
Standard Method of Test for Determination of Composite Activation Energy of Aggregates due to Alkali-Silica Reaction (Chemical Method)

AASHTO Designation: T 364-22¹

Technically Revised: 2022

Technical Subcommittee: 3c, Hardened Concrete



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1. SCOPE

- 1.1. This test method covers chemical determination of the reactivity of an as-received fine and coarse aggregate in terms of measuring composite activation energy of alkali–silica reaction (ASR), where aggregate reacts with an alkaline solution having chemistry similar to the pore solution chemistry of a conventional portland cement concrete.
- 1.2. *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. A specific precautionary statement is given in the section on reagents.*
- Note 1**—The values stated in SI units are to be regarded as standard. The values in inch-pound units are shown in parentheses and are for informational purposes only.
- 1.3. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 6, Fine Aggregate for Hydraulic Cement Concrete
 - M 43, Sizes of Aggregate for Road and Bridge Construction
 - M 80, Coarse Aggregate for Hydraulic Cement Concrete
 - M 231, Weighing Devices Used in the Testing of Materials
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - R 76, Reducing Samples of Aggregate to Testing Size
 - R 90, Sampling Aggregate Products

- < T 11, Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- < T 19M/T 19, Bulk Density ("Unit Weight") and Voids in Aggregate
- < T 27, Sieve Analysis of Fine and Coarse Aggregates
- < T 303, Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction

2.2. *ASTM Standards:*

- < A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- < B21/B21M, Standard Specification for Naval Brass Rod, Bar, and Shapes
- < C125, Standard Terminology Relating to Concrete and Concrete Aggregates
- < C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- < D1193, Standard Specification for Reagent Water
- < E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- < E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

2.3. *International Electrotechnical Commission Standard:*

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

3. SIGNIFICANCE AND STANDARD USE

- 3.1. This test is intended to offer a rapid and reliable ASR standard test method. The as-received aggregate is immersed in an alkaline solution and allowed to react at different temperatures (i.e., 60, 70, and 80°C (140, 158, and 176°F)). The test measures solution volume change (i.e., volume contraction) in a closed system over time (96 to 100 h) as the reaction between aggregates and solution proceeds.
- 3.2. The test method determines the aggregate composite activation energy (CAE) of ASR. CAE is a measure of the aggregate alkali-silica reactivity of an aggregate. For example, the lower the CAE, the higher the reactivity and vice versa. CAE is used to develop an ASR aggregate classification system, which can be used as an effective screening parameter to categorize aggregates based on their reactivity.
- 3.3. The test method reliably predicts aggregate alkali reactivity in a short period of time (within 5 days) and can effectively be used as an alternative to the current test method(s) (e.g., T 303 or ASTM C1260).

4. APPARATUS

- 4.1. *Scales*—The scales and weights used for weighing materials shall conform to the requirements prescribed in M 231.
- 4.2. *Crushing Equipment*—It is recommended to collect aggregates from stockpile with 1-in. maximum size in order to avoid crushing. However, if any coarse aggregate contains particles with maximum size ≥ 37.5 mm (≥ 1.5 in.) then crush using suitable crushing equipment (e.g., a hand hammer) material larger than the 37.5-mm (1.5-in.) sieve to pass the 37.5-mm (1.5-in.) sieve.
- 4.3. *Sieves*—A 25.4-mm (1-in.), 12.5-mm ($1/2$ -in.), 4.75-mm (No. 4), 2.36-mm (No. 8), 1.18-mm (No. 16), 600- μ m (No. 30), 300- μ m (No. 50), or 150- μ m (No. 100) sieve.

- 4.4. *Vacuum Pump*—A small vacuum pump or other suitable equipment capable of applying a vacuum pressure of 76.2 cmHg (30 in.Hg).
- 4.5. *Vibrating Table*—The use of a vibrating table with variable-speed operation facilitates removal of air bubbles from solution through agitating aggregate particles during vacuuming (see Section 4.4).
- 4.6. *Glassware*—All glass apparatus and vessels should be carefully selected to meet the particular requirements for each operation. Standard volumetric flasks, burets, and pipets should be of precision grade.
- 4.7. *Dilatometer Device*—The dilatometer device (see Figure 1, Note 2) consists of a stainless steel container (Figure 1a), a brass lid (Figure 1a), a stainless steel hollow tower (Figure 1b), a brass housing to hold a linear variable differential transducer (LVDT) with vertical alignment (Figures 1c and 1d), and a float system consisting of a stainless steel float, a threaded rod, and an LVDT rod (Figure 2). A detailed drawing of the assembled system is provided in Figure 1. The detailed drawings of the individual parts are provided in Figures 1a, 1b, 1c, and 1d respectively. One end of the tower (Figure 1b) is screwed into the lid (Figure 1a), and the other end is screwed into the LVDT housing (Figure 1c) with O-rings in all three junctions (i.e., [1] between the container and lid, [2] between the lid and tower, and [3] between the tower and LVDT housing). The LVDT (Note 3) is placed in the center hole of the LVDT housing and pushed into an O-ring placed at the bottom of the LVDT. The six set screws located through the side of the housing are properly tightened to ensure a vertical alignment of the LVDT.

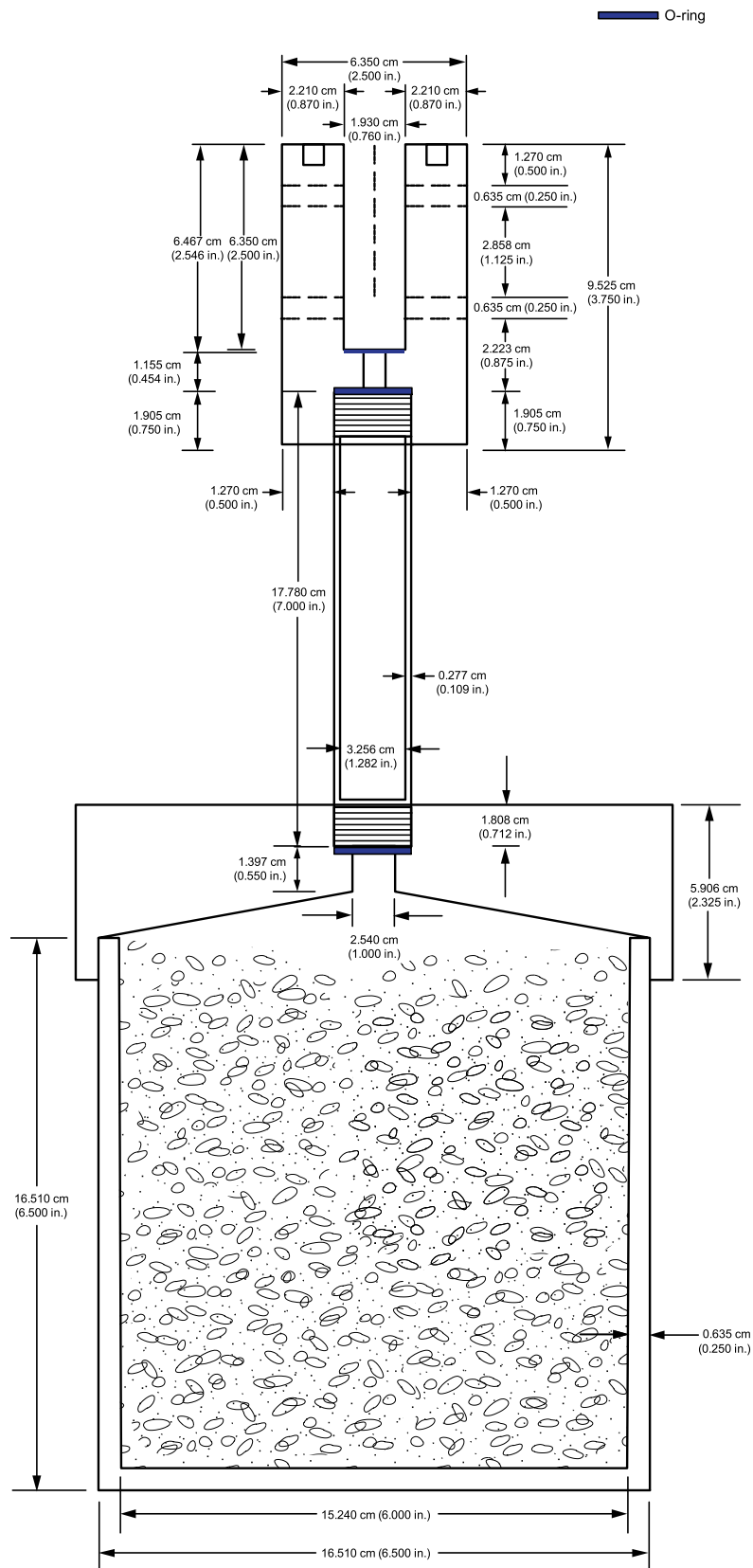


Figure 1—Cross-Sectional View of the Device