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Aluminium oxide primarily used for the production of aluminium — Method for the determination of flow time

Oxyde d'aluminium principalement utilisé pour la production d'aluminium — Méthode de détermination du temps d'écoulement

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Foreword

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The committee responsible for this document is ISO/TC 226, *Materials for the production of primary aluminium*.

Introduction

This International Standard is based on Australian Standard, AS 2879.9, *Alumina—Determination of flow time.*

Aluminium oxide primarily used for the production of aluminium — Method for the determination of flow time

1 Scope

This International Standard sets out a method for determining the amount of time taken for a given quantity of smelter-grade alumina to flow by gravity through a precisely constructed standard funnel.

NOTE Variations in the apparatus and other test variables can create significant inter-laboratory differences in results. (See Table A.1.)

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AS 4538.2, *Guide to the sampling of alumina — Part 2: Preparation of samples*

3 Principle

The standard funnel is loaded with a specified mass of alumina. The time for the alumina to flow out of the funnel is determined.

4 Apparatus

4.1 General

The test may be carried out using manual or automatic timing. An automatic device is shown in Figure 1.

4.2 Funnel, precisely constructed of a corrosion resistant metal, e.g. brass or aluminium, as shown in Figure 2 with an abrasion resistant material, e.g. hardened stainless steel, insert with an outlet diameter of (3,95 to 4,00) mm; this diameter is critical.

4.3 Stand, a suitable device for supporting the funnel.

4.4 Timing device, either a stop watch or automated device capable of an accuracy of 1 s.

4.5 Top-loading balance, capable of weighing 100 g to the nearest 0,1 g.

4.6 Sieve, with apertures within the range (300 to 400) µm to remove abnormal oversize material.

4.7 Container, suitable for containing the test sample.

4.8 Sealable container, suitable for containing and storing the funnel.

5 Sample preparation

The analytical sample shall be conditioned by exposure to the laboratory atmosphere for a minimum of 2 h in a layer of 5 mm maximum thickness. The sample shall then be split as per AS 4538.2 into three

portions of approximately (105 to 120) g for testing. The sample shall then be screened through a sieve (4.6) and the oversize material discarded.

6 Procedure

6.1 General

This procedure is for manually timed determinations.

6.2 Number of determinations

Three determinations shall be carried out.

6.3 Determination

Each determination shall be carried out as follows.

a) Ensure the funnel is clean with no surface oxides present and dry prior to use, otherwise flow times will not be reproducible. Frequent use has usually been found to be an adequate cleaning method.

b) Set up the apparatus by placing the funnel (4.2) on the stand (4.3) in a vibration-free environment.

c) Ensure that the funnel is secure on the stand and that the upper surface is precisely level.

d) For apparatus not in frequent use, clean the funnel by passing several portions of alumina through it [see a)]. Discard this material prior to testing.

e) Take one of the prepared samples (see Clause 5) and accurately weigh a test portion of (100 ± 0,1) g and place into the container (4.7). (See Clause 5.)

f) Pour the test portion uniformly into the funnel while manually obstructing the outlet.

g) Start the flow by removing the outlet obstruction and immediately commence timing. Stop the timing as soon as all the sample has passed through the funnel. Never tap the funnel.

h) Repeat the procedure with the other two test portions (Clause 5).

i) Remove the funnel from the stand and wipe the funnel clean with a dry cloth. Replace it in the sealable container (4.8) to prevent damage to the outlet orifice and minimize atmospheric oxidation of the inner surface.

7 Reporting of results

Report the average of the three results to the nearest second.

8 Precision

A test programme of the method in this International Standard was carried out in accordance with AS 2850. From the results of this programme, a within-laboratory repeatability (r) and between-laboratory reproducibility (R) at the 95 % confidence level as given in Table 1 should be achieved.

NOTE Results of the test programme are given in Annex A.

Table 1 — Precision data for flow time

Repeatability (r)	Reproducibility (R)
2,7	9,7

9 Test report

The test report shall include the following information:

a) identification of the sample;

b) a reference to this International Standard, i.e. ISO 18843;

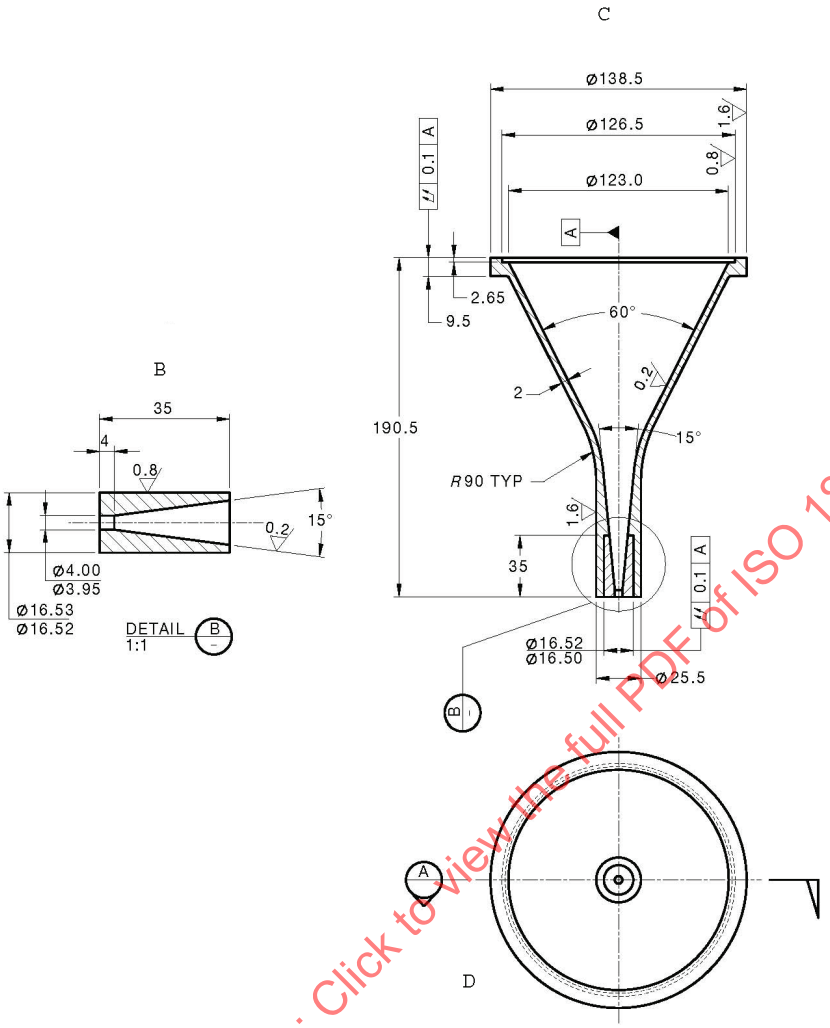
c) average flow time for the sample;

d) the date on which the test was carried out;

e) any factors during the course of the test which may have had an effect on the results.

Figure 1 — Automatic flow funnel time apparatus

Dimensions in millimetres



Key

A datum line through the funnel

B hardened insert with orifice shown *in situ* and as detail

C vertical cross section

D top view

R90 TYP	= Radius 90 typical	FINISH 3,2 UND
A	= Datum line	TOLERANCE ±0,3 UND
0.1 A	= Total run out (i.e. radius tolerance is 0,1 mm)	
ø	= Diameter	
1.6 / 0.8 / 0.2	= Finish (0,2 Fine, 1,.6 Standard)	
ø4.00 / ø3.95	= Tolerance Max./Min.	

Figure 2 — Flow funnel

Annex A
(informative)

Results of planned trial

A planned trial of the method in this International Standard was carried out in accordance with AS 2850. Samples of three smelter grade aluminas were analysed. Results were provided in quadruplicate by six laboratories. The within-laboratory (r) and between-laboratory (R) precision data (at 95 % confidence limits) and mean flow time values calculated from the results are given in Table A.1.

Table A.1 — Precision data obtained using test samples

Sample	Mean flow time s	Repeatability (r)	Reproducibility (R)
S-109	47	1,5	7,3
S-110	68	3,3	10,7
S-111	82	2,9	10,8