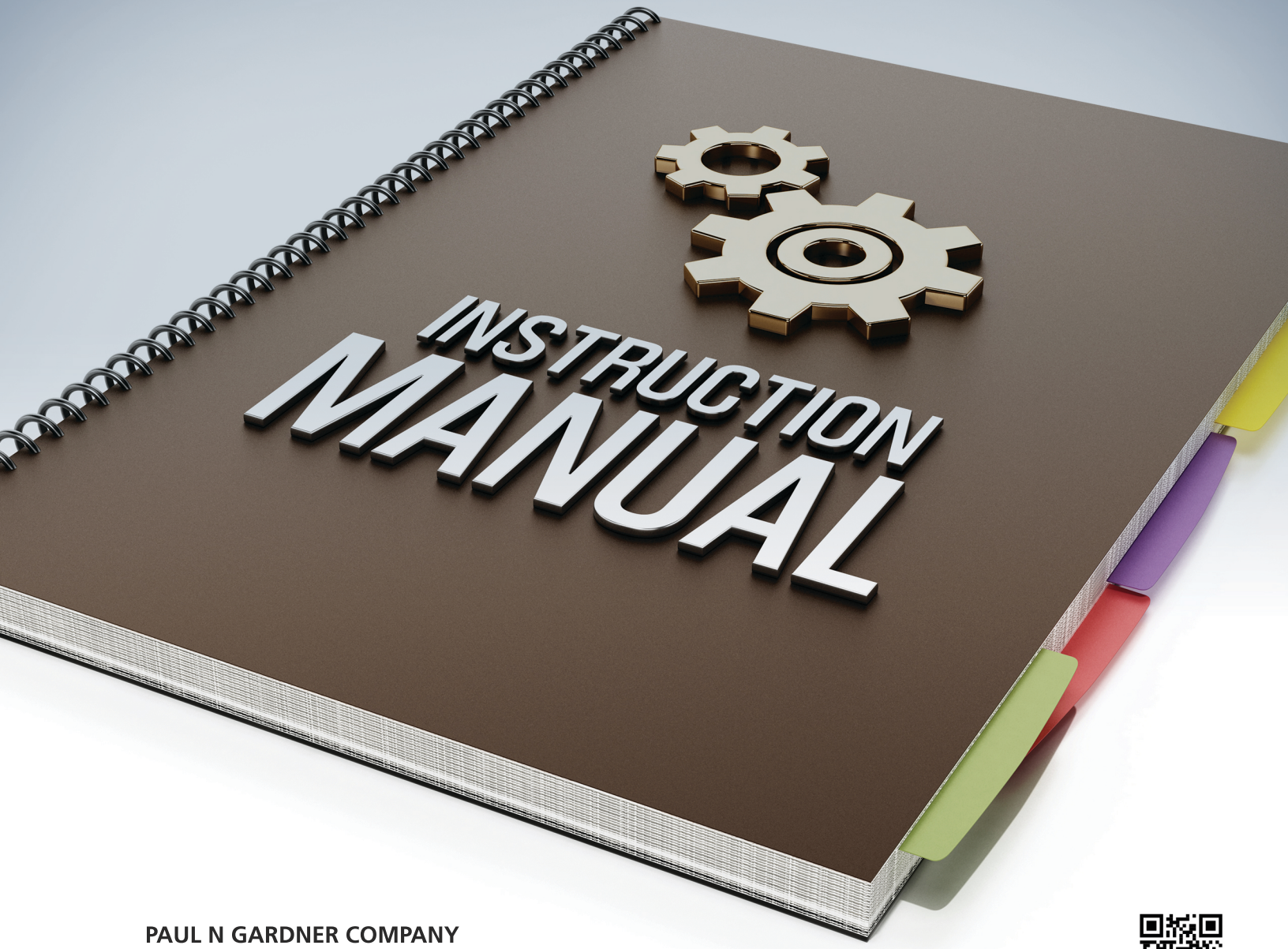


PAUL N GARDNER COMPANY
9104 GUILFORD ROAD, SUITE H
COLUMBIA, MD 21046 USA

EMAIL GARDCO@ALTANA.COM
PHONE +1-954-946-9454

INSTRUCTIONS

GARDCO DISTRIBUTED PRODUCTS

GARDCO®

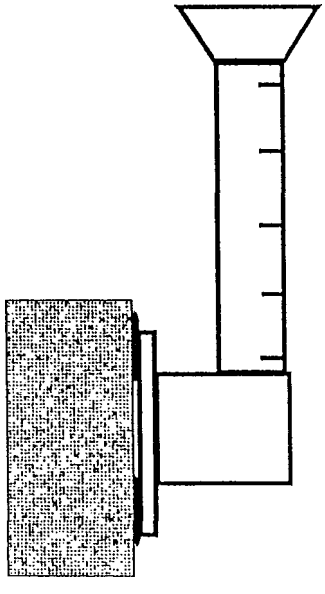
RILEM TUBE TEST PROCEDURES

Introduction

RILEM tube tests are used to evaluate the performance of water repellents in the field. There are two types of RILEM tubes, 5.0 mL (tall) tubes and 60mph (stumpy) tubes. The 5.0 mL tubes are use on brick, natural stone, cast-in-place concrete and precast concrete. The 60mph tubes are used on concrete block. Putty is used to affix the tube to the vertical or horizontal surface and water uptake is measured during a 20 minute time period. Procedures for the 5.0 mL tube and 60mph tube are described below. Where warranty considerations exist, RILEM tube tests should be conducted by a sales manager or a manufacturer's representative.

RILEM Tube Procedure for Brick, Natural Stone, Cast-in-Place Concrete, and Precast Concrete

The 5.0 mL RILEM tube has been the mainstay of field-testing procedures for many manufacturers of water-repellent products. It allows for the only practical, rapid, nondestructive evaluation of comparative water-repellency in the field. Properly conducted, the test procedure allows for a quantitative evaluation of water repellency of both the masonry unit and the unit/mortar interfaces.



Procedure:

1. The masonry surface should be clean, dry and free from poorly adhered coatings and/or partially spalled masonry fragments.
2. Roll out a bead of the putty to approximately 1/4" diameter and 6" length. Attach the putty to the flat brim of the tube.
3. Firmly press the tube with the attached putty to the surface. Press in any putty that extrudes to form a tight seal.
4. Fill the tube with water to the appropriate level, ensuring no air is trapped inside the body. If air is trapped inside, remove the tube and repeat the procedure in a new area.
5. Wait for 20 minutes and then record the amount of water absorbed by the substrate.

Where warranty considerations exist, the following criteria will be applied when determining whether the performance will qualify for an extended warranty:

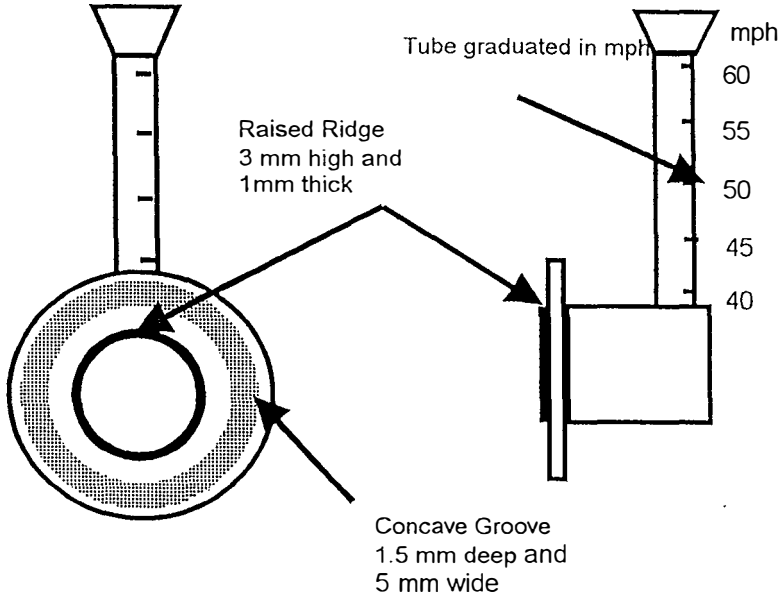
RILEM Tube Procedure for Concrete Block

It has become increasingly apparent that concrete blocks present some unique challenges with respect to water intrusion. The high porosities and the large capillaries in these units render many traditional water-repellent technologies ineffective. Not only has water-repellent technology evolved to address these challenges, but also field-testing procedures have now been revised to incorporate techniques suitable for these materials.

Procedure:

1. The masonry surface should be clean, dry and free from poorly adhered coatings and/or partially spalled masonry fragments.
2. Roll out a bead of the putty to approximately 1/2" diameter and 6" length.
3. Place the putty in the concave groove on the flat brim of the tube.
4. Firmly press the tube with the attached putty to the surface. Press in any putty that extrudes to form a tight seal.

NOTE: The presence of the raised ridge on the underside of the flange makes this step especially important. Compression of the putty will not be as great as with the traditional assembly and therefore a complete seal may not be achieved if this step is omitted.



5. Evaluate the assembly to ensure the putty has not extruded into the "bowl" area of the tube and is not interfering with the test area.
6. Fill the tube with water to the 60-mph level, making sure no air is trapped inside the body. If air is trapped inside, remove the tube and repeat the procedure in a new area.
7. Wait for 20 minutes and then record the maximum wind-driven rain speed that the treated masonry can withstand.

Where warranty considerations exist, the following criteria will be applied when determining whether the performance will qualify for an extended warranty:

MEASUREMENT OF WATER ABSORPTION UNDER LOW PRESSURE

RILEM TEST METHOD NO. II.4

Introduction

RILEM (Reunion Internationale des Laboratoires D'Essais et de Recherches sur les Materiaux et les Constructions), with headquarters in Paris, is the International Union of Testing and Research Laboratories for Materials and Structures. As with our American Society for Testing and Materials (ASTM), Technical Committees are formed within RILEM to develop standard methods for measuring properties and evaluating the performance and durability of many different building materials.

One such technical committee, Commission 25-PEM, has developed tests to measure the deterioration of stone and to assess the effectiveness of treatment methods. The standard tests drafted by Commission 25-PEM fall within several categories, including methods for determining internal cohesion (III.), for measuring mechanical surface properties (IV.), and for detecting the presence and movement of water (II.). Within category II., is Test Method No. II.4, designed to measure the quantity of water absorbed by the surface of a masonry material over a definite period of time.

RILEM Test Method II.4 provides a simple means for measuring the rate at which water moves through porous materials such as masonry. The test can be performed at the site or in the laboratory and can be used to measure vertical or horizontal water transport. Water permeability measurements obtained in the laboratory can be used to characterize unweathered, untreated masonry. Measurements made at the site (or on samples removed for laboratory testing) can be used to assess the degree of weathering that the material has undergone. Test Method II.4 can also be used to determine the degree of protection afforded by a water repellent treatment. A description of the equipment and procedure for conducting this test is provided in paragraphs below. The theoretical basis on which the method is based and the several applications of test data are discussed.

Theory

Because masonry building materials are porous, they are all somewhat permeable to water. The interior structure of a masonry material is a system of fine interconnected pores. Wetting by liquid water involves capillary conduction (suction) through this pore system, proceeding along both vertical and horizontal pathways. Vertical transport occurs when water enters as ground water at the base of a structure or as rain water through leaking gutters. Penetration of driving rain into wall surfaces results in horizontal transport. (Under actual conditions, the amount of rain penetration depends on prevailing wind conditions as well as on the composition and condition of the exposed surface.)

When liquid water comes into contact with a masonry surface, wetting proceeds through the material as a front. Accurate measurements of the advance of this wetting front made on a variety of masonry building materials have demonstrated that the characteristic wetting rate and pattern of each material are directly related to its capillary structure and port size distribution. In fact, rate constants have been measured for brick, limestones and other masonry materials. RILEM Test Method II.4 provides a simple method for measuring the volume of water absorbed by a material within a specified time period.

Equipment

The equipment necessary for measuring water absorption under low pressure is simple. The test can be performed at the site or in the laboratory with a test apparatus available in two forms. One is designed for application to vertical surfaces and measures horizontal transport of water, or, its resistance to wind-driven rain penetration.*

A second form is designed for application to horizontal surfaces and measures vertical transport. Figure 1 illustrates the pipe-like apparatus designed for vertical surfaces. Its flat, circular brim (at the bottom end of the pipe) is affixed to the masonry surface by interposing a piece of putty. The open, upper end of the pipe has an area of 5.7 cm^2. The vertical tube is graduated from 0 to 4 cm^3 with each gradation representing an increment of 0.1 cm^3 (It is therefore possible to estimate to 0.05cm^3.) The total height of the column of water applied to the surface, measured from the center point of the flat, circular brim to the topmost gradation, is 9.8 cm. This corresponds to a pressure of 961.38 pascals (approximately 0.14 psi), or, a dynamic wind pressure of 142.6 kilometers per hour (approximately 88.5 mph). The apparatus designed for application to horizontal surfaces, similar to the one for vertical surfaces described above, is illustrated in Figure 2.

*It should be noted that a standard method for measuring water penetration and leakage through masonry is described in ASTM E 514. The ASTM test method is intended to evaluate wall design and workmanship as well as the degree of weathering and the performance of water repellent treatment. It is therefore necessary to conduct the procedure on a test wall built with a minimum height or length of four feet. The wall is exposed to water (3.4 gallons per square feet per hour) in a test chamber for four hours.

Procedure

The testing apparatus is affixed by interposing a tape of putty between the flat, circular brim of the pipe and the surface of the masonry material. To ensure adhesion, manual pressure is exerted on the cylinder. Water is then added through the upper, open end of the pipe until the column reaches the 0 gradation mark. The quantity of water absorbed by the material during a specified period of time is read directly from the graduated tube. The periods of time appropriate for the test depend on the porosity of the material on which the measurement is being made; generally 5, 10, 15, 20, 30 and 60 minute intervals provide the most useful data. In many cases, it may be important to measure water absorption through the mortar joint as well as through the surface of the brick (or natural stone) substrate.

Report

Results of the test measurements are presented in the form of a water absorption graph with the volume of water absorbed in cubic centimeters reported as a function of time in minutes. The masonry surface tested must be mentioned in the report.

Applications

Water has long been associated with deterioration processes affecting masonry materials. Its presence within the interior pore structure of masonry can result in physical destruction if the material undergoes wet/dry or freeze/thaw cycling. The latter is particularly damaging if the masonry material has a high clay mineral content. Perhaps of greater importance is the fact that the presence of moisture is a necessary precondition for most deterioration processes. Pollutant gases are harmful when they are dissolved in water; fluorescence phenomena are dependent on the migration of salts dissolved in water; moisture is a requirement for the growth of biological organisms. Because of these factors, the water permeability of a masonry material is related to its durability. Thus, results obtained using Test Method II.4 can be used to predict potential vulnerability of untreated, unweathered masonry materials to water-related deterioration.

Test Method II.4 also provides useful information when carried out on weathered masonry surfaces. Water permeability of a material is affected when its surface is obscured by the presence of atmospheric soiling or biological growth, or, when there are hygroscopic salts within the interior. The formation of a weathering crust due to mineralogical changes occurring on the exposed (weathered) surface may substantially affect water permeability measurements. By comparing data obtained on masonry that has been exposed to the elements with measurements made on unweathered samples, it is possible to measure the degree of weathering that has occurred.

Finally, RILEM Test Method II.4 can be used to evaluate the performance of a water repellent treatment. An effective treatment should substantially reduce surficial permeability of the masonry material to water. By so doing, the treatment will reduce the materials's vulnerability to water-related deterioration. A comparison of test results obtained on treated masonry samples with those obtained on untreated samples provides information about the degree of protection that can be provided by the water repellent treatment.

References

Amoroso, G. and Fassina, V. Stone Decay and Conservation. Amsterdam: Elsevier Science Publishers, 1983. (See especially Chapter 1, "Effects of water and soluble salts on stone decay".)

Hochman, Harry. "Measuring water permeability of masonry walls" (Technical Note N-1179). National Civil Engineering Laboratory, August 1971.

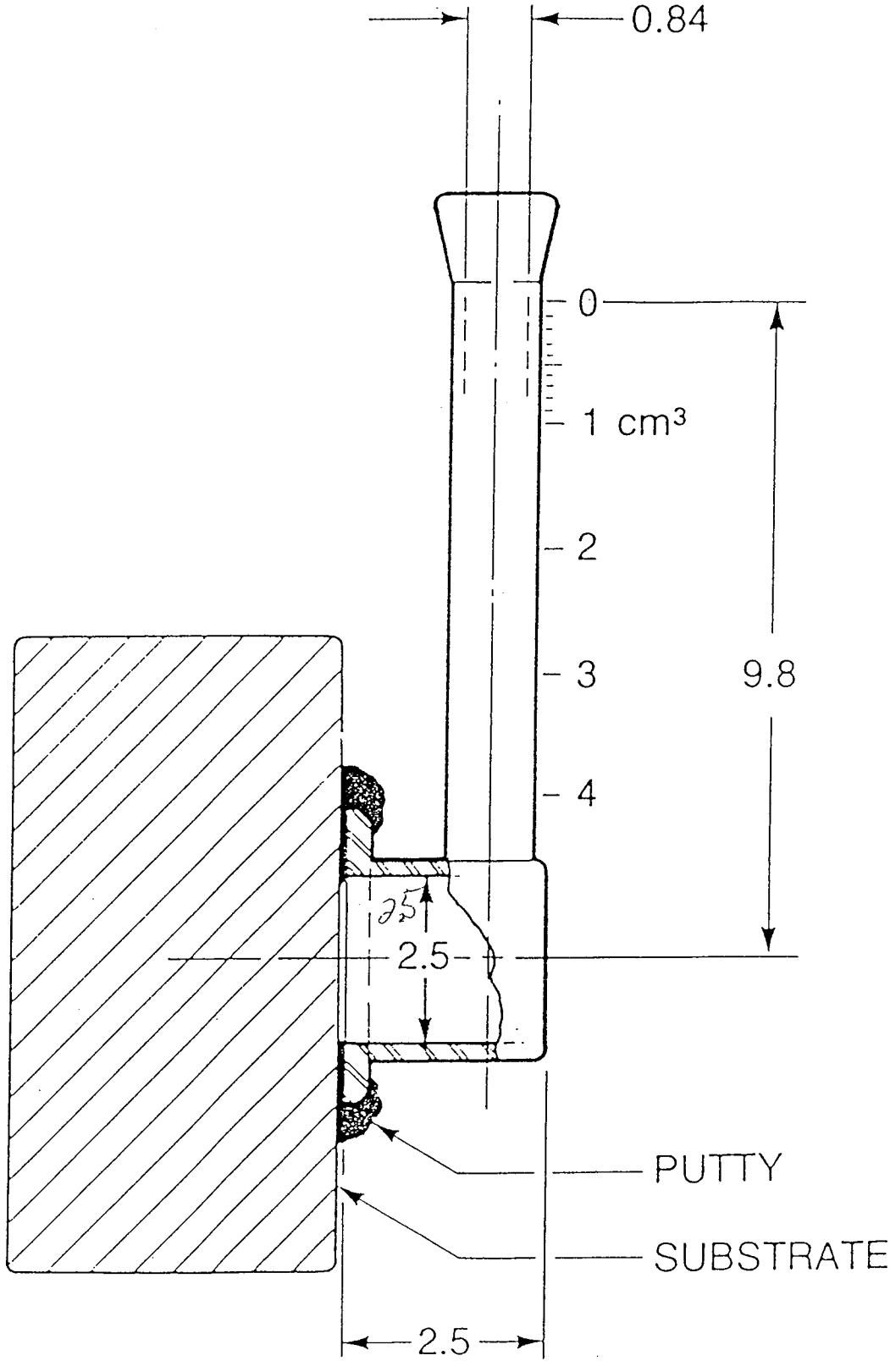
Sereda, P.J. and Feldman, R.H. "Wetting and Drying of Porous Materials" (Canadian Building Digest 130). Ottawa: National Research Council of Canada, 1975.

Sinner, Paulus; Winkler, Erhard; and Ibach, Matthias. "Permeability Measurements, an Indication of the State of Weathering and Consolidation of Building Stone". (Unpublished)

Stambolov, T. and van Asperen de Boer, J.R.J. The Deterioration and Conservation of Porous Building Materials and Monuments. Rome: ICCROM, 1976.

Torraca, Giorgio. Porous Building Materials. Rome: ICCROM, 1981.

Compiled by Frances Gale, September, 1987.



.Figure 1

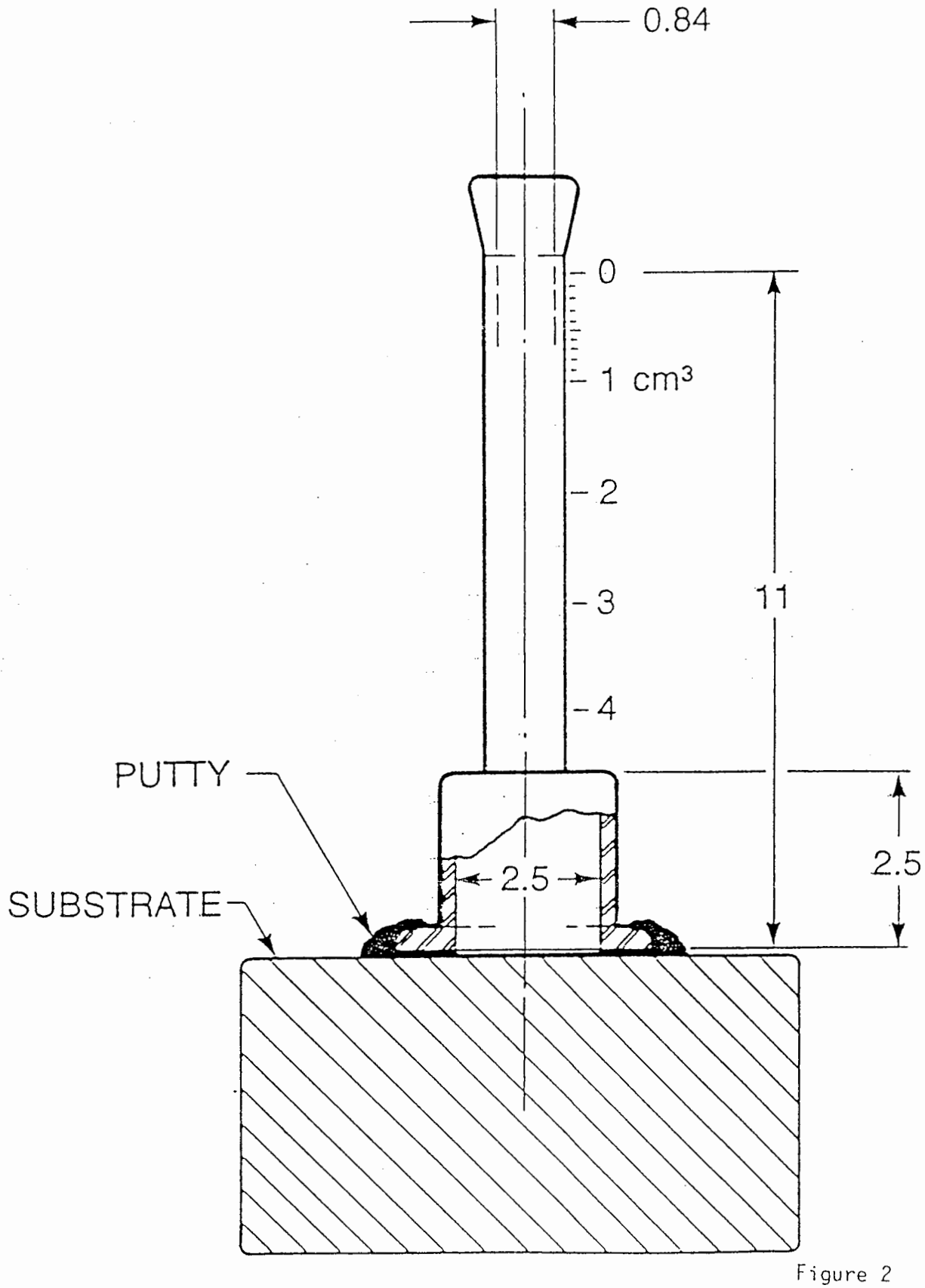


Figure 2