



Designation: D3155 – 11

Standard Test Method for Lime Content of Uncured Soil-Lime Mixtures¹

This standard is issued under the fixed designation D3155; 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 test method covers the determination of the lime content of soil-lime mixtures sampled from a project under construction or at the pug-mill, or both.

1.2 In soils with highly variable amounts of CaCO_3 (such as caliche), it may be difficult to obtain a representative sample.

1.3 The values stated in SI units are to be regarded as standard. The values stated in inch-pound units are provided for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

C51 Terminology Relating to Lime and Limestone (as used by the Industry)

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1193 Specification for Reagent Water

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology **C51** for terms relating to lime.

3.1.2 Refer to Terminology **D653** for terms relating to soil.

4. Summary of Test Method

4.1 A representative specimen is obtained after thorough mixing of the soil and lime and sieving through a 4.75-mm (No. 4) sieve.

4.2 A 300-g specimen of the material passing the 4.75-mm (No. 4) sieve is shaken together with 600 mL of ammonium chloride solution.

4.3 A 10-mL aliquot of fluid from 4.2 is mixed with 100 mL of water, and sodium hydroxide is added until a pH of 13.0 to 13.5 is obtained.

4.4 Triethanolamine and indicator powder is added to the solution and EDTA is used to titrate to a clear blue endpoint.

4.5 The mL of EDTA used is compared to a calibration curve to determine percent lime by dry mass of the total specimen.

5. Significance and Use

5.1 This test method can be used to determine the lime content of uncured soil-lime mixtures.

5.1.1 Lime content in soil-lime mixtures is needed by agencies such as highway departments, to determine lime content in soil-lime mixtures for payments to contractors, to check compliance with specifications, or to check the efficacy of quality control measures.

5.1.2 Lime content is also needed by producers of soil-lime mixtures who have to determine lime content for production control purposes.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice **D3740** are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice **D3740** does not in itself ensure reliable results. Reliable results depend on many factors; Practice **D3740** provides a means of evaluating some of those factors.

¹ This test method is under the jurisdiction of ASTM Committee **D18** on Soil and Rock and is the direct responsibility of Subcommittee **D18.15** on Stabilization With Admixtures.

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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.

*A Summary of Changes section appears at the end of this standard

6. Apparatus

6.1 *Balance*, a class GPI balance having a capacity of 1000 g or more and meeting the requirements of Specification **D4753** for a balance of 0.01-g readability.

6.2 *Glassware*—25-mL graduated cylinder, 1000-mL graduated cylinder, 2-L volumetric flask, 25-mL burets, 10-mL volumetric pipets, 250-mL Erlenmeyer flasks, medicine droppers.

6.3 *Plasticware*—1.9-L (2 qt) polyethylene containers with snap-on covers, 300-mm (12 in.) diameter plastic funnel, 19-L (5-gal) polyethylene bottles for ammonium chloride, 19-L (5-gal) polyethylene bottles for water.

6.4 *Buret Stand*, for 25-mL buret.

6.5 *Stirrer and Stirring Bar*, magnetic, or equivalent apparatus.

6.6 *Stirring Rods*, stainless steel, approximately 300 mm (12 in.) in length.

6.7 *pH Meter*—A pH meter equipped with reference electrode and low-sodium error glass pH-sensitive electrodes (or combination electrode) and a meter capable of displaying 0.01 units pH at 0.2 pH accuracy over a range from 0 to 14.

6.8 *Sieve*, 4.75-mm (No. 4), conforming to Specification **E11** required for soils containing particles larger than this size.

7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, references to water are understood to mean reagent water conforming to Specification **D1193**, Type II.

7.2 *Purity of Reagent Chemicals*—Use reagent grade chemicals in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the committee on Analytical Reagents of the American Chemical Society³, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2.1 *Ammonium Chloride Solution, 100 g/L*—Transfer 1893 g of USP granular ammonium chloride (NH_4Cl) to a 19-L (5-gal) polyethylene bottle. Dissolve it in 7.5 to 11.4 L (2 to 3 gal) of water. Dilute to 18.9 L (5 gal) with water, and mix well.

7.2.2 *EDTA Solution (0.1 M)*—Dissolve 74.45 g of reagent grade disodium (ethylenedinitrilo) tetraacetate dihydrate ($\text{Na}_2\text{C}_{10}\text{H}_{14}\text{N}_2\text{O}_8 \cdot 2\text{H}_2\text{O}$) powder in about 1 L (0.26 gal) of warm water in a beaker. Cool to room temperature, transfer to a 2-L volumetric flask, and dilute to 2 L with water. Store in a polyethylene bottle.

7.2.3 *Sodium Hydroxide Solution, 250 g/L*—With constant stirring, cautiously add 250 g of reagent grade sodium hydroxide (NaOH) pellets to 300 mL of water, stir until dissolved, and allow to cool to room temperature. Dilute to 1 L with water. Store in a polyethylene bottle.

7.2.4 *Triethanolamine Solution, 200 g/L*—Mix 100 mL of reagent grade triethanolamine ($(\text{HOCH}_2\text{CH}_2)_3\text{N}$) in 200 to 300 mL of water in a beaker, dilute to 500 mL, mix well, and store in a polyethylene bottle.

7.2.5 *Hydroxynaphthol Blue Indicator Powder* (CAS No. 63451354)⁴—An indicator for the determination of Calcium by titration with EDTA.

8. Preparation of Calibration Curve

8.1 From the soil and lime materials to be used for construction, prepare three sets of duplicate specimens at the design water content in order that they contain the following amount of lime:

8.1.1 *Set 1*—Two samples at 75 % of the design lime content,

8.1.2 *Set 2*—Two samples at 100 % of the design lime content,

8.1.3 *Set 3*—Two samples at 125 % of the design lime content.

8.2 For each specimen, compute quantities of soil, lime and water as follows:

$$M_s = S/(1 + W/100) \times (1 + L/100) \quad (1)$$

$$M_r = (R/100) \times M_s$$

$$M_f = M_s - M_r$$

$$M_l = (L/100) \times M_s$$

$$V_w = (W/100) (M_s - M_l)$$

M_s = total dry mass of soil, g,

M_r = mass of material retained on 4.75-mm (No. 4) sieve, g,

M_f = mass of material passing 4.75-mm (No. 4) sieve, g,

M_l = mass of lime, g,

V_w = volume of water, mL,

W = design water content, dry mass % of soil,

L = lime content, dry mass % of soil,

R = material retained on a 4.75-mm (No. 4) sieve, %, and

S = specimen size: 300.0 g when 100 % of the soil passes a 4.75-mm (No. 4) sieve; 700.0 g when soil is retained on a 4.75-mm (No. 4) sieve.

8.3 Mix the dry soil and lime thoroughly to a uniform color. Add the water and mix thoroughly until uniformly moist.

8.4 For soils with 100 % passing a 4.75-mm (No. 4) sieve, titrate each 300-g specimen as described in Section 10. After titrating the six specimens, construct a graph showing mL of EDTA solution versus mass percent lime using average figures from Sets 1, 2, and 3.

8.5 For soils with material retained on a 4.75-mm (No. 4) sieve, weigh a 700-g specimen. Screen the specimen thoroughly on a 4.75-mm (No. 4) sieve until all the material retained is free of smaller adhering particles. Mix the material passing the sieve, weigh a 300 g specimen, and titrate as described in Section 10. After titrating six specimens, construct

³ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions of the testing of reagents not listed by American Chemical Society *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K. and the *United States Pharmacopoeia*.

⁴ Available from Mallinckrodt Balur, Inc., Phillipsburg, NJ, as Product Code Number 5630.