



# HOW TO MEASURE pH OF A CONCRETE SURFACE PRIOR TO INSTALLATION OF A FLOOR COVERING

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## Introduction

A review of published literature indicates that there is plenty of information regarding the pH of concrete as it relates to carbonation, embedded steel corrosion, alkali-silica reaction, and effects of mineral admixtures such as fly ash and silica fume. There are, however, only a few research papers published that are related to test methods to measure the pH of a concrete surface.

Portland cement and many other hydraulic-cement-based concretes are highly alkaline materials. Depending on the actual chemistry of the portland cement and amount of alkalis present, the pH of freshly placed concrete can vary from approximately 12 to over 13. The carbonation of concrete is known to lower the surface pH to a value in the vicinity of 9.

The pH of a concrete surface plays an important role in the selection of flooring adhesive and placement of flooring materials, especially with resilient flooring such as sheet vinyl. A concrete pH below 7.0 and above 10.0 is known to negatively affect resilient flooring, its adhesive, or both. The flooring installer is typically required to clean and prepare concrete slab surfaces prior to flooring installation. Pressure washing is not used to clean the concrete surface, as the process will saturate the concrete surface with water and cause flooring failure due to excess slab moisture. Flooring installers often clean and scarify the concrete surface with sandpaper, or shot-blast the surface. The process of sanding or shot blasting can remove the carbonated surface layer of concrete and expose a concrete surface that has higher pH.

When using the [ASTM F710](#) test procedure ([Appendix A](#)), testing laboratories have reported concrete surface pH values as low as 6 or 7 because the test method is incorrect. In fact, it essentially measures the pH of water and readily-soluble materials on the concrete surface versus the true pH of the concrete. Incorrect pH test results could lead to the selection and use of an incompatible adhesive for the flooring, resulting in the risks of flooring failure. The concrete and flooring industries require a test method that measures the pH of concrete surface more accurately.

## Question

How does one measure the pH of a concrete surface prior to the installation of a floor covering?

## Answer

The following method, using either pH paper or a pH meter, is recommended to determine the pH of a newly placed or an existing concrete surface.

## Proposed method

a) Calibrate the pH meter or pH paper with three pH calibration solutions supplied by the pH meter manufacturer or an independent chemical supplier. The three calibration solutions should be of pH 7, 10, and 12. The measuring tip of the pH meter should be cleaned by dipping it in a clean container of fresh distilled water and wiping it dry with a clean paper towel prior to the pH reading. Repeat the same cleaning procedure immediately after each reading and make a note of the pH measurement results.

b) Use an infrared thermometer to measure concrete surface temperature. Note the temperature to the nearest degree in Fahrenheit (Celsius). The concrete temperature should be within  $\pm 10^{\circ}\text{F}$  ( $\pm 5.6^{\circ}\text{C}$ ) of the temperature expected during the flooring installation.

c) If the concrete surface is unclean, mechanically remove surface contaminants such as dirt, concrete sealer, and old adhesive residue. Do not use chemicals to clean the concrete surface.

d) Lightly abrade approximately a 12 in. (300 mm) diameter area of the clean concrete surface for  $60 \pm 10$  seconds with 50-grit sandpaper. Collect and measure 0.0011 lb (0.5 g) of concrete powder.

e) Add 0.0011 lb (0.5 g) of concrete powder to a bottle containing 0.338 oz. (10 mL) of fresh distilled water. Close the bottle lid and shake the bottle for  $30 \pm 5$  seconds.

f) Allow the concrete powder solution in the bottle to rest for approximately 2 minutes.

g) Insert the pH meter or pH paper into the concrete powder solution and note the stable pH reading to the first decimal.

h) Note and report calibration pH readings, pH of concrete surface as measured from the liquid portion of the concrete powder/water solution in the previous steps, and concrete surface temperature.

Three pH tests are recommended for the first 1000 ft<sup>2</sup> (92 m<sup>2</sup>) area of the concrete slab and an additional pH test is recommended for each additional 1000 ft<sup>2</sup> (92 m<sup>2</sup>) or fraction thereof. The pH tests can be conducted in different areas of the building, on different concrete placements, and different concrete mixtures used in a project.

## Discussion

The pH, which is an approximate measure of acidity or alkalinity of a solution, is defined as the negative logarithm of hydrogen ion concentration. In fact, the pH is a measured property of a solution. Because concrete is a solid substance, it is challenging to accurately measure the pH of hardened concrete. To test the pH of solid concrete, the following questions need to be answered:

- How should the samples be collected? Is there a procedure?
- How does one prepare the concrete powder to prepare a test solution?
- What concentration of the solution is required to get a consistent and repeatable pH measurement?
- What factors affect the pH measurement?

The following is a summary of a few ASTM and industry publications related to measuring pH of concrete and solid substances such as limestone. The dilution ratio used for preparing a solution for pH measurement varies among the standards in the range of 1:4 and 1:20 by weight.

a) **ASTM C25**—Using a dilution ratio of 1:20, mix 0.022 lb (10 g) of sample with 200 g (6.76 oz or 200 mL) of deionized water; stir for 30 minutes and let the solution stand for 30 minutes; measure with a pH probe and meter; report pH value to four significant figures. Although ASTM C25 is not directly related to concrete, but instead to limestone and hydrated lime, testing laboratories in the industry often use dilution ratio of 1:20 when preparing solutions to measure the pH of concrete.

b) **ACI 364.3R**—Using a dilution ratio of 1:9, mix 0.022 lb (10 g) of sample passed through the No. 170 mesh with 0.198 lb (90 g) of distilled or deionized water for 1 minute; after settling, measure pH using pH paper or pH probe and meter.

c) **STN 73 1341**—Using a dilution ratio of 1:4, mix 0.11 lb (50 g) of powdered concrete sample with 200 g (6.76 oz or 200 mL) of distilled water; agitate the solution for 6 hours and then filter the solution; use the chemical indicator to determine the pH.

Fundamental research on pH measurement of concrete surfaces has been published by [Grubb et al. \(2007\)](#) and [Kakade \(2014\)](#), who studied the influence of various test parameters. The research works addressed the following variables and their effects: