
Standard Specification for Silica Fume Used in Cementitious Mixtures

AASHTO Designation: M 307-22

Technically Revised: 2022

Technical Subcommittee: 3a, Cement, Lime, and Concrete Materials

ASTM Designation: C1240-20



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This specification covers silica fume for use in concrete and other systems containing hydraulic cement.
 - 1.2. In the cases of slurried or densified silica fume, perform the tests on the raw silica fume from which these products have been made.
 - 1.3. The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.
 - 1.4. The following safety hazards caveat pertains only to the test methods portions, Section 10, of this specification: *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 to determine the applicability of regulatory limitations prior to use.* Read the material safety data sheets for materials used.
 - 1.5. The text of this standard references notes and footnotes that provide explanatory information. These notes and footnotes (excluding those in tables) shall not be considered as requirements of this standard.
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
 - M 194M/M 194, Chemical Admixtures for Concrete
 - M 201, Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 71, Sampling and Amount of Testing of Hydraulic Cement
 - T 105, Chemical Analysis of Hydraulic Cement
 - T 106M/T 106, Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
 - T 137, Air Content of Hydraulic Cement Mortar
 - T 192, Fineness of Hydraulic Cement by the 45- μ m (No. 325) Sieve
- 2.2. *ASTM Standards:*
 - C125, Standard Terminology Relating to Concrete and Concrete Aggregates

- C135, Standard Test Method for True Specific Gravity of Refractory Materials by Water Immersion
- C219, Standard Terminology Relating to Hydraulic and Other Inorganic Cements
- C311/C311M, Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
- C441/C441M, Standard Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
- C604, Standard Test Method for True Specific Gravity of Refractory Materials by Gas-Comparison Pycnometer
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- C1005, Standard Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements
- C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
- C1069, Standard Test Method for Specific Surface Area of Alumina or Quartz by Nitrogen Adsorption
- C1157/C1157M, Standard Performance Specification for Hydraulic Cement
- C1437, Standard Test Method for Flow of Hydraulic Cement Mortar
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard:*

- IEC 60584-1:2013 Thermocouples - Part 1: EMF Specifications and Tolerances

3. TERMINOLOGY

3.1. *Definitions:*

- 3.1.1. *silica fume*—a very fine pozzolanic material, composed mostly of amorphous silica produced by electric arc furnaces as a by-product of the production of elemental silicon or ferro-silicon alloys (also known as condensed silica fume and microsilica).
- 3.1.2. *silica fume, densified*—silica fume processed to increase bulk density to facilitate handling and shipping.
- 3.1.3. *silica fume, undensified*—silica fume in its raw, as produced or as collected, unprocessed form.
- 3.1.4. Other terms in this specification are defined in ASTM C125 and C219.

4. ORDERING INFORMATION

- 4.1. The purchaser shall specify any optional chemical or physical requirements.

5. CHEMICAL REQUIREMENTS

- 5.1. Silica fume shall conform to the requirements for chemical composition prescribed in Table 1.

Table 1—Chemical Requirements

Silicon dioxide (SiO ₂), min percent	85.0
Moisture content, max percent	3.0
Loss on ignition, max percent	6.0

6. PHYSICAL REQUIREMENTS

- 6.1. Silica fume shall conform to the physical requirements prescribed in Table 2. Optional physical requirements are shown in Table 3.

Table 2—Physical Requirements

Oversize	
Percent retained on 45-μm (No. 325) sieve, max percent ^a	10
Percent retained on 45-μm (No. 325) sieve, max variation from average, percentage points ^b	5
Accelerated pozzolanic strength activity index: ^c	
With portland cement at 7 days, min percent of control	105
Specific surface, min, m ² /g	15

^a Exercise care to avoid retaining agglomerations of extremely fine material.

^b The average shall consist of the ten preceding tests or all of the preceding tests if the number is less than 10.

^c Accelerated pozzolanic strength activity index is not to be considered a measure of the compressive strength of concrete containing the silica fume. This is a measure of the reactivity of a given silica fume with a given cement and may vary with the source of both the silica fume and the cement.

Table 3—Optional Physical Requirements^a

Uniformity requirements	
If air-entraining concrete is specified, the quantity of air-entraining agent required to produce an air content volume of 18 percent of the mortar shall not vary from the average established by the 10 preceding tests, or by all preceding tests if less than 10, percent	20
Reactivity with cement alkalis: ^b	
Reduction of mortar expansion at 14 days, min, percent ^a	80
Sulfate resistance expansion: ^c	
(moderate resistance) 6 mos, max, percent	0.10
(high resistance) 6 mos, max, percent	0.05
(very high resistance) one year, max, percent	0.05

^a Optional physical requirements will be made only at the request of the purchaser.

^b The indicated tests for reactivity with cement alkalis should not be requested unless the material is to be used with an aggregate that is regarded as deleteriously reactive with alkalis in hydraulic cement. The test for reduction of mortar expansion may be made using any high-alkali cement in accordance with ASTM C311/C311M if the cement to be used in the work is not known or is not available at the time of the test. The test for mortar expansion should be performed by each of the high-alkali cements to be used in the work.

^c Only one limit shall be specified.

7. SAMPLING

- 7.1. If the purchaser desires that the silica fume be sampled and tested to verify compliance with this specification, perform the sampling and testing in accordance with R 71, modified as described in Section 7.3.

Note 1—Exercise caution in the interpretation of R 71 because there is a difference between the continuous manufacture of hydraulic cement and the generation and collection of silica fume. To a great extent, storage is dictated by the design of the silica fume collection system. The design of silica fume collection systems may not have provided for sampling points and practices.