

Australian Standard™

Refractories and refractory materials—Physical test methods

Method 21: Determination of workability index—Mouldable refractories

PREFACE

This Standard was prepared by the Standards Australia Committee MN-007, Refractories and Refractory Materials to supersede AS 1774.21—1996, *Refractories and refractory materials—Physical test methods*, Method 21: *Mouldable refractories—Workability index*.

This Standard is based on ASTM C181-1991.

The objective of this revision is to align the test with current practice.

This edition has been editorially updated and confirms the method of determining the workability index of mouldable refractories

METHOD

1 SCOPE

This Standard sets out a method for the determination of the workability index of a mouldable refractory at room temperature.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

2243 Safety in laboratories (series)

2780 Refractories and refractory materials—Glossary of items

ASTM

C181 Test method for workability index of fireclay and high-alumina plastic refractories

3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 2780 apply.

4 PRINCIPLE

A cylindrical test specimen is prepared and subjected to impact and the resulting deformation is determined.

5 SAFETY

For information on laboratory safety, reference should be made to the relevant parts of AS 2243.

6 APPARATUS

6.1 Ramming apparatus (see Figure 1)

6.1.1 General

The apparatus shall consist of a modified sand rammer as described in ASTM C181 or an apparatus capable of performing the same operation. It comprises three parts as described below.

6.1.2 Ramming unit

As indicated below:

- (a) *Description* The unit shall consist of a vertical shaft, to the lower end of which is fitted a plunger. The plunger shall be a sliding fit inside the mould (Clause 6.1.3).

A cylindrical weight of mass 6.4 ± 0.1 kg is able to fall freely down the shaft over a distance of 50 ± 1 mm as determined by a restraining collar firmly fixed to the shaft at the lower limit of this distance. Provision shall be made for the cylinder to be raised through its drop height by means of a manually operated cam.

- (b) *Mounting* The ramming unit shall be firmly affixed to the top of a column constructed from hard material such as brick, concrete or steel.

6.1.3 Mould

The mould shall be cylindrical and constructed of hardened steel with internal diameter of 50 ± 1 mm and length 120 ± 1 mm. The mould shall have a removable snug-fitting base.

6.1.4 Extractor

A solid cylinder of sliding fit in the mould, 130 ± 5 mm in length, to eject the test specimen from the mould.

6.1.5 Measuring device

One of the following:

- (a) A steel rule whose scale is graduated in 1.0 mm increments and attached to the top of the ramming unit so as to measure the position of the upper end of the shaft. The rule is positioned as shown in Figure 2, and graduated so that the reading is a direct measurement of the height of the test specimen, corrected where necessary for the height of the mould base/spacer block.
- (b) Callipers.
- (c) A hand-held 150 mm rule graduated in 1 mm increments.
- (d) A clamp-on dial gauge.

6.1.6 Spacer blocks

Sized to prevent the restraining collar/lifting handle assembly from striking the bottom guide.

6.2 Weighing device

A top-loading balance capable of weighing up to 500 g and readable to the nearest 5 g.

7 SAMPLE PREPARATION

Where the mouldable refractory is supplied in block form, remove a small area of material to a depth of about 25 mm. The sample material is then removed from this freshly exposed area using a sampling auger or a hand trowel.

8 PROCEDURE

The procedure shall be as follows:

- (a) Weigh out an appropriate mass of material to give the approximate sample size (see Step (d)).
- (b) Break the material into lumps not exceeding 20 mm in any dimension and transfer the material to the cleaned and oiled mould.
- (c) Place the mould in the ramming unit and compact the test material by subjecting it to 10 impacts. Invert the mould, force the sample to the base of the mould and apply a further 10 impacts.
- (d) Check the height of the specimen. If the height is in the range 62 mm to 68 mm, proceed to Step (e). Otherwise, discard the sample and repeat Steps (a) to (d) using fresh material suitably adjusted in quantity.
- (e) Hook the sliding weight to the suspension pins.
- (f) Using the extractor, strip the specimen from the mould.
- (g) Either—
 - (i) measure the height of the specimen at least to the nearest 0.5 mm using callipers (h_1), place the specimen on the mould base on the ramming unit and gently lower the plunger to it; or
 - (ii) place the specimen on the mould base on the ramming unit, gently lower the plunger to the test specimen without deforming it, and measure the height of the test specimen at least to the nearest 0.5 mm using the measuring device (h_1).
- (h) Unhook the sliding weight and lower it gently until it contacts the restraining collar.
- (i) Apply three impacts to the specimen.
NOTE: If the workability is so high that the restraining collar/lifting handle assembly strikes the bottom guide, the full procedure (Steps (a) to (h)) needs to be repeated on fresh material using a suitably-sized spacer block between the base of the mould and the base of the ramming unit for Steps (c) to (i).
- (j) Remeasure its height at least to the nearest 0.5 mm (h_2) as for Step (g).

9 CALCULATION

The results for the workability index of the sample shall be calculated using the following equation:

$$\text{Workability index} = \frac{h_1 - h_2}{h_1} \times 100 \quad \dots (1)$$

where

h_1 = initial height of the test specimen, in millimetres

h_2 = final height of the test specimen, in millimetres