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Standard Guide for Measurement of pH Below Resilient Flooring Installations[1]

This standard is issued under the fixed designation F3441; 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 discusses procedures that may be used for evaluating the comparative change in pH of reagent water placed on the surface of a properly prepared concrete slab surface.

1.2 This guide is intended to be used in conjunction with the flat surface electrode pH meter manufacturer's calibration procedures, operation instructions, and interpretive data where available.

1.3 This guide is intended to be used in conjunction with the pH paper manufacturer's instructions, product shelf life, and interpretive data where available.

1.4 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.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use* Some specific hazards statements are given in Section 9 on Hazards.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C125 Terminology Relating to Concrete and Concrete Aggregates

D1129 Terminology Relating to Water

D4262 Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces

F141 Terminology Relating to Resilient Floor Coverings

F710 Practice for Preparing Concrete Floors to Receive Resilient Flooring

F2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

2.2 *ACI Standards:*[3]

ACI CT 18 Concrete Terminology

2.3 *OSHA Standards:*[4]

§1926.1153 Respirable Crystalline Silica

3. Terminology

3.1 *Definitions:*

3.1.1 See Terminology C125 for definition of the term: concrete.

3.1.2 See Terminology D1129 for definitions of the terms: alkalinity and reagent water.

3.1.3 See Terminology F141 for definitions of the term: resilient flooring.

3.1.4 See Test Method F2170 for definition of service temperature and relative humidity.

3.1.5 *pH, n*—a measure of acidity or alkalinity of a solution, with neutrality represented by a value of 7, with increasing acidity represented by smaller values, and with increasing alkalinity represented by increasing values. **D4262**

3.1.6 *carbonation, n*—reaction between carbon dioxide and a hydroxide or oxide to form a carbonate, especially in cement paste, mortar, or concrete. **ACI CT 18**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *alkali, n*—a basic, ionic salt of an alkali or alkaline earth metal chemical element; also, a base that dissolves in water.

3.2.2 *properly prepared concrete slab surface, n*—a concrete slab surface that has been prepared in strict accordance with the written instructions of the resilient flooring, adhesive, underlayment manufacturer, Practice F710, or project specifications.

[1] This guide is under the jurisdiction of ASTM Committee F06 on Resilient Floor Coverings and is the direct responsibility of Subcommittee F06.40 on Practices.

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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.

[3] Available from American Concrete Institute (ACI), 38800 Country Club Dr., Farmington Hills, MI 48331-3439, http://www.concrete.org.

[4] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.

4. Significance and Use

4.1 There is typically a higher concentration of soluble alkali salts in the surface region of a concrete slab due to the initial bleeding process of a freshly placed concrete slab. If after a resilient floor covering material is installed there is sufficient moisture within the slab to place these salts into solution a potentially damaging high pH solution can develop beneath the installed material.

4.2 Results obtained through the use of this guide indicate the comparative pH of reagent water placed on properly prepared concrete slab surfaces only at the time of the procedure and in the specific locations evaluated.

4.3 If pre-installation surface pH evaluation is required by the manufacturer of the resilient flooring, adhesive, patching/underlayment products or project specifications, their instructions and limitations should be consulted.

5. Summary of Guide

5.1 This guide covers various procedures that may be used to evaluate the comparative change in the pH of reagent water placed on a concrete slab surface. The pH of the reagent water is first evaluated in a clean vessel and the result recorded. A sample of the reagent water is then placed on a properly prepared concrete slab surface, allowed to set for 60 s, and the pH of the reagent water on the concrete slab surface is evaluated and the result recorded.

NOTE 1—It should be understood that this guide incorporates the addition of an external source of liquid water in order to form a solution in which the pH can be measured. However, if there is not sufficient moisture in the concrete to create a solution, the results of this test procedure do not provide an accurate assessment of the condition that will develop or exist below the flooring and adhesive after they are installed.

NOTE 2—When a water-based adhesive is applied to the surface of a bare concrete slab there may be sufficient free water in the adhesive to place soluble alkali salts in the surface region of the slab into solution and create a high pH condition. However, if the surface region of the slab is porous, and the relative humidity level in the slab is 85 % or lower, as measured by Test Method F2170, the pH effect of water in an adhesive will be a short-term condition.

6. Reagents and Materials

6.1 Unless otherwise indicated, references to water shall be understood to mean deionized (DI) or distilled water.

7. Interferences

7.1 Membrane forming curing compounds used to cure freshly placed concrete slabs may leave a residual surface film of oil, wax, resin, or a combination thereof, which can interfere with the results of concrete slab surface pH testing. Such materials should be completely removed in accordance with F710 before testing concrete slab surface pH.

7.2 As portland cement and cementitious underlayment materials for resilient flooring hydrate, calcium hydroxide and other alkaline hydroxides are formed. The pH of wet concrete and cementitious underlayments are extremely alkaline, typically around pH 12 to 13.

7.2.1 Any portland cement dust or cementitious underlayment dust on the concrete surface could interfere with the results of pH evaluation and should be completely removed before evaluating concrete slab surface pH.

7.3 The surface of concrete slabs will naturally react with atmospheric carbon dioxide to produce calcium carbonate in the hydraulic cement paste through a process known as carbonation, which reduces the pH of the concrete slab surface.

7.3.1 Carbonation slowly progresses deeper into the concrete over time.

7.3.2 Concrete slab surface pH results in the range of pH 8 to 10 are typical for a concrete slab surface with at least a thin layer of carbonation (approximately 0.04 in. (1 mm)).

7.3.3 The more concrete removed from the surface, the less the remaining carbonated layer, if any, so the pH of a solution of water added to the abrasively or mechanically prepared surface is expected to increase, possibly up to that of portland cement (pH 12 to 13).

7.3.4 Shotblasting, sanding, grinding, or other such methods of surface preparation can remove the carbonated surface layer of a concrete slab and expose a more highly alkaline condition, which if tested by this method, will likely result in a higher pH measurement.

7.3.5 Unless required for the proper concrete surface preparation for the materials to be installed, no mechanical surface preparation should be done prior to using this method.

7.4 Accumulation of alkali on a concrete slab is commonly known as efflorescence; the most common efflorescence is a white powdery deposit of calcium carbonate which has a pH of 9 to 10. Such deposits can interfere with the results of concrete slab surface pH evaluation and should be completely removed before evaluating concrete slab surface pH.

7.5 A common misconception concerning reagent water is that it is neutral with a pH of 7. However, reagent water can absorb carbon dioxide from the atmosphere forming carbonic acid. This acidification of the reagent water can cause the reagent water to have a pH of less than 6 and can occur within as little as two hours exposure of the reagent water to normal atmospheric conditions.

8. Hazards

8.1 *Respirable Crystalline Silica and Asbestos Warning*—Concrete slab surfaces, underlayment material, or existing resilient flooring, backing, lining felt, paint, asphaltic cutback adhesives, or other adhesives may contain respirable asbestos fibers or respirable crystalline silica if disturbed.

8.1.1 Consult with OSHA §1926.1153 for latest federal regulatory requirements before sanding, grinding, scarifying, dry sweeping, dry scraping, drilling, sawing, bead-blasting, or mechanically chipping or pulverizing, or otherwise damaging any of these materials.

8.1.2 Avoid creating dust when working with, repairing, preparing, or removing such materials. Use of dust collection equipment and appropriate personal protective equipment such as an approved respirator may be required to control worker exposure to respirable crystalline silica. Inhalation of such dust is a cancer and respiratory tract hazard.

8.1.3 Smoking by individuals exposed to asbestos fibers greatly increases the risk of serious bodily harm. Unless

positively certain that the product is a non-asbestos-containing material, presume that it contains asbestos. Regulations may require that the material be tested to determine asbestos content. The Resilient Floor Covering Institute's (RFCI) *Recommended Work Practices for Removal of Resilient Floor Coverings*[5] should be consulted for a defined set of instructions addressed to the task of removing all resilient floor covering structures.

8.2 *Lead Warning*—Certain paints may contain lead. Exposure to excessive amounts of lead dust presents a health hazard. Refer to applicable federal, state, and local laws and, "Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing," (September 1990) or subsequent editions published by the U.S. Department of Housing and Urban Development regarding: (*1*) Appropriate methods for identifying lead-based paint and removing such paint; and (*2*) any licensing, certification, and training requirements for persons performing lead abatement work.

9. Apparatus

9.1 *Flat Surface Electrode pH Meter*—The flat surface electrode pH meter apparatus shall consist of a pH meter with a flat surface electrode with a minimum range from 4 pH to 12 pH units with the capability of measuring in increments of 0.1 pH units, an LCD readout display, and a separate device for measuring time to the nearest one (1) second.

9.2 *pH Test Paper*—The pH test paper apparatus shall consist of pH test paper with a minimum range of 4 pH to 12 pH units, its associated color comparison chart, and a separate device for measuring time to the nearest one (1) second.

NOTE 3—Different pH papers can produce significantly different measurements and interpreting their results can be difficult. If the pH paper method is required, the requiring organization should indicate the manufacturer of the pH paper, and the specific pH paper from that manufacturer. In the absence of guidance from the requiring organization, the testing agency should use a pH paper they have experience with.

10. Pre-Evaluation Conditioning and Preparation

10.1 If concrete surface pH evaluation is required as a pre-installation criterion, refer to the written instructions of the manufacturer of the resilient flooring, adhesive, patching/underlayment products or project specifications for the proper concrete slab surface temperature, ambient temperature, and ambient relative humidity before evaluating the comparative pH of reagent water placed on a properly prepared concrete slab surface.

10.1.1 In the absence of written manufacturer's instructions or project specifications addressing conditioning required for concrete slab surface pH evaluation, the concrete slab surface temperature, ambient temperature, and ambient relative humidity should be at the service temperature and ambient relative humidity expected during normal use.

10.1.2 If this is not possible, then concrete slab surface and ambient temperature should be 75 °F ± 10 °F (23.9 °C ± 5.5 °C), and the ambient humidity should be 45 % ± 10 % relative humidity.

10.2 Concrete slab surfaces should be prepared in the exact manner as required for each specific floor covering material, adhesive, and or underlayment material that will be in direct contact with the prepared concrete slab surface before evaluating the comparative pH of the reagent water placed on the concrete slab surface.

11. Procedure

11.1 *Flat Surface Electrode pH Meter Method*—Immediately before conducting the flat surface electrode pH meter method, calibrate pH meter in accordance with manufacturer's written instructions.

11.1.1 Once calibrated, place a few drops of reagent water in a clean, glass dish. Allow the puddle to set for 60 (± 5) s. Place the tip of the electrode into the into the reagent water. The pH reading will appear in the display and will flash until it has stabilized.

11.1.2 Record the result.

11.1.3 Place several drops of reagent water on a properly prepared concrete surface, forming a puddle approximately 1 in. (25 mm) in diameter. Allow the puddle to set for 60 (± 5) s. Place the tip of the electrode into the puddle. The pH reading will appear in the display and will flash until it has stabilized.

11.1.4 Record the result.

11.1.5 Compare the result of the concrete slab surface pH to the pH of the reagent water in the clean, glass dish.

NOTE 4—If the Flat Surface Electrode pH Meter Method is being performed as part of a flooring failure investigation and the adhesive is sufficiently wet, the step of adding external water may not be necessary to evaluate the pH of the wet adhesive.

11.2 *pH Test Paper Method*—Immediately before conducting the pH test paper method, place a few drops of reagent water in a clean, glass dish. Allow the puddle to set for 60 s (± 5 s). Dip the pH paper into the reagent water. Compare pH paper to the associated comparison chart to determine pH reading. Record the result.

11.2.1 Place several drops of reagent water on a clean, properly prepared concrete surface, forming a puddle approximately 1 in. (25 mm) in diameter. Allow the puddle to set for 60 s (± 5 s). Dip the pH paper into the reagent water. Remove pH paper immediately. Compare pH paper to the associated comparison chart to determine pH reading.

11.2.2 Record the result.

11.2.3 Compare the result of the concrete slab surface pH to the pH of the reagent water in the clean, glass dish.

NOTE 5—If the pH Paper Method is being performed as part of a flooring failure investigation and the adhesive is sufficiently wet, the step of adding external water may not be necessary to evaluate the pH of the wet adhesive.

12. Acceptance Criteria

12.1 The written instructions and recommendations of the resilient flooring, adhesive, and underlayment manufacturer should be consulted for their recommendations, if any, for the pH limitations associated with their respective products.

12.2 If required, and in the absence of written manufacturers' instructions, the pH readings from the properly prepared

[5] Available from the Resilient Floor Covering Institute (RFCI), 115 Broad St., Suite 201, La Grange, GA 30240, www.rfci.com.