
Standard Method of Test for Nonlinear Impact Resonance Acoustic Spectroscopy (NIRAS) for Concrete Specimens with Damage from the Alkali-Silica Reaction (ASR)

AASHTO Designation: T 379-18 (2022)¹

Technically Revised: 2018

Reviewed but Not Updated: 2022

Editorially Revised: 2021

Technical Subcommittee: 3c, Hardened Concrete



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1. SCOPE

- 1.1. This test method covers determination of material nonlinearity in concrete laboratory specimens prepared in a manner and subjected to conditions of accelerated alkali-reactivity of aggregate. It is assumed that the nonlinearity due to elastic hysteresis is a dominant mechanism for the material nonlinearity in concrete specimens with alkali–silica reaction (ASR) damage and that this nonlinearity is directly proportional to the ASR damage occurring in the specimens. This method may not be necessarily applicable to other forms of damage.
- 1.2. The values stated in SI units are to be regarded separately as standard. The values in inch-pound units are shown in parentheses and are for informational purposes only.
- 1.3. *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.*
- 1.4. *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.*

2. REFERENCED DOCUMENTS

- 2.1. AASHTO Standard:
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 2.2. ASTM Standard:
 - C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction

3. SUMMARY OF TEST METHOD

- 3.1. A prismatic concrete sample, prepared according to specifications for mix composition and geometry in [ASTM C1293](#), is excited in the fundamental transverse mode of vibration by a low-amplitude impact at the center of the specimen. The vibration at one end of the sample is measured using an accelerometer and recorded using an oscilloscope. A series of at least 10 impacts of varying force are made to the specimen and the responses, the time-domain signals, are recorded. Signal processing is performed to measure the frequency and amplitude of the fundamental resonance peaks from the frequency spectra of the recorded time-domain signals. The normalized frequency shift is plotted against the signal amplitude where the slope of this plot is the nonlinearity parameter, η , that is used to classify material nonlinearity.
- 3.2. An initial test is performed just after demolding at 23.5 ± 0.5 h and prior to exposure in the test environment specified in [ASTM C1293](#), with subsequent tests made after periods of exposure to the acceleratory test environment.
- Note 1**—The frequency of subsequent testing will depend upon the anticipated relative reactivity of the aggregate. That is, concrete containing less reactive aggregate or concrete containing supplementary cementitious materials at dosage rates expected to suppress ASR may be tested at less frequent intervals, such as every 2 to 3 months. For aggregates of unknown reactivity, tests should be initially performed every 2 weeks, and the interval can be increased after 2 months.
- Note 2**—After demolding, the measured nonlinearity parameter may be higher than will be typical for a sample; often, within 4 weeks (28 days), the measured nonlinearity will decrease to a more stable value.

4. SIGNIFICANCE AND USE

- 4.1. This test method is applicable to concrete prisms where damage by ASR due to reactive aggregate and aggregate/binder combinations is a concern.
- 4.2. This test method is intended to provide the user with a procedure to assess the potential for a fine or coarse aggregate used in concrete to experience ASR damage, under exposure conditions outlined in [ASTM C1293](#).

5. APPARATUS

- 5.1. The apparatus for inducing alkali–silica reaction shall conform to [ASTM C1293](#).
- 5.2. *Accelerometer*—An accelerometer capable of measuring frequencies up to 10 kHz with less than 5 percent error, weighing less than 3 g (0.11 oz).
- 5.3. *Oscilloscope*—An oscilloscope capable of a sampling rate of 250 kHz or higher with a record length of 0.4 s.
- 5.4. *Impact Hammer*—A lightweight hammer with a maximum mass (weight) of 142 g (5 oz) is recommended.
- 5.5. *Instant Adhesive*—A surface-insensitive instant adhesive is recommended for attachment of the accelerometer. A fast curing gel-type adhesive (e.g., cyanoacrylate) can be applied more consistently than adhesives with higher viscosity.
- 5.6. *Support Mat*—Specimens shall be placed on a thick and compliant, commercially available vibration damping/isolation support mat for testing.