METHOD A1
THE WET PREPARATION AND SIEVE ANALYSIS OF GRAVEL, SAND AND SOIL SAMPLES

1 SCOPE

The preparation of a gravel, sand or soil sample involves the quantitative separation of the soil fines portion, i.e. the material passing the 0,425 mm sieve, from the coarser portion as well as the sieve analysis of the coarser portion. The soil fines are required for the mechanical analysis and for the determination of the Atterberg constants and the linear shrinkage.

2 APPARATUS

2.1 A riffler with 25,0 mm openings.

2.2 The following test sieves, complying with SABS 197, with sieves larger than 4,75 mm of perforated plate and sieves 4,75 mm and smaller of wire mesh:

(a) A 19,0 mm sieve, recommended diameter 450 mm.
(b) A 63,0mm, 53,0mm, 37,5mm, 26,5mm and 19,0 mm sieve, recommended diameter 300 mm, with a pan.
(c) A 63,0 mm, 53,0 mm, 37,5 mm, 2~,5 mm, 19,0 mm, 13,2 mm, 4,75 mm, 2,0 mm and 0,425 mm sieve, recommended diameter 200 mm, with pan and cover.

2.3 A mechanical sieve shaker (optional).

2.4 A balance with a pan to weigh up to 5 kg, accurate to 19.

2.5 Basins and pans:

(a) A basin, about 500 mm in diameter.
(b) Basins, about 350 mm in diameter.
(c) Square pans, about 300 mm square at the top, tapering to 250 mm square at the bottom.

2.6 A 150mm nominal diameter iron mortar and pestle and a rubber-tipped pestle.

2.7 Hotplates or ring gas-burners.

2.8 A drying oven, thermostatically controlled and capable of maintaining a temperature of 105 to 110 EC.

2.9 Brushes:

(a) A brass or copper wire brush, measuring about 50mm x 25mm with bristles not more than 25 mm long.
(b) A hard-bristle nail-brush, measuring about 80mmx25mm.

2.10 A supply tank for distilled water.

2.11 Paper bags, 1 kg capacity.

2.12 A steel-bladed spatula, with a blade about 100 mm long

3 METHOD

3.1 Size of test sample

The size of the test sample will depend on the amount of soil fines (i.e. the portion passing the 0,425 mm sieve) present in the material. At least 300 9 of soil fines are required for the mechanical analysis and for the determination of the soil constants and the linear shrinkage. In the case of a soil which consists mostly of soil fines, a test sample of about 400 gram should prove adequate, whilst in the case of a gravel containing, for example, only 10 per cent of soil fines, the required quantity of material will be approximately 3,000 to 4,000 grams. The sample received from the field should, therefore, be quartered down by means of a riffler to the required size.

3.2 Quartering

3.2.1 The sample is emptied from the sample bag into one or more of the riffler pans. The material is then poured through the riffler by slowly tilting the pan so that the material flows in an even stream over the width of the pan. At the same time the pan is moved to and fro along the full length of the riffler ensuring an even flow of the material. The process is repeated with the contents of one of the pans under the riffler until a sample of the required size is obtained.

3.2.2 The test sample should, of course, be representative of the field sample and it is important to ensure a free flow of the material through the openings of the riffler. Problems arise in the case of samples containing coarse aggregate, large soil clods and/or large lumps of wet clay. As these will lodge in or on the openings of the riffler, they should first be removed by sieving before the material is passed through the riffler. In such cases, the following procedure should be used:

3.2.2.1 The sample is poured onto the 450mm diameter, 19,0 mm opening sieve which is placed in a 500 mm basin. Any large soil aggregations or clods retained on the sieve should be disintegrated in the mortar by applying pressure to the pestle or by tamping very lightly. The disintegrated material is added to the portion passing the sieve, which is then subdivided in the riffler as described above.
The aggregate retained on the sieve is sub-divided by the method of coning and quartering. This is accomplished by forming the material into a cone which is pressed flat and by dividing into tour quadrants, rejecting the two opposite quadrants and continuing the process of coning and quartering until a portion of the required size is obtained. If the material passing the 19,0 mm sieve is divided by the riffler to obtain a portion of say a quarter of the field sample, the coarse aggregate is divided an equal number of times. That portion of the coarse aggregate is now added to the portion passing the 19,0 mm sieve and this then constitutes the test sample which is considered to be representative of the sample as received from the field (see 5.1).

3.2.2.2 There is normally no need to dry the material before quartering, but if the sample contains large lumps of wet clay which cannot be dis-integrated it should first be dried in an oven at a temperature not exceeding 110 EC. The clods are then disintegrated in the mortar so as to pass the 19,0 mm sieve after which the material is divided in the riffler in the same manner as described above.

3.3 Dry Sieving

The material should be sufficiently dry so that it can be sieved through the 0,425 mm sieve without clogging the sieve. Therefore, if the quartered test sample is wet or damp, it should be dried in an oven at a temperature not exceeding 110 E C. The sample is then weighed and sieved through a 0,425 mm sieve. It is desirable to place a 2.00 mm or a 4,75 mm sieve above the 0,425 mm sieve to act as a guard for the finer sieve. The material retained on the 0,425 mm sieve is transferred to a mortar and by rubbing with a rubber-tipped pestle, most of the soil aggregations are disintegrated and at the same time most of the soil adhering to the aggregate is dislodged. The material is then sieved again through the 0,425 mm sieve. As much of the soil fines as possible should be separated in this way. The soil fines thus obtained are transferred to a paper bag which is placed in a drying oven at a temperature of 105 -110EC (see5.2).

3.4 Boiling and Washing

The material retained on the 0,425 mm sieve is transferred to a tin basin, covered with distilled or deionised water and brought to the boil (see 5.3). It is boiled vigorously for about one minute and then allowed to cool. If necessary, the material should then be worked thoroughly by hand in the water so as to ensure that all soil aggregations are disintegrated and that all the soil adhering to the aggregate has been loosened. The larger aggregate is removed and washed with distilled water on the 0,425mm sieve held over a clean basin until the wash water is clear. It is again desirable to protect the sieve by fitting a coarser sieve above it. The clean aggregate is then transferred to a square pan. The finer material remaining in the boiling basin is then stirred vigorously and the mass is poured quantitatively on to the 0,425 mm sieve held over the second basin. Both the sieve and the basin from which the material is poured should be agitated vigorously during pouring. The basin is then washed clean with a jet of distilled or deionised water whilst still being held over the sieve. The material on the sieve is washed by directing a jet of distilled or deionised water on to the material until the wash water is clean. The sieve should be agitated whilst washing. If the soil is very clayey, the sieve should be placed in the water and the material on the sieve agitated by rubbing with the fingers against the side of the sieve as this will speed-up the washing process. The sieve should also be raised and lowered in the wash water as this facilitates washing and keeps the amount of wash water required to a minimum. The washed material is transferred to the square pan by inverting the sieve and washing down with water. The water in the pan is poured off carefully and the material dried in an oven at a temperature of 105 to 110 EC.

3.5 Drying and disintegration of fines

The suspension containing the fines washed through the 0,425 mm sieve is boiled

down to a slurry which is then dried in an oven at a temperature of 105 to 110 EC (see 5.4). The dried soil in the bottom of the basin is loosened with a stiff wire brush or with a spatula in the case of clayey soils. The material adhering to the sides of the basin is brushed down and the slurry is disintegrated as far as possible with the brush. The material is sieved through the 0,425 mm sieve and clods retained on the sieve are disintegrated in the mortar with a rubber-tipped pestle, or if too hard, with the iron pestle. It is not necessary to crush very finely--just sufficiently to enable all the material to pass the 0,425 mm sieve. The soil fines are added to the portion obtained by dry sieving as described in 3.3.

3.6 Sieve analysis

After drying, the material retained on the 0,425 mm sieve is sieved through a nest of sieves consisting of the following: 63,0 mm, 53,0 mm, 37,5 mm, 26,5 mm, 19,0 mm, 13,2 mm, 4,75 mm, 2,0 mm and 0,425 mm. The sieving should be thorough and be done either by hand or by means of a mechanical sieve shaker. On no account should any sieve be overloaded as some of the fine material may be kept back if the layer on the sieve is too deep. If necessary, the material should be divided into fractions which are then sieved separately. After sieving, the material retained on each sieve is weighed and the masses recorded in the appropriate column of Form A1/1 (or a similar form). Weighings should be accurate to the nearest 1 gram. The material passing the 0,425 mm sieve is added to the soil fines portions obtained by dry sieving and by washing. All this material is now transferred to the scoop of the scale (or other similar container) where it is thoroughly mixed by stirring. It is then weighed and returned to the paper bag ready for the mechanical analysis and for the determination of the Atterberg constants and the linear shrinkage.

4 CALCULATIONS

The mass of each fraction retained between two sieves and the fraction passing the 0,425 mm sieve is converted to a percentage of the total mass of the dry material. (The mass of the original test sample is merely determined to serve as a check that no serious error has been made. This latter mass will normally be some- what higher than that of the dry material due to the presence of hygroscopic moisture.) The percentage retained on each sieve is then converted to a percentage passing the sieve. The percentages are calculated and reported to the nearest whole number on the appended A1/2 (or similar) Form and/or plotted on a suitable grading sheet such as the A1/3 Form.

5 NOTES

5.1 I n cases where the quantity of the different sizes of coarse aggregate in the field sample is such that it cannot be subdivided into a reasonably representative portion by coning and quartering, the sieve analysis carried out on the relatively small test sample will be far from accurate. A sieve analysis is, therefore, carried out on all the aggregate retained on the 19,0 mm sieve using a nest of 300 mm diameter sieves with openings from 63,0 mm to 19,0 mm. Seeing that in this case the aggregate is not subjected to the usual boiling and washing, care should be taken to remove any soil adhering to the aggregate before the sieve analysis is carried out. The actual test

sample will now only consist of a portion of the material passing the 19,0 mm sieve and it is, therefore, important to remember that the above sieve analysis should be corrected, as it is carried out on al I the coarse aggregate in the field sample. If the test sample consists of an eighth of the field sample, the masses of the aggregate fractions retained on the sieves should be divided by eight. After the sieve analysis, all the coarse aggregate is returned to the sample bag, i.e. it is combined with the unused portion of the material passing the 19,0mm sieve. It should now be remembered that the material in the bag is no longer a representative sample, and should it be necessary to repeat the test, allowance must be made in the subsequent calculations.

5.2 The soil fines obtained from sieving will contain hygroscopic moisture, except where the test sample was oven-dried prior to sieving. It is not considered necessary to dry the fines to constant mass, but by keeping the paper bag with the fines in the oven for at least the time required to complete all the subsequent processes, some of the moisture will be driven off. Such soil is considered to be sufficiently dry for the determination of the percentage passing through a 0,075 mm sieve and for hydrometer analysis (see Method A5 and Method A6).

5.3 As an alternative to boiling, the material may be left to soak overnight.

5.4 Care should be taken to ensure that the soil is not overheated as this may change its characteristics. The basin should, therefore, be removed timeously from the hot plate or gas burner, i.e. whilst the material is still in the form of a thin slurry.

5.5 Clean rain water may be used instead of distilled or deionised water.

5.6 It is essential that the particle size should not be altered during the preparation. Only friable decomposed material and soil clods should be dis-integrated. The extent to which decomposed material is to be disintegrated cannot be specified and must be left to the discretion of the operator. Material from compacted layers in the road should be prepared without disintegrating the decomposed material.

REFERENCE

AASHTO Designation T146 - 49

SAMPLE NO/MONSTER NR: ---------- DATE /DATUM: ----------

DRY MASS/DROE MASSA: ---------- PAN NO /NR: ----------

SIEVE APERTURE/SIFOPENING mm	MASS RETAINED MASSA WAT AGTERBLY	PERCENTAGE RETAINED PERSENTASIE WAT AGTERBLY	PERCENTAGE PASSING PERSENTASIE DEUR
63,0			
53,0			
37,5			
26,5			
19,0			
13,2			
4,75			
2,0			
0,425			
< 0,425			
TOTAL / TOTAAL			

DESCRIPTION:
BESKRYWING:

SAMPLE NO/MONSTER NR: ---------- DATE/DATUM: ----------

DRY MASS /DROË MASSA: ---------- PAN NO./ NR: ----------

SIEVE APERTURE/SIFOPENING mm	MASS RETAINED MASSA WAT AGTERBLY	PERCENTAGE RETAINED PERSENTASIE WAT AGTERBLY	PERCENTAGE PASSING PERSENTASIE DEUR
63,0			
53,0			
37,5			
26,5			
19,0			
13,2			
4,75			
2,0			
0,425			
< 0,425			
TOTAL / TOTAAL			

DESCRIPTION:
BESKRYWING:

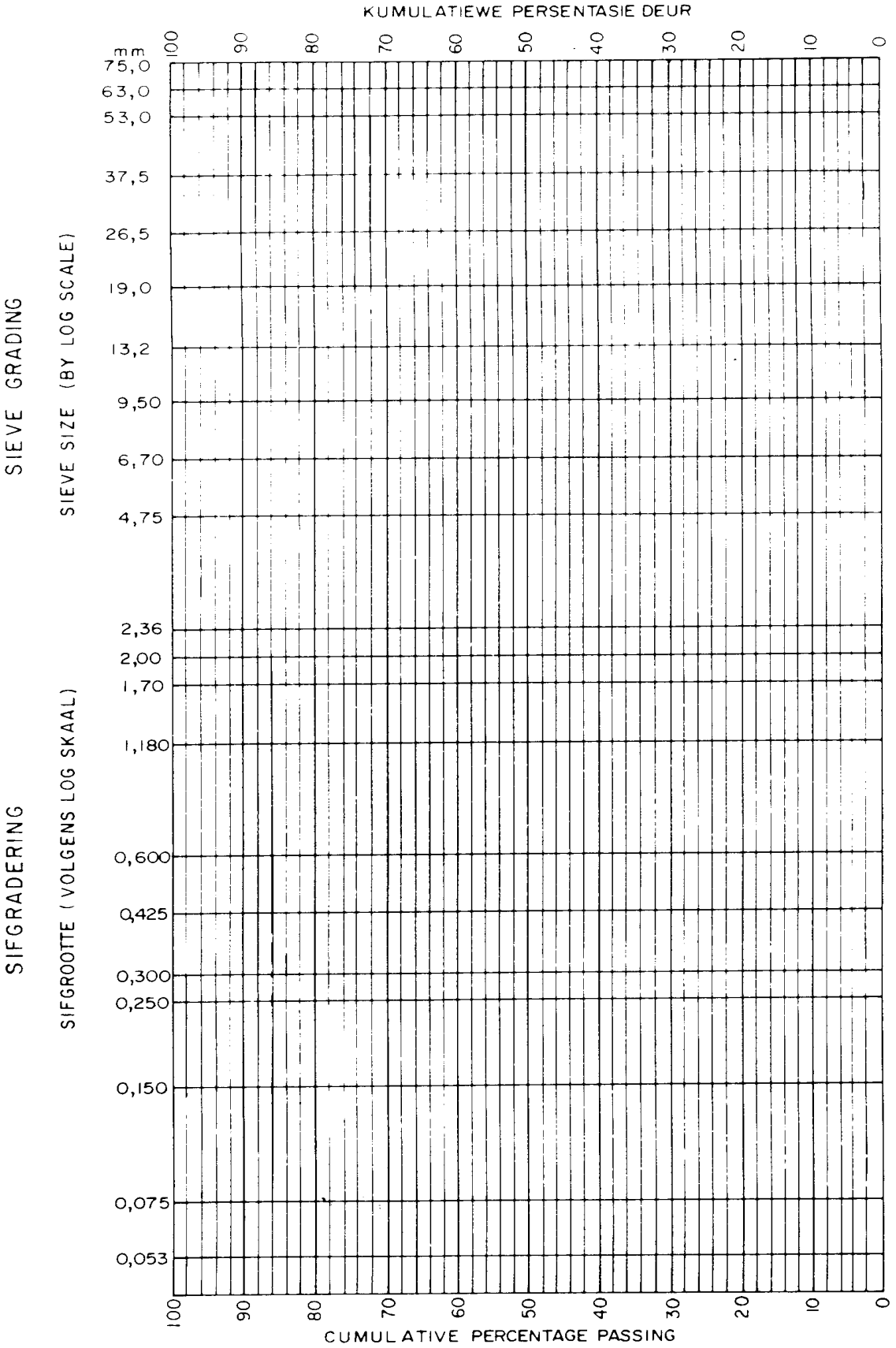
FORM A1/1

Recording sheet for sieve analysis

			SIEVE ANALYSIS / SIFONTLEDING										SOIL MORTAR ANALYSIS GRONDBINDSTOFONTLEDING			ATTERBERG CONSTANTS / -KONSTANTES		
SAMPLE NO. MONSTER NR.	DISTANCE AFSTAND (km) PEG NO. PEN NR.	DEPTH (mm) DIEPTE (mm)	PERCENTAGE BY MASS PASSING SIEVES PERSENTASIE PER MASSA DEUR SIWWE										SAND		MATERIAL MATERIAAL <0,075 mm	LIQUID LIMIT VLOEIGRENS	PLASTICITY INDEX PLASTISITEITSINDEKS	LINEAR SHRINKAGE LINEÊRE KRIMPING
			75,0 mm	53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,0 mm	0,425 mm	0,075 mm	COARSE GROF <2,0 >0,425 mm	FINE FYN <0,425 >0,075 mm				

FORM A1/2

Data sheet for sieve analysis and Atterberg constants



FORM A1/3

Grading sheet for sieve analysis