

Australian Standard®

AS 1141.60.2:2014

Methods for sampling and testing aggregates

Method 60.2: Potential alkali-silica reactivity— Concrete prism method

PREFACE

This Standard was prepared by Standards Australia Committee CE-012, Aggregates and Rock for Engineering Purposes.

This test method for alkali-silica reaction is based on American Standard ASTM C1293-95, *Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction*, and a review of Canadian Standard, CSA A23.2-09, *Test Methods And Standard Practices for Concrete, Section 14A, Test Methods for Potential Expansivity of Cement-Aggregate Combination (Concrete Prism Expansion Method)*, with modifications to suit Australian conditions. The principal modification has been to allow the use of cement with a lower alkali content as obtaining Australian cement with an alkali content of 0.9%, as used in the ASTM procedure, is difficult.

The term 'informative' has been used in this Standard to define the application of the appendix to which it applies. An 'informative' appendix is only for information and guidance.

WARNING: SOME OF THE CHEMICALS OR PROCEDURES SPECIFIED IN THIS STANDARD COULD LEAD TO A HAZARDOUS SITUATION IF CORRECT SAFETY MEASURES ARE NOT FOLLOWED. PERSONS USING THIS AUSTRALIAN STANDARD MUST BE FAMILIAR WITH NORMAL LABORATORY PRACTICE. THIS STANDARD DOES NOT ADDRESS THE SAFETY PROBLEMS, IF ANY, ASSOCIATED WITH ITS USE. IT IS THE RESPONSIBILITY OF THE LEGAL ENTITY USING THIS STANDARD TO ESTABLISH APPROPRIATE SAFETY AND HEALTH PRACTICES, TO ENSURE COMPLIANCE WITH ANY NATIONAL, STATE OR LOCAL REGULATORY REQUIREMENTS, AND TO INSTRUCT IN, AND ENFORCE COMPLIANCE OF, THE SAFETY AND HEALTH PRACTICES.

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- (a) Paragraph 4 of Clause 1, *Scope*.
- (b) Clause 4.9, *Storage container* (modified).
- (c) Clause 4.10.1, *Storage environment—General* (modified).
- (d) Clause 4.10.2, *Storage environment—Required environment*.
- (e) Clause 8.2, *Storage procedures* (modified).

- (f) Item (a) of Clause 9, *Calculation*.
- (g) Item (a) of Clause 11, *Test report*.

METHOD

1 SCOPE

This Standard sets out the procedure to classify aggregate according to its susceptibility to alkali attack leading to expansive reactions in concrete. This expansion is known as alkali-aggregate reaction (AAR) (see Note). The classification is determined from the measured increase in length of concrete prisms prepared using the aggregate under consideration, during storage of the prisms under the prescribed test conditions.

NOTE: The test is suitable for alkali-silica reactivity. It is not suitable for alkali-carbonate reactivity.

The method has been found to correlate well with field performance.

The method is suitable for both coarse and fine aggregates.

This method does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to use.

NOTE: See Preface for copyright information about this Clause.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

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| 1012 | Methods of testing concrete |
| 1012.2 | Method 2: Preparing concrete mixes in the laboratory |
| 1012.3.1 | Method 3.1: Determination of properties related to the consistency of concrete—Slump test |
| 1012.4.2 | Method 4.2: Determination of air content of freshly mixed concrete—Measuring reduction in air pressure in chamber above concrete |
| 1012.5 | Method 5: Determination of mass per unit volume of freshly mixed concrete |
| 1012.13 | Method 13: Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory |
| 1141 | Methods for sampling and testing aggregates |
| 1141.1 | Part 1: Definitions |
| 1141.3.1 | Method 3.1: Sampling—Aggregates |
| 1141.3.2 | Method 3.2: Sampling—Rock spalls and boulders |
| 1141.4 | Method 4: Bulk density of aggregate |
| 1141.60.1 | Method 60.1: Potential alkali-silica reactivity—Accelerated mortar bar method |
| 2350 | Methods of testing portland, blended and masonry cements |
| 2350.12 | Method 12: Preparation of a standard mortar and moulding of specimens |
| 2758 | Aggregates and rock for engineering purposes |
| 2758.1 | Part 1: Concrete aggregates |
| 3972 | General purpose and blended cements |

3 DEFINITIONS

For the purpose of this Standard, the following definition and those in AS 1141.1 apply.

3.1 Yield

The relationship between the measured wet unit mass of a concrete mix and the unit mass of the mix calculated from the mix components, expressed as a percentage.

4 APPARATUS

The following apparatus is required.

4.1 Balance

Of sufficient capacity, readable to 1.0 g with a limit of performance of 0.5 g.

4.2 Laboratory mixing area

The air within the laboratory where preparation of the specimens takes place shall be maintained within a temperature range of 20°C to 27.5°C and the relative humidity of the air shall not be less than 50%.

4.3 Comparator

4.3.1 General

A horizontal or inclined comparator shall be used.

4.3.2 Horizontal or inclined comparator

A horizontal or inclined comparator equipped with a measuring device such as a digital micrometer. The comparator shall be capable of measuring length changes over a range of 290 mm to 300 mm. It shall be of rigid construction and shall consist of a frame for supporting the specimen during the measurement in such a way that minimal weight is carried by the gauge studs (see Note).

The measuring device shall be readable to 0.001 mm. The stem of the measuring device and the end rest for the specimen shall be fitted with flat anvils.

NOTE: Ideally, the specimen will fit the comparator in a horizontal position so that the gauge studs do not support the mass of the specimen. However, practice with comparators of this type has found that a more practical design is to incline the frame.

4.3.3 Reference bar

A reference bar shall be used with the comparator and shall consist of a material characterized by an extremely low coefficient of thermal expansion, such as invar. The reference bar shall be not less than 6 mm in diameter and shall have an overall length of 295 ± 1.5 mm.

Each end shall be reduced in diameter and the end 5 mm shall be approximately the same diameter and have the same end radius of curvature as the projecting end of the gauge stud being used in the specimen (see Clause 4.5). Each end of the reference bar shall be polished.

NOTE: A reference bar designed for use with a vertical comparator cannot be used with a horizontal or inclined comparator.

The central section of the reference bar shall be covered by a rubber tube, or equivalent, of length approximately 100 mm and wall thickness of at least 3 mm to minimize the effect of temperature change during handling. The reference bar shall be provided with a positioning mark and shall always be placed in the comparator in the same orientation.

4.3.4 Operator precision check

The precision of the length measurement by a single operator shall be checked by reporting the length of a specimen prepared following this method, 20 times within a 15 min period, replacing the specimen in the comparator for each reading. The specimen used shall be undamaged and older than 48 h since casting. The standard deviation of these 20 length measurements shall not exceed 0.001 mm. This check shall be performed by each new operator and by each operator at least each six months. Records of the checks shall be maintained in the laboratory.

4.4 Humidity controlled storage area

The humidity controlled storage area shall consist of a fog room, humidity cabinet or similar and shall be maintained at $23 \pm 2^\circ\text{C}$ and a relative humidity not less than 95% for use in this test.

4.5 Gauge studs

Gauge studs shall be of stainless steel and shall comply with the dimensions shown in Figure 1. The radius of curvature of the gauge stud end shall be 147 mm.

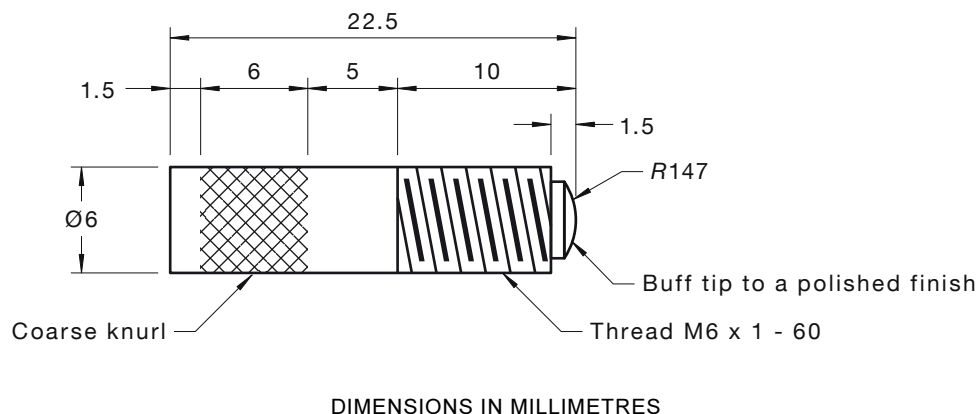


FIGURE 1 TYPICAL GAUGE STUD

4.6 Length gauge

A length gauge shall be provided for checking the nominal length between gauge studs. The length gauge shall be made of metal and shall have a diameter of at least 6 mm and a length of 250 ± 0.2 mm. The ends of the bar shall be flat and perpendicular to its length.

4.7 Mallet

The mallet used in the moulding of specimens shall comply with the relevant requirements of AS 1012.4.2.

4.8 Moulds

4.8.1 General

Moulds shall be made of a non-absorbent material which does not react with cement paste and their internal surfaces shall have a smooth finish. The moulds shall be substantial enough to hold their form without distortion and shall be substantially leak-proof.

Each mould shall be provided with—

- (a) a base plate to which two end plates are securely fastened by screws;
- (b) two side plates which are fastened to the end plates by screws; and
- (c) two partially loose end plates which act as gauge stud holders.

Each gauge stud holder shall fit inside the end of the mould and shall locate and secure a gauge stud during the setting period of the concrete. Each gauge stud holder shall be held in position against the end plate by a retaining screw and shall be capable of release after compaction of the concrete. The opposite side plates shall be parallel and the distance between them shall be 75 ± 0.7 mm. The inside height of the mould shall be 75 ± 0.7 mm.

4.8.2 Construction of the moulds

The construction of each mould shall be aligned coaxially along the central axis of the moulded specimen, with the distance between the inner ends of the two studs being 250 ± 0.5 mm, and that between the outer ends 295 ± 1 mm. Gauge studs shall protrude from the gauge stud holders to a distance of 15 ± 1 mm. A suitable form of construction of the moulds is shown in Figure 2.

4.9 Storage container

The storage container shall have an airtight lid and approximate dimensions of 250 mm to 270 mm diameter at bottom, 290 mm to 310 mm at top, by 450 mm to 490 mm high.

NOTES:

- 1 A 22–25 L polyethylene container with lid has been found suitable for this purpose.
- 2 The container is designed to maintain the prisms at a high relative humidity, which is critical in maintaining reaction conditions.

The storage container shall be prepared as follows:

- (a) Place a perforated rack in the bottom of the storage container so that the prisms are 30 mm to 40 mm above the base of the container.
- (b) Fill the base of the container with water to a height approximately 10 mm below the perforated rack.
- (c) Prevent significant loss of enclosed moisture due to evaporation with an airtight lid seal.

NOTE: A significant moisture loss is defined as a loss greater than 3% of the original amount of water placed at the bottom of the container.

- (d) Place a wick of absorbent material consisting of polypropylene fibres down the inside wall of the container from the top so that the bottom of the wick is immersed in the full depth of the water.

NOTE: See Preface for copyright information about this Clause.

The wick shall not be in contact with any surface of the specimens. This is best achieved by encasing the polypropylene wick in plastic tubing attached to the side of the container.

The exposed wick at the top of the container shall be extended multiple times over the space above the specimens but shall be securely attached to the lid of the pail so that it does not come into contact with the specimens. The object is to ensure that the specimens are enclosed in a high humidity, airtight environment.

4.10 Storage environment

4.10.1 General

A storage environment with suitably controlled temperature and air circulation shall be provided to maintain the 38°C storage temperature consistently and homogeneously.

NOTE: See Preface for copyright information about this Clause.

4.10.2 *Required environment*

The storage environment shall be a sealed space insulated so as to minimize heat loss. A fan shall be provided for air circulation so the maximum variation in temperature measured within 250 mm of the top and bottom of the space does not exceed 4°C. An insulated entry door with adequate seals shall be provided to minimize heat loss. Racks for storage containers within the space shall not be closer than 30 mm to the sides of the enclosure and shall be perforated. An automatically controlled heat source shall be provided to maintain the temperature at $38.0 \pm 2.0^\circ\text{C}$ (see Note 1). The ambient temperature and its variation within the space shall be recorded to ensure compliance.

NOTES:

- 1 It has been found to be good practice to monitor the efficiency of the storage environment by placing thermocouples inside dummy concrete specimens, inside dummy containers, within the storage area.
- 2 See Preface for copyright information about this Clause.

4.11 **Tamping bar (hand compaction)**

The bar used for compacting concrete in the moulds shall be a straight metal rectangular bar having nominal dimensions of 25 mm × 10 mm × 300 mm long with the tamping face flat, and at right angles with the long axis of the bar.

4.12 **Vibrating table**

The external vibrator used to compact concrete in the moulds shall be a table type with provision for clamping of the mould. Internal vibrators shall not be used. A vibrating table conforming to the requirements of AS 2350.12 is suitable.

NOTE: A vibrating table with a nominal frequency of vibration of 50 Hz is usually suitable.