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Standard Guide for Cleaning of Exterior Dimension Stone, Vertical And Horizontal Surfaces, New or Existing¹

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1. Scope

1.1 This guide describes materials and procedures which may be used to clean dimension stone exteriors as well as the conditions under which they may be used. It is intended to aid owners, maintenance supervisors and building managers, architects and engineers, and contractors in cleaning vertical exterior dimension stone on commercial, residential and institutional structures. This guide may also be helpful to those who wish to clean stone masonry on bridges, retaining walls, ramps, and plazas, and free-standing stone objects such as statuary, memorials and grave markers.

1.2 This guide relates primarily, to routine maintenance of the surface finish of exterior dimension stone. The techniques noted herein may not be appropriate or cost effective with regard to restoration of disfigured, severely soiled or stained stonework, or of stonework of particular historic importance. In cases where staining occurs on surfaces which have cultural, civic, historic or architectural significance, consultation with a specialist is recommended.

1.3 The user of this guide should also obtain and have on file at both the job site and the office Material Safety Data Sheets (MSDS) describing the nature of all chemical products utilized during the cleaning process.

1.4 A file of literature from the manufacturers of all products involved within the scope of each project should be available for reference.

1.5 These procedures are not intended for interior stonework.

1.6 This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to repre-

sent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

C119 Terminology Relating to Dimension Stone

C503 Specification for Marble Dimension Stone

E1971 Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings

3. Terminology

3.1 Terms used in this guide are defined in Terminology C119.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *exterior dimension stone*—a general term for a stone installed in a location where temperature, moisture and wind-carried contaminants are regulated solely or primarily by the forces of nature.

3.2.2 *qualified contractor*—a person, persons or organizations having expertise in stone cleaning, proved by documented projects demonstrating successful work, consistency in business or consultancy for a period of five or more years.

¹ This guide is under the jurisdiction of ASTM Committee C18 on Dimension Stone and is the direct responsibility of Subcommittee C18.07 on Environmental Properties, Behavior, and Cleaning.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4. Significance and Use

4.1 Exterior dimension stone is chosen for use in contemporary architecture in part because of its aesthetic appeal. Aesthetics can be significantly diminished when dirt, grime, fly ash, algae and other contaminants collect on the surface of stone.

4.2 This guide is intended to assist those who wish to preserve the original appearance of a new structure or to return a stone-clad building to its original color and appearance.

4.2.1 Note that cleaning may not be able to return discolored or faded stone to its original appearance.

4.3 This guide may be used as a construction document.

5. General Information

5.1 Exterior stone is used in honed, textured, or polished finishes in many modes in exterior environments. However, trade experience discourages the use of a polished finish marble or limestone on exterior applications due to susceptibility to damage by acids in rain or snow, and by wind-driven dirt particles.

5.2 The use of dark colored marbles and limestones for exteriors is discouraged because fading in direct sunlight has been experienced. Discolored or faded stone may not be able to be returned to its original color by cleaning.

5.3 Only marbles with an “A” Soundness Classification should be used for exterior installations. An exception is travertine marble (“C” Soundness Classification) which may be installed with its natural voids either filled or unfilled. See Specification **C503** for soundness classification of marbles.

5.4 Stone installed in a mortar bed should be allowed to cure properly. Do not apply surface treatments to stone set horizontally in a mortar bed for at least four weeks following installation.

5.5 Carefully identify all wet pedestrian areas with barricades, “danger” signs or bright red or orange-colored “danger” pylons.

5.6 Always test any cleaning method on a sample area to determine its effectiveness. Always refer to the manufacturer’s instructions.

5.7 When choosing the materials and procedures for cleaning dimension stone, the most appropriate materials and procedures should be chosen to promote eco-efficiency and avoid adverse impacts on humans, the structure itself, and the environment, see Guide **E1971**. The alternative cleaning processes, cleaning products and their storage, use, and disposal, equipment choices, and training of personnel involved in the work need to be assessed.

5.7.1 Certain pertinent questions should be considered here: (1) how is the building used? (2) are there any special cleaning requirements caused by the type or finish of dimension stone used? If so, identify the cleaning task and performance requirements, (3) are there any at-risk human populations to consider? (4) are there any issues relating to building age or architecture? (5) what criteria or measures will be used to evaluate the quality of cleaning and repairs?

6. Normal Maintenance

6.1 In accessible areas, routinely follow maintenance procedures as specified for Polished Stone, Honed Stone or Textured Finish Stone as applicable. The large expanses of stone traditionally found on exterior multi-story installations should be cleaned as often as necessary to remove accumulated pollutants.

6.1.1 A practice as simple as a hosing down with potable water on a regular basis will prevent accumulation of dust and acidic deposits left by rain or snow.

6.1.2 The cleaning of stone should be done only by qualified contractors who have the craftsmen, equipment, resources, and technical expertise to do the work, as well as make any repair, resetting, or repointing that may be necessary.

6.1.3 Generally, the processes used in multi-story cleaning will be similar to normal procedures, except that pumps for pressure wash, or steam and rinse water may be employed to economize on the amount of time necessary to the work.

6.1.4 Consult material suppliers and qualified contractors to obtain their recommendations for maintenance, materials or repairs.

6.1.5 Always test any cleaning method on a sample area to determine its effectiveness. Always refer to the manufacturer’s instructions.

6.1.6 Always try the least aggressive cleaning media (potable water) first.

6.1.7 Evaluate project conditions with regard to required protection of adjacent properties and public safety. The protection needed for cleaning multi-story structures will differ from that needed for one or two-story buildings.

7. Polished Dimension Stone

7.1 Polished Stone has a glossy surface that reflects light and emphasizes the color and markings of the material.

7.1.1 Normal maintenance involves only periodic washing with clean, potable water and neutral (pH7) cleaners. “Soapless” cleaners are preferred because they minimize streaking and filming. Abrasive cleaners should be avoided.

7.1.2 Stone surfaces should first be wetted with clean, hot (not boiling) water. Then, using the cleaner solution (following manufacturer’s directions) wash in small, overlapping sweeps from top down, or follow manufacturer’s directions if different. Rinse thoroughly with clean, potable water to remove all traces of soap or cleaner solution. If rinsing is done by hand, change the water in the rinse pail frequently. Dry with a soft cloth, cotton flannel or chamois, wiping carefully to avoid streaks. The surface may also be allowed to air-dry.

7.1.2.1 **Warning**—Do not use bleach, acid, or strong alkali solutions on marble or limestone because colors may be lightened and the surface etched.

7.1.2.2 Select a cleaning agent which suits the nature of the stone.

8. Honed Dimension Stone, Normal Maintenance

8.1 A honed finish is a satin smooth surface with relatively little light reflection.

8.1.1 Normal maintenance of a honed finish involves as-needed washing with clean, potable water and neutral (pH7), mildly abrasive cleaners.

8.1.2 Surfaces should be first wetted with hot, clean water. Then, using a mildly abrasive, alkaline cleaner and a medium natural bristle brush, wash in overlapping, swirling strokes. Work from top down or follow manufacturer's directions if different.

8.1.3 Rinse thoroughly then wipe dry with cotton, cotton flannel, or a chamois. Wipe carefully to avoid streaking. Optionally, the stone may be allowed to air-dry.

8.1.4 If further cleaning is needed, make a paste to the consistency of thick syrup by combining a mildly abrasive alkaline cleaning powder and clean, potable water. Apply the paste uniformly over the surface with a broad brush and allow to stand until dry. Then, use a medium bristle brush with additional water and scrub vigorously. (More cleaning powder may be applied at this point.) Rinse thoroughly and dry as described above. Follow manufacturer's directions.

8.1.4.1 See 10.1 and 10.3 for poultice information.

8.1.5 **Warning**—Do not use bleach, acid, or strong alkali solutions on marble or limestone because colors may be lightened and the surface etched.

8.1.5.1 Select a cleaning agent which suits the nature of the stone.

9. Textured Finish Dimension Stone, Normal Maintenance

9.1 Examples of textured finish dimension stone include Thermal Finish Granite, Thermal Finish Limestone, Unfilled Travertine, Rock Face, Split Face, Natural Cleft Slate and Natural Cleft Quartz-Based (Sandstone) Stone. Abrasive, bush-hammered, and sand-blasted finishes are also included in this category.

9.1.1 Regular maintenance becomes difficult if dirt is allowed to accumulate on the uneven surfaces of these stones. If convenient, textured finished stone may be vacuumed clean.

9.1.2 Normal maintenance of textured finish stones involves as-needed washing with clean, potable water and neutral (pH7), mildly abrasive cleaners.

9.1.3 Surfaces should first be wetted with hot, (not boiling) clean water. Then, using a mildly abrasive, alkaline cleaner and a medium bristle brush, wash in overlapping, swirling strokes. Work from top to bottom. Rinse thoroughly with clean water.

9.1.4 **Warning**—Do not use bleach, acid, or strong alkali solutions on marble or limestone because colors may be lightened and the surface etched.

9.1.4.1 Select a cleaning agent that suits the nature of the stone.

10. The Poultice Method

10.1 The Poultice Method is a special cleaning procedure for removal of deep-seated, time-set dirt and grime. The poultice may be applied to honed or textured stone, and is particularly useful on intricate carvings, moldings and other detailing difficult to scrub.

10.1.1 The poultice is essentially a strong fluid cleaner, applied by way of a holding medium with a film or membrane, that concentrates its effort over a period of time.

10.1.2 The mechanism within this practice relies on the ability of the poultice to reliably wick a fluid out from the stone fabric, carrying the staining agent with it. The staining agent is effectively drawn out backwards on the same path that it entered the stone.

10.1.3 The fluid must be capable of dissolving the staining agent and may be water based or solvent based, depending on the origin of the stain. The fluid may have additional chemicals added to further increase its effectiveness. Water, hydrogen peroxide, acetone, and mineral spirits are commonly used fluids.

10.1.4 Holding mediums are powders such as clays, Fuller's earth, talc, diatomaceous earth, baking soda, and even flour. Cloth or paper products, such as cotton balls, paper towels, and gauze pads can also be used as a holding medium.

10.2 The poultice medium is saturated with the fluid, and when placed on the stone surface, allows the fluid to penetrate the stone. As the poultice medium starts drying, it has a greater affinity to draw the fluid than the stone has ability to retain the fluid. This causes the fluid to wick backwards into the poultice medium, carrying the staining agent with it.

10.2.1 A plastic film or membrane is generally required to be placed over the poultice, which will control the rate of evaporation. If the fluid is allowed to evaporate too quickly, there may be ample opportunity for it to dissolve the stain prior to evaporation.

10.3 Preparation and Application of a Typical Poultice:

10.3.1 Mix kaolin or Fuller's earth with either a common laundry bleach or a commercial hair-bleaching solution of hydrogen peroxide (H_2O_2) to form a paste the consistency of peanut butter or cake icing. (For estimating purposes, figure a consumption rate of one pound of paste per square foot of surface.)

10.3.2 Moisten the surface of the stone with the same liquid used to make the paste, wetting beyond the extent of the stained areas.

10.3.3 Apply the poultice paste to the stone with a wooden or plastic spatula, ensuring a uniform coat about 1/4-in. (0.635 cm) thick. Cover the entire area to be cleaned and somewhat beyond to prevent the soil from being forced into the clean stone. Ensure the poultice is in full contact with the stone with no entrapped air pockets or voids.

10.3.4 Tape plastic sheeting over the poulticed area to prevent quick drying-out and to allow it to act for 48 h.

10.3.5 After this standing period, dampen the poultice with clean, cool water to prevent undue dust generation. Remove the poultice with a wood or plastic spatula to avoid scratching. Rinse the cleaned area thoroughly with clean water; blot or wipe off excess water; allow it to dry.

10.3.6 When water-spotting has disappeared after complete drying, inspect for remaining soil. A second poultice application may be necessary.

10.4 Commercial "Marble Poultice" base powders are available.

10.4.1 Poultice products are also available commercially through stone equipment supply catalogs. Generally, these are

sold pre-mixed in gel form, and are usually specific to the type of stain that is intended to be removed.

10.4.2 With any commercial poultice, read and follow the manufacturer's directions.

10.5 Warnings:

10.5.1 Do not use poultice containing additives (such as bleach or solvent) other than water on dark colored stone.

10.5.2 A poultice applied to polished finish marble will dull the surface, requiring repolishing.

10.5.3 The poultice is used primarily to attack and reduce heavy deposits of normal soiling, or to remove stains resulting from the action of moisture on normal soiling.

10.5.4 For stains resulting from a known origin, see Section 13.

11. Graffiti Removal

11.1 Graffiti is writing or drawings that have been scribbled, scratched, or sprayed illicitly on a wall or other surface in a public place. Graffiti ranges from simple written words to elaborate wall paintings.

11.2 One of the keys to preventing the recurrence of graffiti is prompt removal. The graffiti artist will be reluctant to paint in an area or on a building where the graffiti is quickly removed and not seen by many people.

11.2.1 Studies have shown that removal within 24 to 48 h results in a recurrence rate of nearly zero.

11.2.2 An additional benefit of promptness is that the paint will not have had time to fully cure and will respond more favorably to removal methods.

11.3 Paint, particularly spray paint, and marker pens are the most commonly used graffiti materials.

11.3.1 Spray paints consist of a colored pigment suspended in a binder/solvent mixture. When applied, the solvent evaporates, allowing the binder to attach the pigment to the masonry.

11.3.2 Binders can be enamel, acrylic, polyurethane, or latex based. The most widely used graffiti spray paints commonly use some form of acrylic binder.

11.3.3 Identifying the type of spray paint and its binding agent will make it easier to choose a removal process.

11.3.4 The most difficult colors to remove are black and reds because the pigments for those colors tend to be small and can get deeper into the stone substrate.

11.4 Identification of the stone type is also important.

11.4.1 The porosity and absorption properties of the stone are good indicators of the difficulty of graffiti removal. More porous and more absorptive stones will allow the pigment to penetrate into the stone making removal very difficult.

11.5 Typically, graffiti is most easily removed from hard stones with a polished finish. Granites and some of the harder marbles fall into this category. However, some stones, usually used on interiors, achieve a polish by the use of chemicals or waxes. The chemical used for the polish can be damaged by the solvent in the spray paint. The whole stone may have to be re-polished to achieve a match to surrounding stones.

11.6 Flame finished stone is more difficult to treat than polished, but if the grain structure is tight, the graffiti can still be effectively removed.

11.7 Sandstones do not tend to allow the paint to bond well because of their silica base, but the paint can still be trapped between the grains of the stone, causing a shadow or outline of the original drawing.

11.8 Softer stones, such as limestone and some of the travertines, are the most difficult and can require a solvent to penetrate into the pores to dissolve the pigment and draw it out of the stone. Several treatments with a poultice (as outlined in Section 10) may be required to reach an acceptable appearance.

11.9 Several graffiti removal methods are available. They are, in order of least to most aggressive:

11.9.1 pressure washing with water,

11.9.2 detergents,

11.9.3 poultices with organic solvents or alkaline compounds,

11.9.4 bleaches, and

11.9.5 pressure washing with an abrasive medium.

11.10 To avoid damage to the stone, cleaning should start with a gentle procedure and work toward the more aggressive solutions.

11.11 Low-pressure water should be the first treatment tried. If the paint is not more than a day or two old, low-pressure water will generally not harm the stone and will remove most of the not yet fully cured paints and markers. The guidelines for pressure washing in Section 12 must still be followed.

11.12 If low-pressure water does not remove the graffiti, detergent with a stiff bristle brush should be tried next.

11.12.1 The stone should be thoroughly wetted and the detergent applied to the affected area by scrubbing with a stiff bristle brush.

11.12.2 A wire brush should never be used as it will damage the finish.

11.13 If there is still an apparent stain after pressurized water cleaning and scrubbing with a detergent, then a poultice should be applied. See Section 10 on Poultices.

11.13.1 Poultices can be used with a myriad of solvents to soften the binding agent in the paint and draw out the pigments from the stone.

11.13.2 If the poultice is tried before pressurized water, the volume of the pigment available can cause the solvent to drive the pigment deeper into the stone making removal much more difficult.

11.13.3 Stone can be damaged by a solvent that attacks the bonding agent in the stone itself. Some stone reacts negatively with alkali solvents.

11.13.4 A stone consultant with experience in graffiti removal should be consulted before any aggressive technique is tried.

11.13.5 If at all possible, any removal method should be tested in a low traffic area to verify that the chosen method does not damage the stone.

11.14 Sometimes, an organic bleach compound can lighten the remaining shadow of the paint to an acceptable level. The