

# **Tests for geometrical properties of aggregates —**

## **Part 8: Assessment of fines — Sand equivalent test**

The European Standard EN 933-8:1999 has the status of a  
British Standard

ICS 91.100.15

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## National foreword

This British Standard is the English language version of EN 933-8:1999. It is included in a package of European Standards declared by CEN/TC 154.

The UK participation in its preparation was entrusted by Technical Committee B/502, Aggregates, to Subcommittee B/502/6, Test methods, which has the responsibility to:

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### Summary of pages

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English version

## Tests for geometrical properties of aggregates — Part 8: Assessment of fines — Sand equivalent test

Essais pour déterminer les caractéristiques  
géométriques des granulats — Partie 8: Evaluation  
des fines — Equivalent de sable

Prüfverfahren für geometrische Eigenschaften von  
Gesteinskörnungen — Teil 8: Beurteilung von  
Feinanteilen, Sandäquivalent-Verfahren

This European Standard was approved by CEN on 19 February 1999.

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Comité Européen de Normalisation  
Europäisches Komitee für Normung

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## Foreword

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This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 1999, and conflicting national standards shall be withdrawn at the latest by December 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard is one of a series of standards for tests for geometrical properties of aggregates.

Test methods for other properties of aggregates are covered by parts of the following European Standards.

EN 932, *Tests for general properties of aggregates*.

EN 1097, *Tests for mechanical and physical properties of aggregates*.

EN 1367, *Tests for thermal and weathering properties of aggregates*.

EN 1744, *Tests for chemical properties of aggregates*.

A European Standard, *Tests for filler aggregate used in bituminous mixtures*, is in preparation.

The other parts of EN 933 will be:

- Part 1: *Determination of particle size distribution — Sieving method*;
- Part 2: *Determination of particle size distribution — Test sieves, nominal size of apertures*;
- Part 3: *Determination of particle shape — Lakiness index*;
- Part 4: *Determination of particle shape — Shape index*;
- Part 5: *Determination of percentage of crushed and broken surfaces in coarse aggregate particles*;
- Part 6: *Determination of flow coefficient of aggregates*;
- Part 7: *Determination of shell content — Percentage of shells in coarse aggregates*;
- Part 9: *Assessment of fines — Methylene blue test*;
- Part 10: *Assessment of fines — Grading of fillers (air jet sieving)*.

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## 1 Scope

This European Standard specifies a method for the determination of the sand equivalent value of the 0/2 mm fraction in fine aggregates and all-in aggregates. It applies to natural aggregates.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 932-2, *Tests for general properties of aggregates — Part 2: Methods for reducing laboratory samples.*

EN 932-5, *Tests for general properties of aggregates — Part 5: Common equipment and calibration.*

EN 1097-5, *Tests for mechanical and physical properties of aggregates — Part 5: Determination of the water content by drying in a ventilated oven.*

## 3 Definitions

For the purposes of this standard, the following definitions apply.

### 3.1

#### laboratory sample

sample intended for laboratory testing

### 3.2

#### test portion

sample used as a whole in a single test

### 3.3

#### test specimen

sample used in a single determination when a test method requires more than one determination of a property

### 3.4

#### fines

particle size fraction of an aggregate which passes the 0,063 mm sieve

### 3.5

#### particle size fraction

fraction of an aggregate passing the larger of two sieves and retained on the smaller; the lower limit can be zero

## 4 Principle

A test portion of sand and a small quantity of flocculating solution are poured into a graduated cylinder and are agitated to loosen the clay coatings from the sand particles in the test portion. The sand is then "irrigated" using additional flocculating solution forcing the fine particles into suspension above the sand. After 20 min, the sand equivalent value (*SE*) is calculated as the height of sediment expressed as a percentage of the total height of flocculated material in the cylinder.

## 5 Reagents

### 5.1 Concentrated solution, made up from:

- crystalline calcium chloride,  $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$  or anhydrous calcium chloride,  $\text{CaCl}_2$ ;
- glycerine, 99 % glycerol, laboratory reagent quality;
- formaldehyde solution, 40 % by volume, laboratory reagent quality;
- distilled or demineralised water.

Dissolve  $(219 \pm 2)$  g of crystalline calcium chloride in  $(350 \pm 50)$  ml of distilled or demineralised water, cool to room temperature and if necessary filter through a medium or coarse grade filter paper. Add  $(480 \pm 5)$  g of glycerine and  $(12,5 \pm 0,5)$  g of formaldehyde solution and dilute to 1 l of solution with distilled or demineralised water and mix thoroughly.

NOTE 1 219 g  $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$  is equivalent to 111 g anhydrous calcium chloride  $\text{CaCl}_2$ .

NOTE 2 It is recommended that the concentrated solution is stored protected from light in glass or plastics flasks containing  $(125 \pm 1)$  ml.

### 5.2 Washing solution, prepared by diluting $(125 \pm 1)$ ml of concentrated solution (5.1) to $(5,00 \pm 0,01)$ l using distilled or demineralised water.

NOTE In preparing the washing solution, the concentrated solution should first be vigorously shaken and subsequently its container should be rinsed several times using distilled or demineralised water, pouring the rinsing water into the 5 l flask before diluting to 5 l.

Washing solution shall not be used more than 28 days after preparation or if it is cloudy or contains any precipitate or mould.

## 6 Apparatus

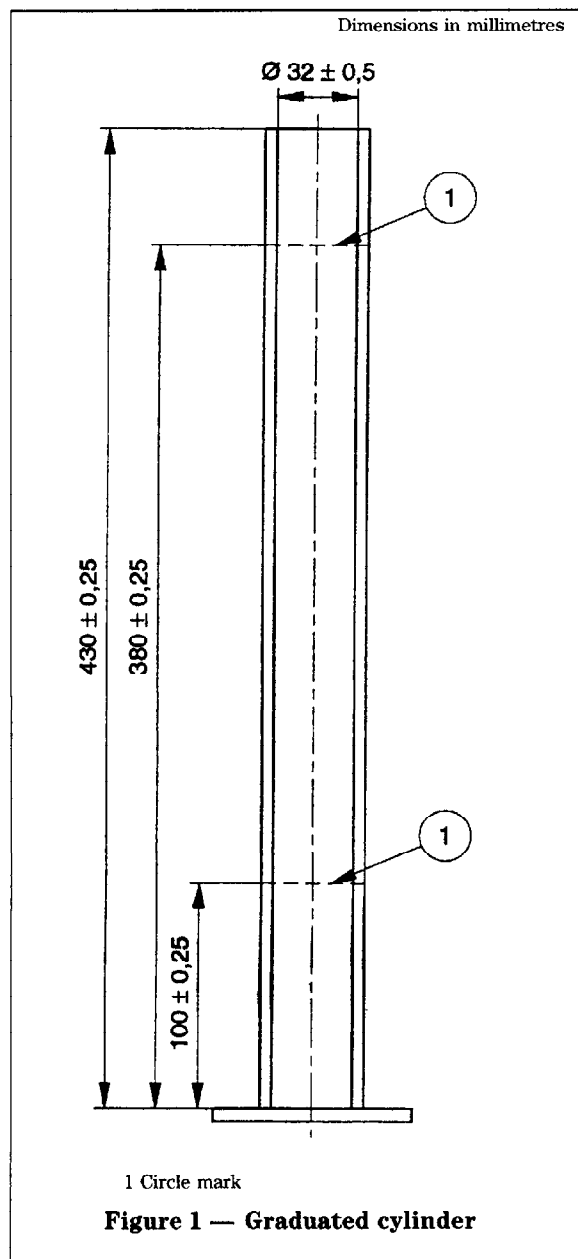
### 6.1 All apparatus, unless otherwise stated, shall conform to the general requirements of prEN 932-5.

### 6.2 Two graduated cylinders, of glass or clear plastic (see Figure 1) complete with rubber bungs and with the following dimensions:

- wall thickness, about 3 mm;
- inside diameter  $(32,0 \pm 0,5)$  mm;
- height  $(430,00 \pm 0,25)$  mm.

Each cylinder shall be clearly marked in two positions:

- a) at  $(100,00 \pm 0,25)$  mm from the base; and
- b) at  $(380,00 \pm 0,25)$  mm from the base.



**6.3 Test plunger assembly**, (see Figure 2) comprising:

- a) a rod  $(440,00 \pm 0,25)$  mm long;
- b) an end piece  $(25,0 \pm 0,1)$  mm diameter, its lower surface being flat, smooth and perpendicular to the rod axis and which includes three guides at the side for centring the plunger in the cylinder, leaving a small clearance;

- c) a collar,  $(10,0 \pm 0,1)$  mm thick, suitable for use with the graduated cylinder, acting as a guide for the rod and, at the same time, used to indicate the distance the test plunger is inserted inside the cylinder. The collar shall include a screw which enables it to be locked onto the rod of the test plunger and the collar shall also have a slot for a rule;

- d) a plunger head, fixed to the upper end of the rod, to give the test plunger assembly, excluding the collar, a total mass of  $(1,00 \pm 0,01)$  kg.

The immersed parts of the plunger assembly shall be made from non-corrodible metal.

**NOTE** Before first use of a test plunger or a graduated cylinder, the plunger assembly should be placed in the empty cylinder. With the collar resting on the rim of the cylinder the distance between the upper face of the collar and the lower face of the plunger head should not exceed 0,5 mm. If this clearance exceeds 0,5 mm or if the end piece does not reach the bottom of the cylinder, this combination of test plunger and graduated cylinder should not be used.

**6.4 Stopclock(s)**, readable to 1 s.

**6.5 500 mm rule**, graduated in millimetres.

**6.6 Test sieve**, 2 mm square aperture with, if necessary, a guard sieve.

**6.7 Sieve brush**.

**6.8 Spatula**.

**6.9 Washing tube**, (see Figure 3) comprising a rigid tube of non-corrodible metal with the following dimensions:

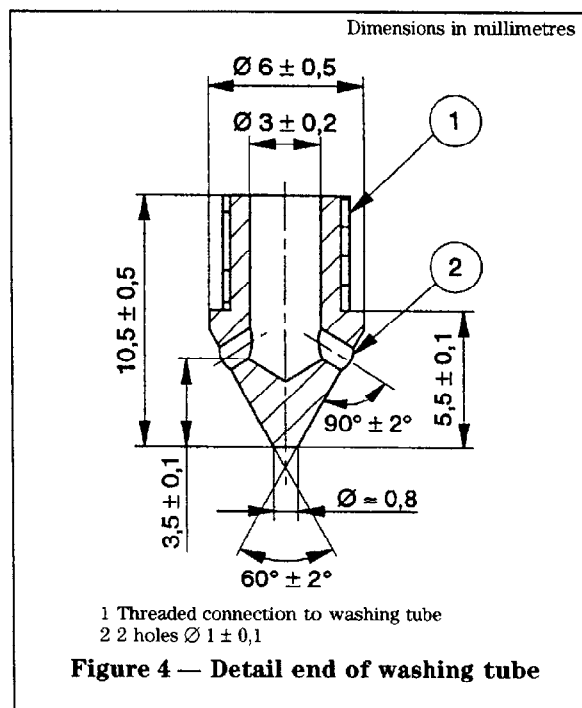
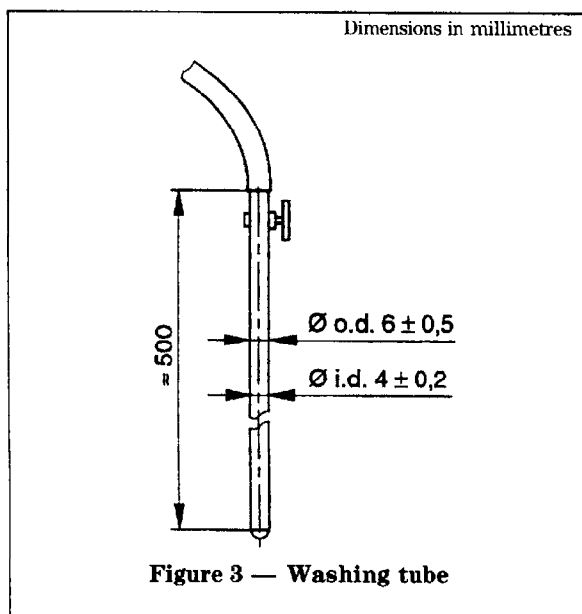
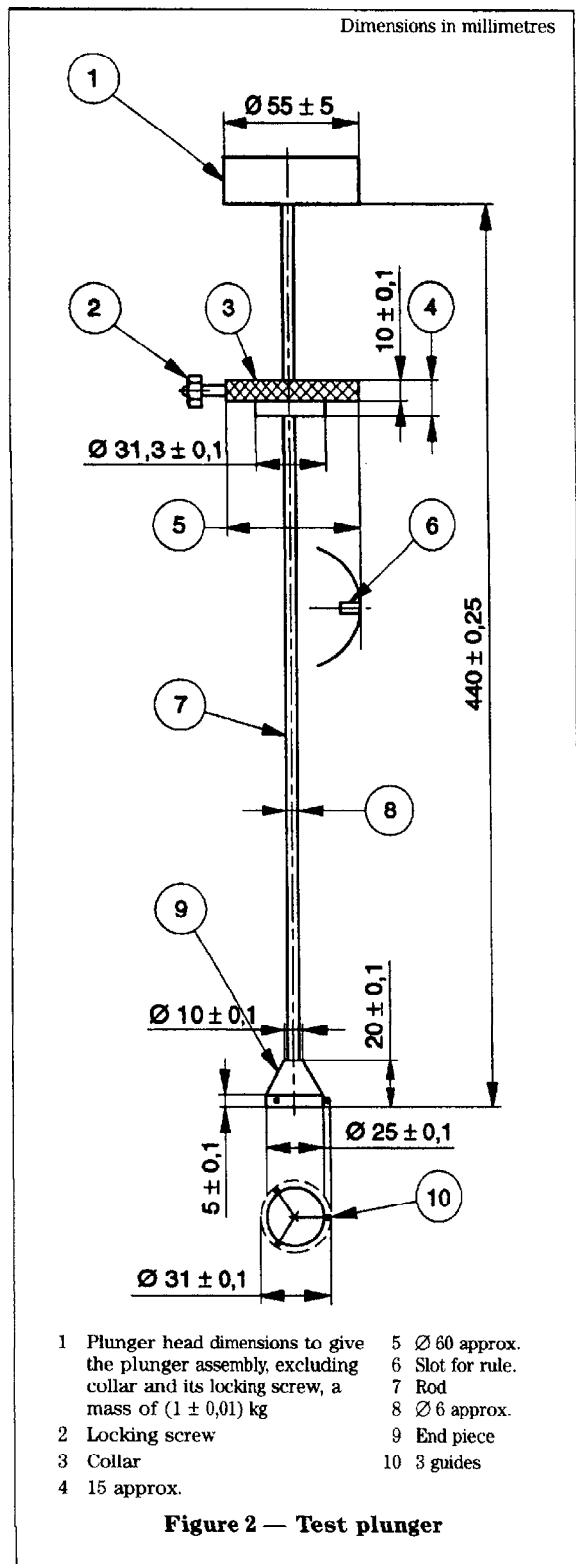
- a) outside diameter  $(6,0 \pm 0,5)$  mm;
- b) inside diameter  $(4,0 \pm 0,2)$  mm;
- c) length about 500 mm.

The washing tube shall be fitted with a tap at the top. The bottom end of the tube (see Figure 4) shall be conical, made from non-corrodible metal and have a threaded (screw) connection. A hole  $(1 \pm 0,1)$  mm diameter shall be made diametrically in each face of the cone.

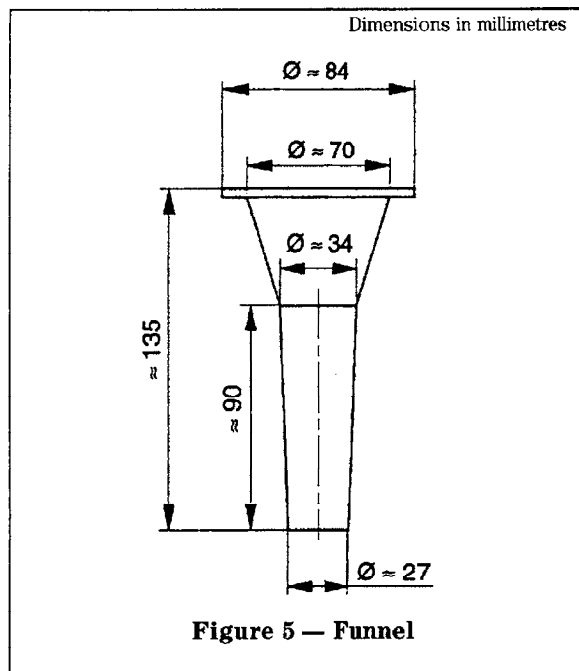
**6.10 Flask**, of glass or clear plastic of 5 l capacity fitted with a siphon system, its base being positioned about 1 m above the work bench.

**6.11 Rubber or plastic tube**, of length approximately 1,50 m, and inside diameter approximately 5 mm, connecting the washing tube to the siphon.

**6.12 Funnel**, for transferring the test portion into the graduated cylinder (see Figure 5).







**6.13 Shaking machine**, capable of imparting to the cylinder a horizontal, rectilinear, periodic and sinusoidal movement of  $(200 \pm 10)$  mm amplitude, at a frequency of one-third of a second.

**6.14 Thermometer**, readable to  $1^\circ\text{C}$ .

**6.15 Balance**, readable to 0,1% of the mass to be weighed.

**6.16 Filter paper**, medium or coarse grade.

## 7 Preparation of test specimens

The laboratory sample shall be reduced in accordance with EN 932-2 to obtain a test portion.

The test shall be carried out on the 0/2 mm fraction at a moisture content less than 2 % and at a temperature of  $(23 \pm 3)^\circ\text{C}$ .

The test portion shall not be oven dried.

NOTE 1 In some cases it may be necessary to reduce or increase natural moisture content to obtain a test portion with less than 2 % but greater than 0 % moisture.

NOTE 2 If the test portion is taken from an all-in aggregate, the laboratory sample should be sieved at a moisture content less than 2 % on a 2 mm sieve protected by a guard sieve, using a sieve brush to ensure effective separation and collection of all particles in the 0/2 mm fraction.

The test portion shall be reduced in accordance with EN 932-2 to obtain two test specimens.

The mass of each test specimen shall be equal to

$$\frac{120(100 + w)}{100} \text{ g (to the nearest gram)}$$

where

$w$  is the moisture content of the sand (percentage of dry mass).

NOTE If required the moisture content of the 0/2 mm fraction should be determined separately by oven drying at  $(110 \pm 5)^\circ\text{C}$  in accordance with prEN 1097-5.

## 8 Procedure

### 8.1 Filling of the graduated cylinders

Siphon washing solution (5.2) into each graduated cylinder up to the lower mark on the cylinder.

Using the funnel pour a test specimen into each graduated cylinder, holding the cylinder vertical.

Tap the bottom of each cylinder several times, using the palm of the hand, to dislodge air bubbles and to facilitate wetting of the test specimen.

Leave each cylinder for  $(10 \pm 1)$  min to soak the test specimen.

### 8.2 Shaking the graduated cylinders

At the end of the 10 min period seal one cylinder using one of the rubber bungs and fix the cylinder onto the shaking machine.

Shake the cylinder for  $(30 \pm 1)$  s and then replace the cylinder on the test bench, in an upright, vertical position.

NOTE This shaking time should correspond to  $(90 \pm 3)$  cycles using the apparatus specified in 6.13.

Repeat the shaking procedure with the second cylinder.

### 8.3 Washing

Remove the rubber bung from one graduated cylinder, and rinse it above the cylinder using the washing solution, ensuring all material is returned to the cylinder.

Insert the washing tube into the cylinder, first rinsing the walls of the cylinder using the washing solution and then push the tube down through the sediment to the bottom of the cylinder.

Hold the cylinder in a vertical position whilst allowing the washing solution to agitate the contents and encourage the fines and clayey components to rise upwards.

Then, while subjecting the cylinder to a slow rotation movement, slowly and regularly raise the washing tube.

When the level of liquid approaches the upper engraved mark slowly lift the washing tube and regulate the flow so as to maintain the level of liquid at the upper mark until the tube has been withdrawn entirely and the flow stopped.

Start to time the settling period immediately on withdrawing the washing tube.

Repeat the washing procedure with the second cylinder.

### 8.4 Measurements

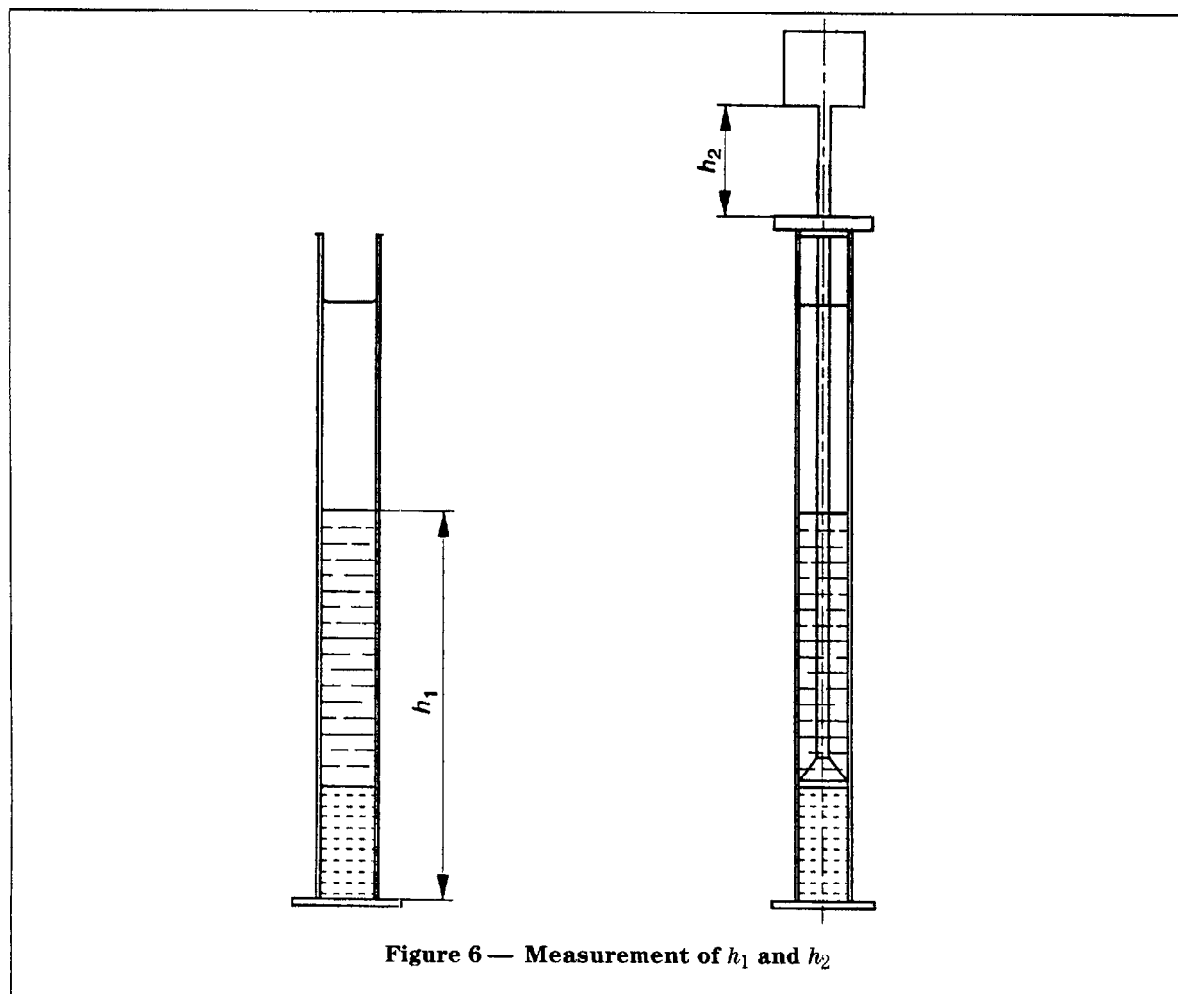
Leave each graduated cylinder to settle, without disturbance and free from vibration, for  $(20,00 \pm 0,25)$  min.

At the end of this period, using the rule (6.5), measure the height  $h_1$  of the upper level of the flocculate relative to the base of the graduated cylinder (see Figure 6).

Carefully lower the plunger assembly into the cylinder, until the end piece rests on the sediment.

NOTE During this operation the sliding collar, which should not yet be locked onto the plunger rod, will contact the top of the graduated cylinder.



Figure 6 — Measurement of  $h_1$  and  $h_2$ 

Locate the collar on top of the cylinder and then lock it onto the plunger rod.

Determine the height of sediment  $h_2$  by measuring the distance between the lower face of the plunger head and the upper face of the collar using the graduated rule inserted into the slot in the collar (see Figure 6).

Record the heights  $h_1$  and  $h_2$  to the nearest millimetre.

Measure and record heights  $h_1$  and  $h_2$  in the same manner with the second cylinder.

## 9 Calculation and expression of results

Calculate the ratio  $(h_2/h_1) \times 100$  for each cylinder to one decimal place.

If the two values differ by more than 4 the test procedure shall be repeated.

Calculate the sand equivalent value (SE) as the average of the ratios  $(h_2/h_1) \times 100$  obtained on each cylinder and record to the nearest whole number.

## 10 Test report

### 10.1 Required data

The test report shall include the following information:

- reference to this European Standard;
- identity of laboratory;
- identification of the sample;
- value of SE to the nearest whole number;
- date of receipt of sample;
- sampling certificate, if available.

### 10.2 Optional data

The test report can include the following information:

- name and location of the sample source;
- description of the material and of the sample reduction procedure;
- masses of test specimens;
- moisture content of test portion;
- date of test.

## Annex A (normative)

### Procedure for the determination of the sand equivalent value of the 0/4 mm fraction

**A.1** Prepare test portions and test specimens as specified in clause 7, but using the 0/4 mm size fraction at a moisture content less than 8 %.

**A.2** Follow the test procedure specified in clause 8 and record heights  $h_1$  and  $h_2$  in each graduated cylinder.

**A.3** Calculate the sand equivalent value ( $SE_4$ ) as the average of the ratios  $(h_2/h_1) \times 100$  obtained on each cylinder and record the value to the nearest whole number.

**A.4** Test reports shall include appropriate information in accordance with clause 10 substituting  $SE_4$  for the sand equivalent value in clause 10.

## Annex B (informative)

### Example of a test data sheet

EN 933-8	Laboratory:
Identification of the sample:	Date:
	Operator:

	1st test specimen	2nd test specimen
Mass of test specimen (grams)		
$h_1$ (millimetres)		
$h_2$ (millimetres)		
$100 (h_2/h_1)$ (recorded to 1 decimal place)		
NOTE Values of $100 (h_2/h_1)$ for the two test specimens should not differ by more than 4.		

Sand Equivalent value ( $SE$ ) – the average of  $100 (h_2/h_1)$  for the two test specimens.

$SE =$   (to nearest whole number)

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