Designation: E 1857 – 97

An American National Standard

Standard Guide for Selection of Cleaning Techniques for Masonry, Concrete, and Stucco Surfaces[1]

This standard is issued under the fixed designation E 1857; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide outlines procedures for the selection and assessment of cleaning techniques for removing soiling and staining from masonry, concrete, and stucco surfaces. Removal of paints, coatings, and graffiti may require measures beyond the scope of this guide. New construction is excluded from the scope of this guide.

1.2 This guide does not purport to address the causes of soiling or staining or to propose remedies for recurring soiling or staining.

1.3 Where work on surfaces of artistic, architectural, cultural, or historic significance is being considered, guidance from specialists should be sought.

1.4 This guide does not purport to address removal and replacement of prior repairs, repair of damaged surfaces, or other irregularities that contribute to the uneven or discolored appearance of masonry, concrete, and stucco surfaces.

1.5 *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 limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 43 Terminology of Structural Clay Products[2]

C 119 Terminology Relating to Dimension Stone[3]

D 4262 Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces[4]

E 631 Terminology of Building Constructions[5]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, see Terminology C 43, C 119, or E 631.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *coating*—clear or pigmented surface treatment applied for aesthetic improvement, enhanced durability, or other purpose.

3.2.2 *contaminant*—a foreign substance not intentionally introduced to a surface.

3.2.3 *muriatic acid*—commercial grades of hydrochloric acid that often contain iron impurities.

3.2.4 *nebulized water spray*—cleaning with a mist of water from fine nozzles.

3.2.5 *poultice*—cleaning systems composed of one or more liquids mixed with powder to form a paste.

3.2.6 *soiling*—a deposit of finely divided particulate matter or other contaminants adhered to the surface.

3.2.7 *soiling crust*—accumulation of soiling into a hardened layer at the surface. Partial or complete detachment of the crust may damage the substrate.

3.2.8 *staining*—a contaminant that has penetrated the surface.

3.2.9 *surface*—the exposed face of masonry, concrete, or stucco.

4. Significance and Use

4.1 Cleaning of masonry, concrete, and stucco surfaces is undertaken for a variety of reasons including aesthetic improvement, removal of contaminants, maintenance, and surface preparation. This guide provides for selecting, testing, and evaluating cleaning techniques for removal of soiling and staining.

4.2 Cleaning systems may adversely affect both building materials being cleaned as well as other materials, mechanical, electrical, and other building systems, and building exterior, interior, and site features.

4.3 In some situations, it may be prudent to spot clean or to not clean.

4.4 It should be noted that, in some cases, cleaning may be inconsistent with the goals of historic preservation.

---

[1] This guide is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.24 on Building Preservation and Rehabilitation Technology.

Current edition approved Jan. 10, 1997. Published March 1997.

[2] *Annual Book of ASTM Standards*, Vol 04.05.

[3] *Annual Book of ASTM Standards*, Vol 04.07.

[4] *Annual Book of ASTM Standards*, Vol 06.02.

[5] *Annual Book of ASTM Standards*, Vol 04.11.

5. Identification and Characterization of Substrate

NOTE 1—The substrate should be identified and characterized before a cleaning method is selected. Building records and any other relevant historic sources should be reviewed for information about the substrate and any previous treatments that might affect the proposed cleaning process.

5.1 Substrate samples should be analyzed to describe the following characteristics:

5.1.1 Mineralogical composition of major constituents,

5.1.2 Microtexture,

5.1.3 Water solubility,

5.1.4 Acid solubility,

5.1.5 Water absorption, and

5.1.6 Soluble salt content.

NOTE 2—ASTM describes specific test methods for each masonry type. Judgment should be used to select the current test method appropriate to the proposed cleaning project. Tests may be modified to accommodate the number and size of available samples.

6. Identification of Soiling and Staining

6.1 Identification of the composition of soiling or staining present on surfaces to be cleaned will assist in determining appropriate cleaning techniques for testing. This may be accomplished through laboratory testing. Cleaning techniques should always be further evaluated in test areas.

7. Selection Criteria

7.1 Performance goals for cleaning masonry, concrete, or stucco surfaces should be established prior to selection of the cleaning technique.

7.2 Selection of cleaning techniques shall be based on the following factors:

7.2.1 The level of cleanness desired,

7.2.2 The effectiveness of the cleaning system,

7.2.3 Adverse effects to the surfaces, substrates and related components, and adjacent surfaces,

7.2.4 Environmental concerns, such as human exposure and the collection, neutralization, and disposal of cleaning residue and run-off, and

7.2.5 Other practical considerations such as time and cost factors.

8. Cleaning Techniques

NOTE 3—The following cleaning techniques are not necessarily listed in order of aggressiveness. It is the responsibility of the user of this guide to determine the advantages and disadvantages of the various cleaning procedures as they relate to the surfaces being cleaned. Whenever possible, contact the masonry, concrete, or stucco manufacturers and suppliers, the cleaning product manufacturers, and the cleaning equipment manufacturers to determine compatibility. Specialists may also be consulted.

8.1 *Water Cleaning*, relies on the ability of water to dissolve, swell, and loosen soiling and staining, enabling their removal from the surface. Mechanical scrubbing may enhance removal when staining is deeply deposited.

8.1.1 The effectiveness of water cleaning is influenced by the following factors:

8.1.1.1 *Pressure Rating*, refers to the gauge pressure measured at the nozzle of the cleaning equipment. Equipment capable of generating a pressure of 100 to 3000 psi (0.7 to 20 MPa) is commonly used. Surfaces and substrates can be damaged by abrasion. Testing should determine the minimum effective pressure. The location of the pump with respect to the nozzle can affect the pressure rating.

8.1.1.2 *Water Flow Rate*—Water supplied by the pump to the rinsing apparatus measured in gallons per minute (gpm) or litres per minute (L/min). Pumps delivering 1.5 gpm (3.8 L/min) may be used effectively in cleaning operations that require containment or control of effluent. More efficient cleaning is generally achieved with equipment providing a flow rate of 4 to 8 gpm (15 to 30 L/min).

8.1.1.3 *Spray Tip*, determines the size and configuration of the water spray delivered to the substrate. Fan-type spray tips producing 15 to 40° fan spray patterns have proven most effective for cleaning masonry, concrete, and stucco surfaces. Laser tips, 0° tips, or fan spray tips with less than 15° spray patterns produce a concentrated stream of water that may damage surfaces. Rotating spray heads that produce a scouring action may also damage surfaces. Care must be taken to keep the spray tip as far from the surface as possible to provide effective cleaning. Water from a spray tip held 3 ft (0.9 m) from the substrate may have no adverse effect on the surface but may remove the surface of the substrate when held 6 in. (150 mm) from the wall.

8.1.2 *Water Cleaning Methods*:

8.1.2.1 *Nebulized Water Spray*—Effective for removal of soiling or other deposits from surfaces that could not withstand high pressure water or abrasive cleaning techniques.

8.1.2.2 *Pressure Water Spray*—Effective for removal of loosely adhered soiling.

8.1.3 *Limitations*—Problems associated with water cleaning include intrusion of water into interior spaces, brown staining when iron-containing minerals are present, and the encouragement of biological growth. When water pressures are excessive, the surface can be abraded. Metal tools should not be used as scrubbing implements.

8.2 *Chemical Cleaning*, relies on chemical reaction to dissolve, capture, or mobilize soiling or staining. Chemical cleaning utilizies detergents, organic solvents, acids, and alkalis. Cleaning compounds, which are often proprietary products, are available as water-thin liquids and as thickened gels. Poultices can be used for removal of stains. Use of a chemical in conjunction with water washing reduces both the chemical concentrations and the water volume required. In most cases, chemical cleaning should be preceded and followed by thorough water rinsing. Poultices enhance removal when staining is deeply deposited.

NOTE 4—Application frequently involves use of proprietary chemical cleaning compounds. Products should be used in accordance with the manufacturer's recommendations for suitability, protection, dilution, application, surface contact times, and rinsing procedures.

8.2.1 *Chemical Types*:

8.2.1.1 *Detergents*—Suitable for removal of dust, dirt, water soluble surface contaminants, oil, grease, and other emulsifiable staining materials. Water-detergent solutions can be acidic, alkaline, or pH neutral. Neutral pH detergents are sometimes referred to as nonionic.

8.2.1.2 *Organic Solvents*—Suitable for removal of caulking compound residues, oils, grease, bituminous materials, and other stains that are not soluble in water.

NOTE 5—Organic solvents are frequently flammable and combustible. They must be used in accordance with all applicable safety and environmental regulations concerning flammable, toxic, and combustible materials.

8.2.1.3 *Acids*—Suitable for removal of dust, dirt, water soluble surface contaminants, oil, grease, soot, fly ash, hydrocarbon residues, biological growth, and stains due to polluted environments. When using acidic cleaners, care must be taken to ensure complete removal or neutralization of acidic residues after the cleaning process. This is done by measuring the surface pH in accordance with Test Method D 4262. When evaluating surface pH, the pH of the substrate prior to cleaning and that of the rinse water must be considered. Alkaline neutralizing rinses are sometimes used in conjunction with acidic cleaners. The resulting salts should be removed by rinsing with water. In addition to surface pH, the ion content of the rinse water can be monitored.

8.2.1.4 *Alkalis*—Suitable for removal of dust, dirt, water soluble surface contaminants, oil, grease, soot, fly ash, hydrocarbon residues, grease, biological growth, and stains due to polluted environments. When using alkaline chemicals, care must be taken to ensure complete removal or neutralization of alkaline residues after the cleaning process. This is done by measuring surface pH in accordance with Test Method D 4262. When evaluating surface pH, the pH of the substrate prior to cleaning and of the rinse water must be considered. Acidic neutralizing rinses are sometimes used in conjunction with alkaline cleaners. The resulting salts should be removed by rinsing with water. In addition to surface pH, the ion content of the rinse water can be monitored.

8.2.2 *Limitations*:

8.2.2.1 All limitations associated with the use of water cleaning should be considered for chemical cleaning.

8.2.2.2 When pressure rinsing equipment is used in conjunction with chemical cleaning compounds, attention must be given to selecting appropriate equipment. Care must be taken to use sufficient water to remove all chemical residues and dissolved soiling and staining from the surfaces.

8.2.2.3 Acidic cleaners applied to polished surfaces may reduce or remove the polish.

8.2.2.4 Fluoride-based cleaners may etch or otherwise damage glass, ceramic, aluminum, and other metallic materials.

8.2.2.5 Chemical reaction with adjacent surfaces may result from direct contact of the acidic cleaning solution or by vapors from the cleaning solution.

8.2.2.6 Acids containing chlorides may contribute to corrosion of ferrous materials that are within or adjacent to the substrate. Alkalis may damage aluminum and other metallic materials.

8.2.2.7 In most instances, a chemical cleaner should not be applied with pressurized equipment. Such an application may force chemicals deep within the surface of the masonry that are difficult to remove and may adversely affect the surface. Such an application may result in an unintended dispersion of chemicals.

8.2.2.8 Metal tools should not be used as scrubbing implements.

8.3 *Abrasive Cleaning*, relies on the mechanical application of a material to remove soiling or stains from a substrate.

8.3.1 *Types of Abrasive Cleaning*:

8.3.1.1 *Mechanical Scrubbing*, is effective for removal of surface dust and debris deposited on or loosely adhered to surfaces.

8.3.1.2 *Wet Abrasion*, is effective for removal of a variety of types of soiling. Wet abrasion combines the dirt softening and rinsing properties of water with the ability of abrasive materials to erode soiling from the surface. Wet abrasion reduces airborne matter, allows greater control of abrasive materials during the cleaning process, and may reduce the time required to achieve the desired level of cleaning.

8.3.1.3 *Dry Abrasion*, is effective for removal of a variety of types of soiling. Abrasive grit is applied with air pressure to erode soiling matter from treated surfaces. Select the least damaging abrasive materials and lowest air pressure sufficient for cleaning.

8.3.1.4 *Sanding/grinding*, is effective for removal of a variety of surface soiling.

8.3.2 *Limitations*—If the surface is to be retained, abrasive cleaning may not be appropriate. Care must be taken to avoid damage by airborne dust depositing on or entering into treated and adjacent properties or mechanical systems and to avoid excessive erosion of surfaces. Abrasive cleaning should never be performed on masonry units with sand or slurry finishes. With both wet and dry abrasion, hard or sharp edged abrasives can irreparably damage soft substrates. All cautions associated with water washing and pressure washing equipment should be considered. With sanding and grinding, care must be taken to avoid surface variations created by uneven application of abrasion material. Sanding/grinding may not be suitable for use on carved or molded surfaces.

9. Test Areas

9.1 Test areas should be used to evaluate the appropriateness and effectiveness of cleaning techniques. It is safer to use a trial-and-error method on a test area before committing the entire project to one procedure. This is especially true when cleaning an unfamiliar substrate or using an unfamiliar cleaning technique. Cleaning test areas shall be used to:

9.1.1 Determine the various types of soiling or staining to be removed during cleaning.

9.1.2 Test several cleaning procedures in small areas before committing the entire project to one procedure.

9.1.3 Determine the impact of the cleaning process on adjacent materials, surfaces, and surroundings. If protection is required, identify the protective materials and methods to be used.

9.2 Test areas shall be located in such a way that:

9.2.1 They encompass all materials and representative examples of surface finishes and surface conditions.

9.2.2 They can be visually compared with each other and adjacent untreated surfaces under similar lighting and exposure conditions.

9.2.3 They can be readily inspected or accessed for sample extraction to determine the impact of the cleaning process on the substrate and on adjacent surfaces.

9.2.4 The water and utilities necessary for the cleaning techniques are available. It may be necessary to import water and utilities to the test area when the location of unusual staining is not accessible by available water and utilities.

10. Testing Procedures

10.1 Identify all applicable environmental regulations for containment and disposal of cleaning effluent generated by the cleaning procedures and comply with such regulations.

10.2 Protect surfaces adjacent to test areas in the same manner as proposed for the entire project.

10.3 Selection of cleaning technique should begin with the least harmful techniques appropriate for the substrate, adjacent surfaces, the soiling or staining, and the environment. For chemical cleaning, vary the chemical concentration and select the least concentrated solution possible to provide effective cleaning.

10.4 Based on the cleaning technique selected, clean the test area utilizing the same materials, equipment, and procedures as those used to clean the entire project. Because weather conditions may determine the effectiveness of cleaning, perform test area cleaning under weather conditions similar to those anticipated during cleaning of the entire project.

11. Evaluation

11.1 Allow the test area to be exposed to environmental conditions for a period of time before evaluating the effectiveness of cleaning. The period of time will vary with substrate characteristics, environmental factors, and the cleaning system used.

11.2 Evaluation of the work shall include assessment of the following:

11.2.1 The extent to which the surface was cleaned with regard to the performance goals.

11.2.2 The extent to which the proposed cleaning technique detrimentally affected the surface being cleaned or adjacent surfaces with regard to the performance goals. The effects of a cleaning operation on the substrate can be assessed most accurately through field or laboratory evaluation of samples from the test area by a qualified petrographer or materials specialist.

11.2.3 The effectiveness of protection procedures for adjacent surfaces with regard to the performance goals.

12. Keywords

12.1 abrasive cleaning; chemical cleaning; concrete; dimension stone; granite; marble; masonry; sandstone; stucco; water cleaning

BIBLIOGRAPHY

(**1**) Amoroso, G. G., and Fassina, V., *Stone Decay and Conservation*, Elsevier Science Publishers B. V., 1983, pp. 254–298.

(**2**) Ashurst, J., and Ashurst, N., *Practical Building Conservation*, Vol 1, Gower Technical Press Ltd., Aldershot, England, 1988, pp. 43–67.

(**3**) Ashurst, J., and Ashurst, N., *Practical Building Conservation*, Vol 2, Gower Technical Press Ltd., Aldershot, England, 1988, pp. 76–78.

(**4**) Ashurst, J., and Ashurst, N., *Practical Building Conservation*, Vol 3, Gower Technical Press Ltd., Aldershot, England, 1988, pp. 49–79.

(**5**) Ashurst, J., and Dimes, F. G., *Stone in Building*. The Architectural Press Ltd., London, 1977, pp. 40–50.

(**6**) Clifton, J. R., ed, *Cleaning Stone and Masonry*, ASTM Special Technical Publication 935, Philadelphia, PA, 1983.

(**7**) Grimm, C. T., *Cleaning Masonry—A Review of the Literature*, Construction Research Center, University of Texas at Arlington, Arlington, TX, Nov. 1988.

(**8**) Grimmer, A. E., *Keeping it Clean*, U.S. Government Printing Office, Washington, DC, 1988.

(**9**) Johnson, Jr., L., ed, *Handbook of Maintenance Techniques*, Texas Historical Commission, Austin, TX, 1985, pp. 42–46.

(**10**) London, M., *Masonry: How to Care for Old and Historic Brick and Stone*, National Trust for Historic Preservation, Washington, DC, 1988, pp. 89–109.

(**11**) Matthys, J. H., and Borchelt, J. G., eds, *The Masonry Society*, Proceedings of the Third North American Masonry Conference, 1985, pp. 24-1–14, pp. 54-1–13, pp. 56-1–7.

(**12**) Stambolov, T., and van Asperen de Boer, J. R. J., *The Deterioration and Conservation of Porous Building Materials in Monuments*. International Centre for Conservation (ICCROM), Rome, 1976, pp. 36–43.

(**13**) Verhoef, L. G. W., ed, *Soiling and Cleaning of Building Facades*, Chapman and Hall, New York, NY, 1988, pp. 124–135.

(**14**) Webster, R. G. M., ed, *Stone Cleaning and the Nature, Soiling, and Decay Mechanisms of Stone*, Proceedings of the International Conference, Edinburgh, UK, 14–16 April 1992.

(**15**) *Annotated Master Specifications for the Cleaning and Repointing of Historic Masonry*, Queen's Park Printer for Ontario, Can, 1985.

(**16**) *Cleaning (Home Repair and Improvement)*, Time-Life Books, Alexandria, VA, pp. 20–27.

(**17**) *Conservation of Historic Stone Buildings and Monuments*, National Academy Press, Washington, DC, 1982, pp. 272–280.

(**18**) *Indiana Limestone Institute of America, Inc.*, 17th Ed Handbook. Bedford, IN, pp. 120–121.

(**19**) *Respectful Rehabilitation*, National Trust for Historic Preservation, Washington, DC, 1982, pp. 163–164.

(**20**) *Science for Conservators*, Book 2, Crafts Council, London, England, 1983.

(**21**) *BS 6270: Parts 1 & 2*, British Standard Code of Practice for Cleaning and Surface Repair of Buildings.

(**22**) *The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings*, 1990 Revision.