Designation: C110 – 20

Standard Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone[1]

This standard is issued under the fixed designation C110; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 These test methods cover physical testing of quicklime and hydrated lime, and of limestone not otherwise covered in ASTM standards.[2]

NOTE 1—Quicklime and hydrated lime have a high affinity for moisture and carbon dioxide. Caution should be taken to protect both hydrated and quicklime during sampling, storage, and testing (see Practice C50).

1.2 The test methods appear in the following order:

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

1.4 *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.*

1.5 *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:*[3]

C28/C28M Specification for Gypsum Plasters
C50 Practice for Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products
C51 Terminology Relating to Lime and Limestone (as Used by the Industry)
C91 Specification for Masonry Cement
C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)
C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
C150 Specification for Portland Cement

[1] These test methods are under the jurisdiction of ASTM Committee C07 on Lime and Limestone and are the direct responsibility of Subcommittee C07.06 on Physical Tests.

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[2] For tests on limestone as aggregate, see Vol 04.02 of the *Annual Book of ASTM Standards*. For tests on limestone as building stone, see Vol 04.05 of the *Annual Book of ASTM Standards.*

[3] 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.

C185 Test Method for Air Content of Hydraulic Cement Mortar
C188 Test Method for Density of Hydraulic Cement
C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
C204 Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus
C207 Specification for Hydrated Lime for Masonry Purposes
C230/C230M Specification for Flow Table for Use in Tests of Hydraulic Cement
C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
C430 Test Method for Fineness of Hydraulic Cement by the 45-μm (No. 325) Sieve
C472 Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete
C595 Specification for Blended Hydraulic Cements
C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
C702 Practice for Reducing Samples of Aggregate to Testing Size
C778 Specification for Standard Sand
C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in Physical Testing of Hydraulic Cements
C1107 Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
D75 Practice for Sampling Aggregates
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 Unless otherwise specified, for definitions of terms used in these test methods see Terminology C51.

4. General Procedures

4.1 *Sampling*—Samples of lime and limestone for physical analysis shall be taken and prepared in accordance with the requirements of Practice C50 applicable to the material to be tested.

4.2 *Calculation:*

4.2.1 The calculations included in the individual procedures sometimes assume that the exact weight specified has been used. Accurately weighed samples which are approximately but not exactly equal to the weight specified may be used provided appropriate corrections are made in the calculation. Unless otherwise stated, weights of all samples and residues should be recorded to the nearest 0.0001 g.

4.2.2 In all mathematical operations on a set of observed values, the equivalent of two more places of figures than in the single observed values shall be retained. For example, if observed values are read or determined to the nearest 0.1 mg, carry numbers to the nearest 0.001 mg in calculation.

4.3 *Rounding Figures*—Rounding of figures to the nearest significant place required in the report should be done after the calculations are completed, in order to keep the final results free from calculation errors. The rounding procedure should follow the principle outlined in Practice E29.

PLASTIC PROPERTY TESTING

5. Standard Consistency of Lime Putty

5.1 *Significance and Use:*

5.1.1 In order to measure certain physical properties of a lime putty, such as plasticity, it is necessary to have a uniform or standard consistency (viscosity), since the property measurement is affected by the consistency level.

5.2 *Apparatus:*

5.2.1 *Modified Vicat Apparatus*—The apparatus, constructed as shown in Fig. 1, shall consist of a bracket, *A*, bearing a movable brass rod, *B*, 6.3 mm in diameter and of suitable length to fit the Vicat bracket. A plunger, *C*, 12.5 mm in diameter, made of aluminum tubing, shall be attached to the lower end of the rod. The total weight of the rod with plunger shall be 30 g. The lower end of the plunger shall be closed without shoulders or curvature and the tube may be loaded with shot to the specified weight. The total weight required may also

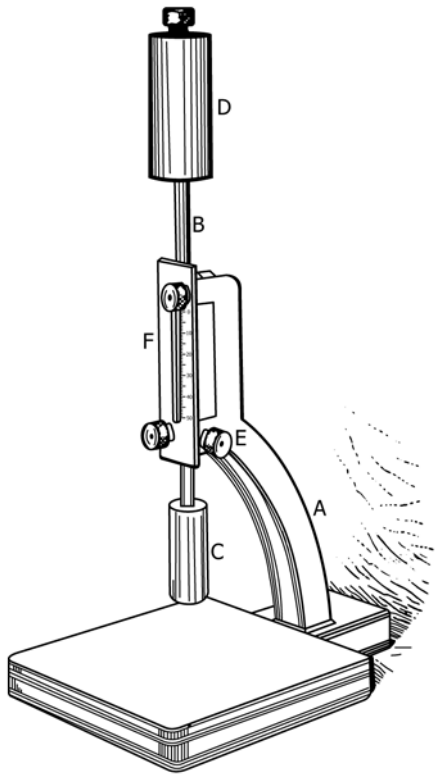


FIG. 1 Modified Vicat Apparatus

be obtained by means of a weight, *D*, screwed into the rod. The rod can be held in any position by means of a screw, *E*, and has a mark midway between the ends which moves under a scale, *F*, graduated in millimetres, attached to the bracket, *A*.

5.2.2 *Mold*—The conical ring mold shall be made of a noncorroding, nonabsorbent material, and shall have an inside diameter of 70 mm at the base and 60 mm at the top, and a height of 40 mm.

5.2.3 *Base Plate*—The base plate for supporting the ring mold shall be of plate glass and about 100 mm square.

5.2.4 *Mechanical Mixers.*

5.3 *Standard Consistency Determination:*

5.3.1 *Mechanical Mixing Procedure Using the Vac-U-Mixer*—To a measured amount of water contained in an 800 cm^3 Vac-U-Mix bowl, add 300 g of hydrated lime and hand mix for 10 s with a stiff spatula (Note 2). Cover putty to prevent evaporation of water. After the applicable soaking period, 30 min maximum for Type S, special hydrated lime, and not less than 16 h nor more than 24 h for Type N, normal hydrated lime, insert the paddle assembly and mix the putty for 30 s with the mechanical mixer. Remove the paddle assembly and scrape down any putty adhering to it and to the sides of the mixing bowl. Remix for 30 s and determine the consistency as prescribed in 5.3. If the penetration is less than 15 mm, return all of the material to the mixer bowl, add additional water, and remix for 15 s. If the penetration is greater than 25 mm, repeat the test.

NOTE 2—Most lime hydrates will require 250 to 300 mL of water to produce a putty of proper consistency for this test if 300 g of lime are used.

5.3.2 *Mechanical Mixing Procedure Using the Hobart N-50 Mixer*—To a measured amount of water contained in the N-50 mixing bowl, add 600 g of hydrated lime and hand mix for 10 s with a stiff spatula (Note 3). Cover putty to prevent evaporation of water. After the applicable soaking period, 30 min maximum for Type S, special hydrated lime, and not less than 16 h nor more than 24 h for Type N, normal hydrated lime, insert the paddle assembly and mix the putty for 1 min at a slow speed. Stop the mixer and scrape down the paddle and the sides of the mixing bowl. Remix for 4 min at a slow speed. Determine the consistency as prescribed in 5.3.3. If the penetration is less than 15 mm, return all of the material to the mixing bowl, add additional water, and remix for 15 s. If the penetration is more than 25 mm, repeat the test.

NOTE 3—Most lime hydrates will require 500 to 600 mL of water to produce a putty of proper consistency for this test if 600 g of lime are used.

5.3.3 *Consistency Determination*—To determine consistency, place the mold with its larger end resting on the glass base plate and fill with the lime putty. Then strike off the putty flush with the top of the mold. Center the lime putty, confined in the ring mold resting on the plate, under the rod of the modified Vicat apparatus (Fig. 1). Bring the plunger end, *C*, in contact with the surface of the lime putty and take an initial reading. Release the rod and take the final reading 30 s after the plunger is released. The lime putty is of standard consistency when a penetration of 20 ± 5 mm is obtained. Record both the total amount of water required to bring the putty to standard consistency and the actual penetration. Proceed with the plasticity determination in accordance with 6.3.

5.4 *Precision and Bias:*

5.4.1 The precision and bias of this test method has not been determined.

6. Plasticity of Lime Putty

6.1 *Significance and Use:*

6.1.1 This test method provides a measure of the degree of stiffening of lime putty of standard consistency as water is withdrawn from it by a standard suction base plate.

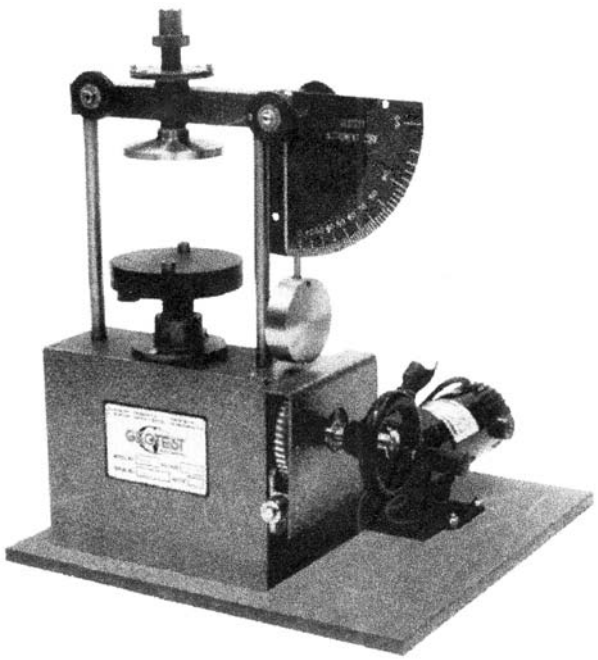
6.1.2 Plasticity is an important property when applying mixtures containing lime putty to porous or absorptive surfaces such as in plastering, stuccoing, and masonry construction.

6.2 *Apparatus:*

6.2.1 Determine the plasticity of lime putty using the plasticimeter shown in Fig. 2.[4]

6.2.2 *Cleaning and Care of Base Plates*—Base plates may be made of porcelain or plaster. In making the plasticity determinations, much of the success attainable depends upon the condition of the base plates. In the case of porcelain plates

[4] The sole source of supply of the apparatus known to the committee at this time is Geotest Instrument Corporation, 910 University Place, Evanston, IL 60201, USA. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.



Constants of the Machine:

Absorption of Porcelain and Plaster Base Plate—Minimum of 40 g in 24 h. For rate of absorption of base plates see 6.2.3.2.

Dimension of Base Plate—25 mm [1 in.] in thickness by 100 mm [4 in.] in diameter.

Dimensions of Disk—0.8 to 12.7 mm [1/32 to ½ in.] in thickness by 76 mm [3 in.] in diameter.

Speed of Vertical Shaft—One revolution in 6 min, 40 s.

Torque on Disk when Bob Reading is 100—1.41 N·m.

FIG. 2 Emley Plasticimeter