



## Standard Specification for Agricultural Liming Materials<sup>1</sup>

This standard is issued under the fixed designation C 602; 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 Department of Defense.*

### 1. Scope

1.1 This specification covers agricultural liming materials, such as burnt lime (quicklime), hydrated lime, limestone, (calclitic and dolomitic), marl, shells, and byproducts including slag, and other materials.

1.2 The following precautionary caveat pertains only to the test method portion, Section 8: *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:

C 25 Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime<sup>2</sup>

C 125 Terminology Relating to Concrete and Concrete Aggregates<sup>3</sup>

D 3176 Practice for Ultimate Analysis of Coal and Coke<sup>4</sup>

E 11 Specification for Wire-Cloth and Sieves for Testing Purposes<sup>5</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *agricultural liming material*—a product whose calcium and magnesium compounds are capable of neutralizing soil acidity.

3.1.2 *air-cooled blast-furnace slag and granulated blast-furnace slag*—air-cooled blast-furnace slag and granulated blast furnace slag as defined in Terminology C 125.

3.1.3 *calcium carbonate equivalent (C.C.E.)*—the acid-neutralizing capacity (of an agricultural liming material) of the material expressed as weight percent of calcium carbonate.

### 4. Chemical Classifications

4.1 Agricultural liming materials shall be classified in terms

of calcium carbonate equivalent (C.C.E.), as shown in Table 1.

NOTE 1—Marl and some byproduct liming materials are used for neutralizing soil acidity, but due to their varying composition, their chemical limits are not included. In some economic circumstances limestone, slag, and shells of less than 80 % C.C.E. may be used.

### 5. Sieve Analysis Classifications for Agricultural Limestone

5.1 Agricultural limestone shall be classified according to the minimum percentages passing the No. 8 (2.36-mm) and No. 60 (250-μm) sieves conforming to Specification E 11, as shown in Table 2.

NOTE 2—These classifications apply where the agricultural limestone is obtained by the normal crushing procedure and the product contains the fines of fracture. In some economic circumstances, coarser products are used. The No. 60 (250-μm) sieve was selected because research has shown that this sieve gives a more accurate representation of the particle size distribution of most agricultural limestones presently produced than a finer or coarser sieve. The No. 8 (2.36-mm) sieve is used to control the upper limit on the amount of coarse limestone particles that may be in the product.

### 6. Sieve Analysis Classifications for Agricultural Slag

6.1 *Air-Cooled Blast-Furnace Slag*—Air-cooled blast-furnace slag shall be classified the same as agricultural limestone as shown in Section 5.

6.2 *Granulated Blast-Furnace Slag*—Granulated blast-furnace slag shall be classified in accordance with the minimum percentages passing the No. 8 (2.36-mm) and the No. 60 (250-μm) sieves.

### 7. Particle Size Requirements for Hydrated Lime and Burnt Lime

7.1 Hydrated lime and burnt lime for agricultural use shall be classified in accordance with the minimum percentages passing the No. 8 (2.36-mm) and No. 60 (250-μm) sieves, as follows:

|                   | Min. %        |            |
|-------------------|---------------|------------|
| Passing Sieve No. | Hydrated Lime | Burnt Lime |
| 8 (2.36 mm)       | 100           | 95         |
| 60 (250 μm)       | 97            | 35         |

### 8. Sampling

8.1 Agricultural liming materials shall be sampled using the following equipment and procedures:

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C07 on Lime, and is the direct responsibility of Subcommittee C07.03 on Industrial Uses.

Current edition approved Nov. 10, 1995. Published February 1996. Originally published as C 602 – 67 T. Last previous edition C 602 – 95.

<sup>2</sup> Annual Book of ASTM Standards, Vol 04.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 04.02

<sup>4</sup> Annual Book of ASTM Standards, Vol 05.05.

<sup>5</sup> Annual Book of ASTM Standards, Vol 14.02.

TABLE 1 Agricultural Liming Materials

| Material      | Calcium Carbonate Equivalent (C.C.E.), percent |
|---------------|------------------------------------------------|
| Burnt lime    | not less than 140                              |
| Hydrated lime | not less than 110                              |
| Limestone     | not less than 80                               |
| Slag          | not less than 80                               |
| Shells        | not less than 80                               |

TABLE 2 Classification for Agricultural Limestone

| Class Designation | Passing No. 8 (2.36-mm) Sieve, min, percent | Passing No. 60 (250-μm) Sieve, min, percent |
|-------------------|---------------------------------------------|---------------------------------------------|
| S                 | 100                                         | 100                                         |
| T                 | 99                                          | 75                                          |
| O                 | 95                                          | 55                                          |
| N                 | 90                                          | 40                                          |
| E                 | 80                                          | 25                                          |

### 8.1.1 Sampling Apparatus:

8.1.1.1 *Sampling Tube, or Probe*, of thin brass or other noncorroding metal  $\frac{3}{4}$  to 1 in. (19 to 25 mm) in diameter and 3 ft (915 mm) in length, fitted with a solid point and with an open side of which one edge is sharpened and flared so that upon turning, the liming material is forced into the tube.

8.1.1.2 *Soil Probe*, for sampling marl, 1 in. (25 mm) in diameter and 20 in. (508 mm) long with an open end and side.

8.1.1.3 *Pails*, galvanized iron, two, 2½-gal (0.5-L) capacity.

8.1.1.4 *Pointed Shovel*.

8.1.1.5 *Riffle with Pans*, as specified in Practice D 3176.

8.1.1.6 *Sample Containers*, airtight, vapor-proof, and moisture-resistant, such as polyethylene jars or metal cans, of 1-qt (946-cm<sup>3</sup>) and 1-gal (3784-cm<sup>3</sup>) capacities.

8.1.2 *Taking the Samples*—Samples shall be taken so as to represent an average of all parts of the lot, avoiding a disproportionate amount of surface material or of any modified or contaminated zone. Preferably, the sample shall be taken at the point of final weighing for sale.

8.1.2.1 *Burnt Lump Lime, in Bulk*—Collect a composite sample of not less than ten shovelful per car, or shipment, taking each shovelful from different parts of the mass. Crush immediately to pass a 2-in. (51-mm) diameter circular opening, mix thoroughly and rapidly, quarter down to a 5-lb (2.3-kg) sample and place immediately in a labeled, dry sample container.

8.1.2.2 *Hydrated Lime and Ground Burnt Lime in Bags*—Select ten bags from different parts of each lot, or shipment, of 20 tons (18 metric tons), or less, and one additional bag for each additional 5 tons (4.5 metric tons). From each selected bag, withdraw a core from top to bottom with the sampling tube, place these subsamples in a pail and then mix them by passing through the riffle three times, recombining the splits between each pass. After the third pass, by means of the riffle, reduce the sample to 2 lb (0.92 kg) and place in a labeled, dry sample container. Mix and reduce the sample rapidly to prevent either loss or absorption of moisture.

8.1.2.3 *Ground Limestone, Slag, Shells, and Marl, in Bags*—Proceed as in 8.1.2.2.

8.1.2.4 *Ground Limestone, Ground Burnt Lime, Hydrated Lime, Slag, Shells, and Marl, in Bulk*—Take at least ten subsamples, representative of the lot, from the lot (car, truck, or stockpile), using the sampling tube. If possible, the tube should be inserted to its full length, given a one-half turn and then removed. If the material is too hard for use of the probe, dig holes distributed over the entire surface of the mass, to a depth of about 2 ft (610 mm) and from the sides of the hole take approximately 1-pt (473-cm<sup>3</sup>) subsamples. Collect the subsamples in a pail and mix the sample by passing through the riffle three times, recombining the splits between passes. After the third pass, by means of the riffle, reduce the sample to 2 lb (0.92 kg) and place immediately in a labeled, dry sample container. Mix and reduce the sample rapidly to prevent loss or absorption of moisture. When the sample is too wet for adequate field mixing and reduction, the entire sample is dried in a laboratory dryer prior to mixing and reduction to size. Spread the sample in a dry, tared metal pan to a maximum depth of  $\frac{1}{2}$  in. (13 mm), weigh the pan and contents, dry, reweigh, and report the percentage lost. Mix the dry sample and reduce to size as specified above.

## 9. Chemical Methods

9.1 Reagent grade chemicals or equivalent and water purity shall be used as specified in Test Methods C 25.

9.2 The analytical sample for chemical methods relative to this standard shall be pulverized to pass a 60 mesh sieve.

9.3 The following chemical parameters are to be determined using the methods as specified in Test Methods C 25.

9.3.1 Calcium carbonate equivalent, and

9.3.2 *Total calcium and magnesium*—determination can be made either gravimetrically or by EDTA titration.

## SIEVE ANALYSIS OF AGRICULTURAL LIMING MATERIALS

### 10. Preparation of Sample

10.1 Dry the sample to constant weight at  $110 \pm 5^\circ\text{C}$  and store in an airtight container. Obtain the sample from a larger sample of the material to be tested by the use of a riffle or a sample splitter in accordance with Practice D 3176, or by the method of quartering. The sample for sieve analysis shall have a weight of 100 to 150 g.

10.2 Where limestone contains clay, some agglomeration of fine particles may occur. The agglomerates must be broken by rolling the dry sample with a hard rubber roller on a hard rubber mat or by some equally effective means that does not result in crushing the limestone.

### 11. Procedure

11.1 Weigh the dried sample to an accuracy of 0.1 g. Sieve the sample through an 8-in. (203-mm) diameter No. 8 (2.36-mm) sieve and an 8-in. diameter No. 60 (250-μm) sieve. The sieves shall conform to Specification E 11. Conduct the sieving operation by means of a lateral and vertical motion of this sieve, accompanied by a jarring action so as to keep the sample moving continuously over the surface of the sieve. Continue sieving until not more than 0.5 weight percent of the total sample passes either sieve during 1 min. The sieving operation

may be performed either by hand or by a mechanical apparatus. Determine the weight of liming material passing each sieve on a scale or balance sensitive to at least 0.1 g. Calculate the amount of liming material passing the No. 8 (2.36-mm) and the No. 60 (250-μm) sieves to the nearest whole percentage of the total weight of the dry sample.

## 12. Report

12.1 Report the following results for agricultural liming materials:

12.1.1 *Percentage Calcium Carbonate Equivalent*—The percentage calcium carbonate equivalent (C.C.E.) shall be reported on the as-received basis. Calculate as follows:

$$\text{C.C.E. (as-received)} = [1 - (\% \text{ moisture} \div 100)] \times \text{C.C.E. (oven-dry)} \quad (1)$$

12.1.2 *Percentage Moisture*—Calculate as follows:

$$\text{Moisture, \%} = \frac{\text{Weight of sample (as received)} - \text{oven-dry weight} \times 100}{\text{Weight of sample (as-received)}} \quad (2)$$

12.1.3 *Percentage Calcium and Magnesium*—The percentages of elemental calcium and elemental magnesium on the basis of the as-received sample.

12.1.4 *Sieve Analysis*—The amount of dried sample passing the No. 8 (2.36-mm) and No. 60 (250-μm) sieves as a percentage of the total weight of the dried sample with the figures rounded to the nearest whole percentage point.

## 13. Keywords

13.1 agricultural liming materials; agricultural limestone; burnt lime; calcium carbonate equivalent; hydrated lime; lime byproducts; limestone; slag

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