Standard Method of Test for

Potential Alkali Reactivity of Aggregates and Effectiveness of ASR Mitigation Measures (Miniature Concrete Prism Test, MCPT)

AASHTO Designation: T 380-19[1]

Technical Subcommittee: 3c, Hardened Concrete

Release: Group 1 (April)

AASHTO

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1. SCOPE

1.1. This test method allows detection of the potential for deleterious alkali–silica reaction of aggregate in miniature concrete prisms within 56 days (8 weeks) for most of the aggregates. An additional 28 days (4 weeks) may be necessary in the case of low/slow reacting aggregates to assess their potential reactivity. To assess the effectiveness of mitigation measures of SCMs (supplementary cementitious materials, such as fly ash, slag, silica fume, and others); the test method is conducted for 56 days.

1.2. 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. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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. *AASHTO Standards*:

- M 85, Portland Cement
- M 201, Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- R 70M/R 70, Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete
- 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*:

- C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete
- C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

- C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- C295/C295M, Standard Guide for Petrographic Examination of Aggregates for Concrete
- C490/C490M, Standard Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete
- C511, Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- C702/C702M, Standard Practice for Reducing Samples of Aggregate to Testing Size
- C778, Standard Specification for Standard Sand
- C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- D75/D75M, Standard Practice for Sampling Aggregates
- D1193, Standard Specification for Reagent Water

2.3. *Federal Standard*:

- Fed. Std. No. 29, CFR 1910.1200 OSHA Hazard Communication Standard; see also Permissible Exposure Limits—Annotated Tables, https://www.osha.gov/dsg/annotated-pels/

3. SIGNIFICANCE AND USE

3.1. Alkali–silica reaction (ASR) is a chemical reaction between certain forms of reactive silica present in aggregates and alkali hydroxides present in the concrete pore solution. The alkali ions (Na^+ and K^+) are primarily derived from portland cement, although other sources can potentially elevate their concentration in the pore solution.

3.2. This test method is intended to evaluate the potential of an aggregate (fine and coarse) to expand deleteriously due to any form of alkali–silica reactivity. A companion nonreactive aggregate should be used with a reactive aggregate in question. Also, this test method is intended to assess the effectiveness of various mitigation measures.

3.3. When selecting a sample or deciding on the number of samples for test, it is important to recognize the variability in lithology of material from a given source, whether a deposit of sand, gravel, or a rock formation of any origin. For specific advice, see ASTM C295/C295M.

3.4. MCPT was developed as an alternative to the existing standard test methods such as ASTM C1260 and ASTM C1293 to evaluate aggregate reactivity. This test method was developed with some modifications to standard test methods T 303 (ASTM C1260) and ASTM C1293. When evaluating coarse aggregate reactivity, MCPT has the advantage of not requiring the coarse aggregate to be crushed into smaller (sand-sized) particles, as typically required in ASTM C1260 Also, the MCPT method yields test results in 8 weeks to characterize the aggregate reactivity, which is much shorter than the test duration required in ASTM C1293.

3.5. The total alkali content of the cement used in this test method should have a Na_2O_{eq} content of 0.90 ± 0.10 percent.

3.6. For the vast majority of the aggregates that are either nonreactive or moderately to highly reactive, this test characterizes the aggregate reactivity in 8 weeks. For some specific aggregates that have a tendency to exhibit low/slow reactivity, an additional 4 weeks of testing is required. For the purpose of providing guidance on aggregate reactivity characterization, the following general guidelines are used in classifying the aggregate:

3.6.1. Very highly/highly reactive aggregates are considered as those aggregates that, when present in concrete with typical alkali loading (3 to 5 lb/yd^3), exhibit incipient signs of ASR distress in the field, typically at an age less than 5 years.

3.6.2. Moderate reactive aggregates are considered as those aggregates that, when present in concrete with typical alkali loading (3 to 5 lb/yd^3), exhibit incipient signs of ASR distress in the field, typically at an age between 5 and 10 years.

3.6.3. Low/slow reactive aggregates are considered as those aggregates that, when present in concrete with typical alkali loading (3 to 5 lb/yd^3), exhibit incipient signs of ASR distress in the field, typically at an age beyond 10 years.

3.7. Results of tests conducted as described herein should form a part of the basis for a decision as to whether precautions should be taken against excessive expansion due to alkali–silica reaction. This decision should be made before a particular aggregate is used in concrete construction.

3.8. The basic intent of this test method is to develop information on a particular aggregate at a specific alkali level of 5.25 kg/m^3 (8.85 lb/yd^3). It has been found that this high alkali level is required to detect the effects of certain deleteriously reactive aggregates.

3.9. When the expansions in this test method are greater than the limit (0.040 percent) shown in Table 1, the aggregate is potentially alkali reactive. An additional 28 days (4 weeks) may be necessary in the case of low/slow reacting aggregates (percent expansion between 0.031 and 0.040 percent) to assess their potential reactivity based on rate of expansion. When the expansions are ≤0.030 percent, then the aggregate is considered nonreactive.

Table 1—Proposed Criteria for Characterizing the Aggregate Reactivity in the MCPT Protocol

Degree of Reactivity	Expansion at 56 Days, % (8 Weeks)	Average 2-Week Rate of Expansion from 8 to 12 Weeks[a]
Nonreactive	≤0.030	N/A[b]
Nonreactive	0.031–0.040	≤0.010% per 2 weeks
Low/slow reactive	0.031–0.040	>0.010% per 2 weeks
Moderate reactive	0.041–0.120	N/A[b]
Highly reactive	0.121–0.240	N/A[b]
Very highly reactive	>0.240	N/A[b]

[a] Example calculation for averaged rate of expansion from 8 to 12 weeks:
If the average expansions of the three prisms at 8, 10, and 12 weeks are 0.035 percent, 0.046 percent, and 0.059 percent, respectively, then the average rate of expansion between 8 to 12 weeks is equal to (0.059 – 0.037)/2 = 0.012 percent per 2 weeks.

[b] Not applicable.

3.10. The criteria to determine the effectiveness of the SCMs in mitigating ASR expansions are given in Table 2.

Table 2—Proposed Criteria for Characterizing Effectiveness of ASR Mitigation Measures in MCPT Method

Efficiency of Mitigation	Expansion at 56 Days, % (8 Weeks)
Effective	<0.020
Uncertain[a]	0.020%–0.025
Not effective	>0.025

[a] Recommend retest with MCPT using a higher dosage of mitigation.