Designation: C911 – 06 (Reapproved 2011)

Standard Specification for Quicklime, Hydrated Lime, and Limestone for Selected Chemical and Industrial Uses[1]

This standard is issued under the fixed designation C911; 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 specification covers lime and limestone products suitable for the following chemical and industrial uses:

Cooking rags
Sulfite pulp
Silica brick
Other water treatment uses
Calcium carbide
Grease
Calcium silicate products
Hypochlorite (bleach)

The following uses are addressed in other ASTM standards:

Use	Standard(s)
Neutralization of Waste Acid (Test Methods)	C400
Agricultural Liming Materials	C602
Soil Stabilization	C977
Asphalt	C1097
Flue Gas Desulfurization (Test Methods)	C1318
Drinking Water Softening	C1529
Waste and Wastewater Neutralization	C1529
Wastewater Treatment Plant Residuals (Biosolids) Stabilization	C1529 and D6249

1.2 The type designations in Table 1 signify the following:

Limestone, high-calcium—CL
Limestone, dolomitic—DL
Limestone, magnesian—ML
Quicklime, high-calcium—CQ
Quicklime, dolomitic—DQ
Quicklime, magnesian—MQ
Hydrated lime, high-calcium—CH
Hydrated lime, dolomitic—DH
Hydrated lime, magnesian—MH

1.3 The buyer shall designate the use, as listed in Table 1, and may specify one or more of the type designations in 1.1.

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]

C25 Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
C50 Practice for Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products
C110 Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone
C400 Test Methods for Quicklime and Hydrated Lime for Neutralization of Waste Acid
C602 Specification for Agricultural Liming Materials
C977 Specification for Quicklime and Hydrated Lime for Soil Stabilization
C1097 Specification for Hydrated Lime for Use in Asphalt Cement or Bituminous Pavements
C1318 Test Method for Determination of Total Neutralizing Capability and Dissolved Calcium and Magnesium Oxide in Lime for Flue Gas Desulfurization (FGD)
C1529 Specification for Quicklime, Hydrated Lime, and Limestone for Environmental Uses
D6249 Guide for Alkaline Stabilization of Wastewater Treatment Plant Residuals

3. Chemical Composition

3.1 The requirements for quicklime, hydrated lime, and limestone for the selected end uses are as shown in Table 1, and are on the basis of the weight of sample taken at the place of manufacture, except as noted in footnote *B* after the requirement. In this case, the requirement is on a moisture and carbon dioxide-free basis.

NOTE 1—Rags are cooked for the manufacture of paper in a digester under steam pressure with lime or with lime and soda ash. They are then washed to eliminate as much of the noncellulose material as possible. A standard composition without rejection limits is specified for the reason that lime of either higher or lower total oxides, available lime, calcium oxide, or calcium hydroxide than the standard, may safely be used under

[1] This specification is under the jurisdiction of ASTM Committee C07 on Lime and is the direct responsibility of Subcommittee C07.02 on Specifications and Guidelines.

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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**

TABLE 1 Lime and Limestone for Chemical and Industrial Uses

Use	ASTM Specification[A]	Notes Referenced	Approved Types of Lime or Stone	Chemical Requirements, %									
				CaO min	CaO, +MgO min	SiO_2 +Fe_2O_3, +Al_2O_3, max	MgO, max	CO_2, max	SiO_2 + insoluble matter, max	Al_2O_3 + Fe_2O_3, max	Available CaO, min	Fe_2O_3, max	Chemical Other
Cooking rags	C45	1	CH	...	...	...	...	...	...	...	64.3[B]	...	...
Cooking rags	C45	1	CQ	...	...	...	...	...	...	...	90.0[B]	...	...
Sulfite pulp	C46	2	CQ, MQ	...	95.0[C]	3.0[C]	...	...	...	...	...	...	...
Sulfite pulp	C46	2	CL, ML	...	95.0[C]	3.0[C]	...	...	...	...	...	...	...
Silica brick	C49	3	CH	90[C]	...	...	2.5[C]	2.5	3.0[C]	1.5[C]	...	...	{Free CaO
Silica brick	C49	3	CQ	90[C]	...	...	2.5[C]	2.5	3.0[C]	1.5[C]	...	...	≤1.5
Other water treatment uses	C53	4	CQ, DQ, MQ	...	93.0	...	...	...	...	...	...	...	...
Other water treatment uses	C53	4	CH, DH, MH	...	93.0[C]	...	...	...	...	...	...	...	...
Calcium Carbide	C258		CQ	92[C]	...	...	1.75[C]	4.0	2.0[C]	1.0[C]	...	0.5	P≤ 0.02[C] {S ≤ 0.2[C]
Grease	C259		CH	...	...	...	1.5	...	1.0	...	...	0.5	available {Ca (OH)$_2$ ≥90
Calcium silicate products	C415		CH	90[C]	...	...	1.3[C]	2.5	3.0[C]	1.5[C]	...	...	...
Calcium silicate products	C415		CQ	90[C]	...	...	1.3[C]	2.5	3.0[C]	1.5[C]	...	...	...
Hypochlorite (bleach)	C433	5	CH	...	...	...	...	...	...	...	68	0.3[C]	...
Hypochlorite (bleach)	C433	5	CQ	...	...	...	...	...	...	...	90	...	...

[A] These specifications have all been incorporated into the current issue of this specification and are now discontinued. The discontinued specifications are available through Global Engineering Documents, 15 Inverness Way, East Englewood, CO 80112–5704.
C45 Specification for Quicklime and Hydrated Lime for Cooking of Rags in Paper Manufacture
C46 Specification for Quicklime and Limestone for Sulfite Brick Manufacture
C49 Specification for Quicklime and Hydrated Lime for Silica Brick Manufacture
C53 Specification for Quicklime and Hydrated Lime for Water Treatment
C258 Specification for Quicklime for Calcium Carbide Manufacture
C259 Specification for Hydrated Lime for Grease Manufacture
C415 Specification for Quicklime and Hydrated Lime for Calcium Silicate Products
C433 Specification for Quicklime and Hydrated Lime for Hypochlorite Bleach Manufacture
[B] Standard composition.
[C] On a nonvolatile basis.

suitable conditions for the purpose herein specified, depending primarily upon economic considerations. In the present state of the art, it is believed that the more serviceable type of specification for the product herein specified is that which defines a reasonable standard rather than one that fixes actual rejection limits. It is generally recognized that, other things being equal, lime meeting this standard is preferable to lime that does not, and lime surpassing the standard should be considered of premium quality.

NOTE 2—Lime is used in the "milk of lime" or "tank" system of sulfite pulp manufacture for making the cooking liquor. The milk of lime is held in solution or suspension in a series of tanks equipped with suitable agitators. The sulfur dioxide (SO_2) is forced or drawn through these tanks successively. In some cases, the tanks are built on top of each other in the form of a tower. The contents of the first tank are drawn off when the liquor has reached a certain strength (3.5 to 6 % total SO_2) and the contents of the second and third tanks progress to the first and second tanks respectively. The third tank is again charged with fresh milk of lime. There are other systems of absorption that provide for continuous instead of intermittent operation. The function of the lime is to furnish the base for the formation of the bisulfites of calcium and magnesium.

NOTE 3—In the manufacture of silica brick, silica in the form of massive quartzite or quartz conglomerate is ground until the particles are less than ¼ in. (6 mm) in size. Lime in the form of either slaked or hydrated lime is then added in quantities varying from 1.5 to 3.0 % calcium oxide (CaO), with sufficient water to produce about 5 to 7 % moisture content, and the shapes are molded and dried. They are then burned in downdraft or tunnel kilns until most of the quartzite has been converted into tridymite or cristobalite.

NOTE 4—For most water treatment applications, such as color removal and clarification of water for municipal and industrial supplies, high-calcium lime is preferred. However, for applications involving silica removal from boiler feedwater, dolomitic lime is usually preferred. Drinking water softening and wastewater neutralization are addressed in Specification C1529.

NOTE 5—In manufacture of calcium hypochlorite bleach, lime hydrate in water suspension is reacted with chlorine. Lime hydrate suitable for this application should be rapidly reactive, low in sludge-forming impurities, and particularly low in iron oxide, that may catalyze bleach decomposition.

4. General Requirements

4.1 Quicklime shall be reasonably free of unslakable residues and shall be capable of disintegrating in water to form a suspension of finely divided material.

5. Sampling and Inspection

5.1 Conduct the sampling, inspection, rejection, retesting, packaging, and marking in accordance with Methods C50.

6. Test Methods

6.1 The chemical analyses shall be made in accordance with Test Methods C25.

6.2 The physical tests shall be made in accordance with Test Methods C110.

7. Keywords

7.1 by-product lime; calcium oxide; calcium silicate; chemical uses; color removal; dolomitic hydrated lime; dolomitic lime; dolomitic limestone; dolomitic quicklime; high calcium hydrated lime; high calcium limestone; high calcium quicklime; hydrated lime; hypochlorite bleach; industrial uses; lime; limestone; magnesian hydrated lime; magnesian limestone; magnesian quicklime; quicklime; silica brick; silica removal; sulfite pulp

APPENDIX

(Nonmandatory Information)

X1. TEST METHOD FOR FREE CALCIUM OXIDE IN HIGH-CALCIUM HYDRATED LIME

X1.1 Scope

X1.1.1 This test method covers the determination of the amount of free calcium oxide (CaO) in high-calcium hydrated lime capable of being hydrated by steam at atmospheric pressure.

X1.2 Summary of Test Method

X1.2.1 This test method is based on the principle of gain in weight of CaO when it is hydrated to form calcium hydroxide ($Ca(OH)_2$).

X1.2.2 The sample is dried, subjected to steam at atmospheric pressure, again dried, and the gain in weight calculated to CaO.

X1.3 Apparatus

X1.3.1 *Drying Oven,* thermostatically controlled, CO_2-free atmosphere.

X1.3.2 *Analytical Balance.*

X1.3.3 *Steam Bath,* as shown in Fig. X1.1.

X1.4 Procedure

X1.4.1 Weigh a clean, dry, 10-mL Erlenmeyer flask on an analytical balance.

NOTE X1.1—Once started, complete the test without interruption.

X1.4.2 Add to the flask, by means of a widestem funnel, 3 to 5 g of the lime to be tested. Reweigh to get the exact sample weight.

NOTE X1.2—The flask should be kept stoppered at all times, except when weighing, drying, or steaming.

X1.4.3 Place the flask in the drying oven that has been previously heated to 120 °C, and maintain at this temperature for 30 min. Remove, stopper, cool in a desiccator, and weigh.

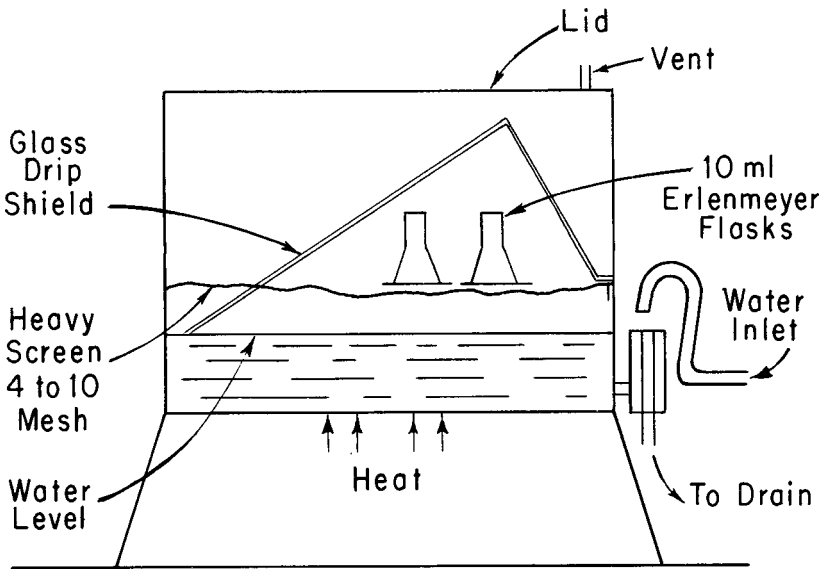

FIG. X1.1 Steam Chamber

NOTE X1.3—Oven atmosphere can be kept CO_2 free by placing therein a container of soda lime, quicklime, or other suitable CO_2-absorbing medium.

X1.4.4 Place the flask and the sample in a vigorously boiling steam bath and steam for 30 min. Protect the flask in the steam bath by a drip shield during the steaming period. Remove the flask to the oven, dry for 30 min at 120 °C, stopper, cool in a desiccator, and weigh.

X1.4.5 Record all weighings to the fourth decimal place.

X1.5 Calculation

X1.5.1 Calculate the percentage of water and CaO as follows:

$$\text{Free water, } \% = [(W_1 - W_2)/S] \times 100 \quad \text{(X1.1)}$$

$$\text{Free CaO, } \% = \frac{(W_3 - W_2) \times 3.114}{S} \times 100$$

where:

W_1 = weight of sample and flask before drying,
W_2 = weight of sample and flask after drying,
W_3 = weight of sample and flask after steaming and drying, and
S = weight of sample.

SUMMARY OF CHANGES

Committee C07 has identified the location of selected changes to this specification since the last issue, C911 – 05, that may impact the use of this specification. (Approved November 15, 2006)

(*1*) Revised 1.1, moving part of it to new 1.2, and renumbered subsequent paragraphs.

(*2*) Revised Note 4.

(*3*) Revised the Use column in Table 1.