



Methods of testing soils for engineering purposes

Part 3.6.3: Soil classification tests — Determination of the particle size distribution of a soil — Standard method of fine analysis using a hydrometer



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Preface

This Standard was prepared by the Standards Australia Committee CE-009, Testing of Soils for Engineering Purposes, to supersede AS 1289.3.6.3—2003, *Methods of testing soils for engineering purposes, Soil classification tests—Determination of the particle size distribution of a soil—Standard method of fine analysis using a hydrometer*.

This Standard is part of the AS 1289 series. A list of all parts in this series can be found in the Standards Australia online catalogue.

The objective of this Standard is to establish a method for the quantitative determination of the particle size distribution in a soil using an hydrometer.

The major changes in this edition are as follows:

- (a) Preparation of the sample.
- (b) Pre-treatment relocated to [Appendix A](#).

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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1 Scope

This Standard sets out a method for the quantitative determination of the particle size distribution in a soil from a coarse sand size down, using an hydrometer for particles finer than the 75 μm sieve (see [Clause 9](#) Note 1).

The method as described is applicable if —

- (a) more than 10 % of the material passes the 75 μm sieve as measured in AS 1289.3.6.1; and
- (b) only an ASTM 152H hydrometer conforming to ASTM E100 is used. A method for calibrating an hydrometer is set out in [Appendix B](#).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS 1289.0, *Methods of testing soils for engineering purposes, Part 0: General requirements and list of methods*

AS 1289.1.1, *Methods of testing soils for engineering purposes, Method 1.1: Sampling and preparation of soils—Preparation of disturbed soil samples for testing*

AS 1289.2.1.1, *Methods of testing soils for engineering purposes, Method 2.1.1: Soil moisture content tests—Determination of the moisture content of a soil—Oven drying method (standard method)*

AS 1289.3.5.1, *Methods of testing soils for engineering purposes, Method 3.5.1: Soil classification tests—Determination of the soil particle density of a soil—Standard Method*

AS 1289.3.6.1, *Methods of testing soils for engineering purposes, Method 3.6.1: Soil classification tests—Determination of the particle size distribution of a soil—Standard method of analysis by sieving*

ASTM E100, *Standard Specification for ASTM Hydrometers*

3 Terms and definitions

For the purposes of this document, the terms and definitions in AS 1289.0 and the following apply.

3.1

factor F_1

volume and hydrometer scale calibration

3.2

factor F_2

temperature correction for soil particle density

3.3

factor F_3

determination of effective particle diameter

3.4**may**

indicates the existence of an option

3.5**shall**

indicates that a statement is mandatory

3.6**should**

indicates a recommendation

4 Reagents

Only reagents of recognized analytical grade and distilled water or water of equivalent purity shall be used:

(a) *Stock dispersing solution* — shall be prepared as follows:

- (i) Dissolve 33 g of sodium hexametaphosphate together with either 7 g of anhydrous sodium carbonate (Na_2CO_3) or 18.9 g of hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) in distilled water to make 1 L of solution.

The decahydrate ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) is more readily soluble in water than is anhydrous sodium carbonate (Na_2CO_3) which is only sparingly soluble. The use of warm distilled water will also accelerate the solution of the chemicals.

- (ii) Store the stock solution in a dark bottle away from sunlight. The date of preparation, or expiry date, shall be recorded on the bottle. The stock solution will be unstable and shall not be used if more than one month old.

NOTE Sodium hexametaphosphate is recommended as the dispersing agent as it has been found suitable for a wide range of soils. However, lateritic soils cannot be dispersed adequately with sodium hexametaphosphate and the use of sodium phosphate is advised (Wintermyer^[1]).

(b) *Barium chloride solution* — shall be prepared by dissolving 50 g of barium chloride in 1 L of distilled water.

5 Apparatus

The following apparatus shall be used:

(a) An hydrometer conforming to ASTM E100 and with the following features (see [Figure 1](#)):

- (i) The glass used for the bulb and stem is as free as possible from visible defects.
- (ii) The stem and bulb are circular in cross-section and symmetrical about the longitudinal axis, with no abrupt changes in cross-section, which may trap air bubbles or hinder cleaning or drying.
- (iii) The basis of the scale is either density in grams per millilitre (g/mL) at 20 °C or grams per litre (g/L) of colloid in suspension at 20 °C. The g/mL scale is normally calibrated from 0.995 to 1.038 with graduation lines at every 0.0005 g/mL and a maximum permissible scale error of plus or minus one scale division (0.0005 g/mL).

The g/L scale is normally graduated from -2 to +60, with graduation lines every g/L, and a maximum permissible scale error of plus or minus one scale division (1 g/L).

- (b) Two 1 L capacity parallel-sided graduated glass measuring cylinders about 60 mm internal diameter and 450 mm high, marked at 1 L volume and graduated in divisions of 10 mL. Cylinders used in tandem shall have uniform dimensions.
- (c) A thermometer covering the range from 0 °C to 50 °C and accurate to 0.5 °C.
- (d) A high-speed mechanical stirrer, e.g. an electrically driven mixer with a vertical shaft and a speed typically greater than 10 000 rpm, a cup to fit, and equipped with a wire baffle. The container and baffle shall be of material resistant to chemical attack from the reagents used.

NOTE Alternative mechanical dispersion devices such as rubber mortar and pestle or air jet dispersion devices may be required for some soils. Residual soils of igneous origin suffer severe breakdown when subjected to mechanical stirring. The use of pestle and mortar is also unsatisfactory for these soils and it may be preferable to use an air-jet dispersion cup.
- (e) Sieves, ranging from 2.36 mm to 75 µm, and a receiver, as specified in ISO 3310.
- (f) A balance readable to 0.01g with a limit of performance not exceeding ±0.05 g.
- (g) An oven as specified in AS 1289.0.
- (h) A stop-clock or stopwatch.
- (i) A vernier calliper of at least 150 mm in length and readable to 0.1 mm.
- (j) A beaker.
- (k) A Buchner funnel and filter flask of about 500 mL capacity with cover glass.
- (l) A 100 mL measuring cylinder.
- (m) A wash bottle containing distilled water.
- (n) Filter papers (Whatman No. 54 or similar grade) to fit the Buchner funnel.
- (o) Litmus paper (blue) or suitable universal pH indicator papers.
- (p) Two types of stirrers are specified, a mechanically driven device (preferred) or air jet device. Studies have shown that the air jet device may give significantly different test results.
- (q) A glass rod about 200 mm long and 5 mm diameter.
- (r) A means of obtaining a vacuum, e.g. a filter or vacuum pump.
- (s) A desiccator containing anhydrous silica gel.
- (t) A constant temperature room capable of maintaining the soil suspension during sedimentation at a constant temperature of 20 °C ± 2 °C. The bath or cabinet shall be free of vibration.