, marker, niche cover, maintenance, and facility maintenance operations).

Maintenance practices must have an eye toward the future. Many cleaning methods may be able to remove soiling from headstones. Some will be more effective than others. But the long-term effects must also be considered. Anyone developing a cleaning method must look at the soiling agent to be removed, the potential threats caused by the soiling, and the possible unintended results of cleaning.

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Soiling Agents or Accumulations

Soiling agents are accumulations on stone that alter the appearance of the stone and may cause additional damage. Different soiling agents may respond better to a particular cleaning method. Soiling agents include:

- **Dirt**, including soil and mud, often arises from transferring the topsoil to headstone surface. Dirt can lead to dark staining on the surface or an overall dingy appearance. Dirt can penetrate into the pores of the stone and be difficult to remove. Minerals containing iron can leach into the marble surface and leave rust colored stains behind. If the headstone has sunk into the ground over time, then is raised and realigned, a distinct line of soiling can be seen. Dirt can retain moisture after rainfall and lead to the growth of mold or mildew on the stone surface.
- **Air pollution**, including particles from vehicle exhaust, can deposit on the surface of marble. Nearby factories or industrial activities can generate pollutants that can change the appearance of the stone or chemically interact with the stone over time. For example, sulfur dioxide produced through manufacturing processes and vehicle exhaust can interact with marble surfaces to cause gypsum crusts. These crusts can capture soil and pollution particles to create rough, gray surfaces.[2]
- **Biological organisms**, such as bacteria, mold, mildew, algae, mosses, or lichen can adhere to the headstone and result in appearance changes. Microorganisms are capable of establishing a biofilm on the surface of the stone. Biofilms include proteins and sugars that are hard to remove through standard cleaning practices and provide food for regrowth of organisms.[3] Bacteria can consume air pollutants and produce acids that can attack the stone. Fungi can penetrate the pore system of stone and carry bacteria further into the stone.[4]
- **Bird droppings** or other animal secretions can stain the stone. Depending on the animal's diet, the stains may be difficult to remove. Urine seeps into porous materials and with time produces yellow stains.
- **Plant or tree sap** is a sticky substance that drips from overhanging trees. The material may contain resins that are not easily dissolved in water. The sugars in the sap may attract insects or provide food for molds and mildews. Shrubs have falling berries that can stain surfaces.

Other threats to headstones

- **Salt damage** can cause disintegration of a stone surface. The presence of salts within the stone, in the grounds surrounding the stone, in irrigation water, in some herbicides, and in some cleaners, can migrate through the stone's porous network and cause damage. Salts are dissolved and transported by water. They can recrystallize and exert pressures in the pores that may exceed the strength of the stone.[5, 6] Thus, do not use cleaners that leave behind salts to clean marble headstones.
- **Freeze thaw cycles** can increase stone weathering. Water can enter into openings, cracks, and pores of stone. If freezing temperatures exist, the water can freeze and expand. With many freeze thaw cycles, water can damage stone.[7] Since most cleaning efforts require saturating the stone with water or liquids, do not clean headstones during freezing temperatures or when a freeze is expected within 48 hours of the cleaning.
- **Improper cleaning** can stain the surface or accelerate stone deterioration. Well-meaning but ill-informed custodians of cemetery headstones do damage through poor selection of cleaning methods. This would include use of power-washing equipment too close to the stone, not rinsing after application of cleaner, and using products in a greater strength than the manufacturer recommends.

Important factors to consider

- **Use the gentlest, least invasive method**
Select cleaning methods and materials that, to the best of your knowledge, do not affect the headstone. Chemicals and physical treatments should be undertaken using the gentlest means possible to insure the longevity of the headstone and to minimize the need to replace the stone.
- **Do no harm to the stone**
Do no harm to the headstone during its care or the care of the cemetery. A headstone is placed on a soldier's grave as a marker to identify burial site, but serves other roles as well. It is intended to honor the deceased and thus should be treated with respect. Over time the headstone takes on meaning to the loved ones who visit. By its very nature, it possesses added value and association to the veteran's service.

- ***Consider long-term effects***

Recognize that cleaning efforts are part of a continuum of cleaning that will be applied to the headstone. All efforts to clean headstones affect the surface in ways that are not always obvious. Marble is made up of interlocking grains of carbonate mineral which is bound together in a network that includes varying amounts of pores. When the surfaces are cleaned, some of the grains can be loosened and lost. Sometimes the mineral binder that holds the stone together can be affected. Over time and many cleaning campaigns, the surface can be altered noticeably and result in a sugaring appearance. Some marble is more prone to this type of deterioration than others. For example, Colorado Yule marble is more affected by cleaning than Cherokee White marble from Georgia.

- ***Don't remove the original surface***

The original surface may be polished and smooth. The inscriptions are generally carved into the headstone. If the original surface is altered, the way the headstone subsequently weathers may be changed. As the surface roughens, it will soil more easily. The inscriptions can be eroded away, making the headstone harder to read. Never aggressively scrub the surface, or use wire brushes or mechanical methods such as sanders or grinders to clean the surface. See also –mechanical cleaning: power tools, below.

- ***Minimize cleaning impacts***

Minimize the number of times a headstone is cleaned in its lifetime. While a cyclic maintenance plan is needed to maintain the appearance of the headstone, over-cleaning should be avoided. If possible, historic headstones should not be cleaned more frequently than once a year.

- ***Test cleaner first***

ALWAYS TEST the cleaner for suitability and results before overall cleaning. Conduct the test using the recommended application procedures. Let test area dry thoroughly before inspection. When using a biocidal cleaner, it may take several days before the full cleaning effect is realized. When practical, allow two or more weeks for biological soiling to disappear.

- ***Consider Environmental Conditions***

Environmental conditions may dictate the frequency of cleaning. For example, headstones that are located in shady and damp areas under trees may need to be cleaned more frequently than headstones in sunny areas.

Cleaning techniques known to damage stone

- ***Bleach or bleach-like products***

Household bleach or other oxidizing cleaners, such as Daybreak cleaner or HTH Shock 'N Swim pool treatment may chemically react with the stone surface and leave soluble salts in the pores of the stone which will lead to decay. Check the label of the cleaner or the Materials Safety Data Sheet (MSDS) for active cleaning ingredients. If the products contain sodium hypochlorite (NaClO), sodium perborate, sodium percarbonate, sodium persulfate, tetrasodium pyrophosphate, calcium hypochlorite or urea peroxide, do not use them for cleaning the headstone. For example, Daybreak cleaner contains 14% sodium hypochlorite and is not recommended.

- ***Strong acids or bases***

Strong acids, including muriatic acid, hydrochloric acid, or others are too harsh and will dissolve the stone surface. Because they are corrosive, they can also be hazardous to workers. Strong bases, such as concentrated ammonia, sodium hydroxide, calcium hydroxide, potassium hydroxide, or others may be aggressive on the surface of the stone and may be hazardous to workers.

- ***Mechanical cleaning: Power tools***

Harsh mechanical devices such as sand blasting, or power tools such as sanders or drills equipped with a wire brush remove the original material of the grave marker.

- ***Mechanical cleaning: High-pressure washing***

Pressure washing systems are mechanical sprayers that use water under high pressures to clean surfaces. Commercially available pressure washers operate at pressures between 750 psi and 30,000 psi that will damage marble headstones. This technique can cut into and mar the surface of the stone. The appropriate distance and pressure needed to properly clean an individual headstone is generally about 12 inches with a pressure of 500 psi or less. Some stones may not be able to tolerate these conditions depending on their condition. A test patch in a small unobtrusive area on the headstone is recommended prior to cleaning.

Cleaning methodology

A cleaning regimen for headstones should be based on environmental considerations such as humidity, biological growth rates, tree cover and vegetation, precipitation and other factors that influence the frequency of cleaning necessary to maintain an appropriate appearance.

- ***Choosing the cleaner***

Cleaning should be undertaken with the mildest, least-abrasive method. Improper cleaning can lead to accelerated deterioration or loss of original materials. Always begin by reviewing the Materials Data Safety Sheet (MSDS) for any chemical product to be used. The MSDS may be found by searching online or by contacting the manufacturer or distributor. The MSDS contains important chemical information and necessary safety precautions needed for use of the product.

Make sure to note the manufacturer's application recommendations. The two most important features to note are the dilution ratio and the dwell time. If the manufacturer recommends diluting the cleaner, use the recommended dilution ratio. A small amount of the cleaner should be added to water to create the required ratio. Using the cleaner in a more concentrated form may increase the risk of damage to the headstone. The dwell time is the amount of time that the cleaner is left on the surface of the stone before scrubbing and rinsing the stone. The dwell time varies depending on the cleaner.

Biocidal cleaners are available for use on stones that have biological growth, such as algae, mildew, moss, and lichen. Most biocidal additives also help to keep biological from returning to the stone for an extended period of time. Recommended biocidal cleaners include **D/2 Biological Solution** manufactured by Sunshine Makers,² Enviro Klean® BioWash®,³ or other cleaners that contain quaternary ammonium compounds. Consult with the product manufacturer to determine if the biocidal cleaner contains buffers that may leave salts behind on the stone. Follow directions as specified by the biocide manufacturer, making sure to rinse thoroughly. It is important to know that marble cleaned with biocides should continue to lighten over the next few days. The advantage of a biocidal cleaner is that it helps remove a wide range of soiling including

biological growth. The disadvantage is that the cleaners are more expensive than other products on the market.

- ***Equipment needed***

Personal Protective Equipment

While no special equipment is required under normal use, gloves and eye protection are recommended. Avoid eye contact where splashing of the cleaner may occur, such as during spray applications. Wash hands thoroughly after handling any cleaner and before eating, drinking or smoking.

Brushes

Soft bristle brushes are required when cleaning stones. They can have natural or synthetic bristles. Vegetable brushes or soft grooming brushes for large animals are a few that can be found in chain or farm supply stores. All rough or metal edges must be covered with tape to reduce the chance of scratching the stone.

Hand or Backpack Sprayers

A variety of hand-pump sprayers can be used for cleaning headstones. Make sure that the sprayer is dedicated to the cleaners to be used and not used for other functions like applying pesticides. Backpack sprayers are useful when cleaning a large number of headstones typical in the national cemeteries. These consist of a holding tank, hose, and wand with adjustable nozzle. The sprayers generally operate in a 15-80 psi pressure range.

Clean Water

One of the most important things to locate in the cemetery is the nearest source of water. It takes a lot of water to properly clean stone. If the cemetery does not have clean running water then it is important to bring barreled or bucketed water to the site.

- ***Pre-wetting the stone***

Soak the stone liberally with water before applying the cleaner with a hand or backpack sprayer. Stone is a very porous material and will absorb the cleaner. By soaking it beforehand, the cleaner will stay on the surface of the stone and minimize penetration of the cleaner in to the stone. This action minimizes potential adverse effects by the cleaner, such as salt crystallization in the pores of the stone. It makes it easier to rinse the cleaner from the stone surface.

- ***Applying the cleaner***

Always keep the stone wet during cleaning and thoroughly rinse afterwards. Do not allow the cleaner to dry on the stone. Apply the cleaner according to the manufacturer's recommendations. Changes to the dilution or dwell time are considered "off-label" and the effectiveness of the cleaning method cannot be guaranteed. Evenly apply the cleaner with a sprayer to saturate the surface.

- ***Agitating the surface***

Agitate the surface gently in a circular motion using a soft bristle brush. Work in small areas, starting from the bottom and moving toward the top of the headstone. Agitation will loosen soiling from the surface of the stone.

- ***Rinsing the stone***

Remember to rinse after cleaning each area and to thoroughly rinse the stone at the end to make sure that no cleaner is left behind.

A typical cleaning regime may include a three-person team. The first person thoroughly wets the stone with clean water using a hose or a portable backpack sprayer. A second person sprays the stone surface with the biocidal cleaner. After the appropriate dwell time, a third person gently agitates the cleaner on the stone surface with a soft bristle brush, then rinses the stone with clean tap water.

Glossary of Terms

Ionic cleaner: A substance that aids in the removal of dirt and serves as an emulsifier by bridging between water and oil. The substance is a long chain chemical that has a charge on one terminal.

Non-ionic cleaner: A substance that is similar to an ionic cleaner, except that it does not have a charge.

Surfactant: A compound that is a surface active agent. It reduces the surface tension between liquids that do not normally mix together. It aids in the cleaning of a surface.

Biocide: A chemical capable of killing living organisms.

Pressure washer: a mechanical sprayer that uses high-pressure water to clean and remove dirt and other accretions from surfaces and objects.

Dilution ratio: reduction of the concentration of a chemical by mixing with water or another solvent by a specific portion. A useful reference chart for specific dilution ratios can be found at http://www.tomorrowchemicals.com/files/Dilution_Ratios_TC.pdf.

Dwell time: The time a cleaner remains on the surface of a stone before agitation or rinsing.

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