Test Method

Initial Preparation from Disturbed Samples

RC 301.01

1. Scope

This method describes the processes used for preparing untreated bulk samples prior to testing. Separating by sieving, removing soil coatings from coarse particles, breaking up clods, splitting out representative test samples of specified size and milling material for plasticity tests are some of the more important phases of sample preparation. Before proceeding to prepare soil for any test, the operator must make him/herself familiar with the preparation processes required in the particular test method, as specified elsewhere in this Manual.

2. Apparatus

(a) Crusher — a machine which is capable of crushing material ranging from hard stone to dry clay and which can be adjusted to produce material passing a 4.75 mm sieve. In the case of stone, a spalling hammer or larger crusher may be required to reduce oversize pieces enough to permit the material to be fed into the crusher.

(b) Rock cleaning and clod breaking device — a device for removing fines from coarse particles and breaking up clods without appreciably reducing the natural size of individual particles.
The following devices may be used:

(i) Rotary cleaner or 'Rumbler' with or without a charge of chain, wooden battens or rubber covered cast iron balls. The machine is mainly used for removing fines from coarse particles and breaking up aggregations during the preparation of gravels and crushed stone products.

(ii) Crusher—as listed above (a). Used for clod breaking where the material is a dry heavy clay.

(iii) Wooden mallet and metal plate. Used for clod breaking where stone is present in a predominantly fine grained material, also used where a crusher is not available.

(iv) Rubber (or other suitable material)-lined mill with rotary pestle of wood or other suitable material. Used on material passing the 2.36 mm sieve in the preparation of material for plasticity tests.

(v) Mortar and rubber-covered pestle. May be used instead of or in addition to the foregoing mainly in circumstances where increased operator control of the preparation process is desired.

(vi) Hammer mill. Used where large quantities of dry heavy clay are to be prepared for compactions and strength testing.

(c) Splitters — Riffle splitters as defined in AS 1141.2 or AS 1289.1 or Cone-type (VicRoads pattern) splitters.

(d) Quartering sheet — a heavy duty canvas or plastic sheet, 1-1.5 m square.

(e) Scale — 20 kg capacity with a limit of performance not exceeding ± 100 g.

(f) Balance — 5 kg capacity with a limit of performance not exceeding ±5 g.

(g) Oven — thermostatically controlled to operate at a temperature of up to 50°C, preferably with mechanical ventilation.

(h) Sieves — large diameter of approximately 13.2 and 3.35 mm apertures.

300 mm diameter, AS sizes: 4.75 and 2.36 mm and pan.

200 mm diameter, AS sizes: 1.18 mm. 425 µm and pan.

(i) Sieve shaker — any mechanical sieve shaker may be used which produces the thoroughness of sieving required; i.e. not more than one percent by mass of the residue retained on any sieve after mechanical sieving is completed shall pass that sieve during one minute of continuous hand sieving.

(j) Sample containers—various sizes and shapes but those made of low density polythene are very suitable. Low density polythene containers must not be used if the temperature to which they will be subjected exceeds 50°C. Metal trays must be used if a sample is to be dried in a high temperature oven (110°C).

Table 1 -Methods of Preparation

Material		Common Tests	Standard Preparation	Procedure
1.	Fine grained materials	Sieve Analysis Plasticity Index Linear Shrinkage	Air Dry Break up clods Split out sieve analysis and plasticity samples. Complete breakdown of plasticity sample, mill and sieve	7.1 7.2 (d), (e), (f) 7.3 7.4
2.	Pavement materials	Sieve Analysis Plasticity Index Linear Shrinkage Sand Equivalent	Air Dry Break up aggregations and clean the particles. Split out sieve analysis, plasticity and sand equivalent. Complete breakdown of plasticity sample, remove stone particles, mill and sieve.	7.1 7.2 (a), (b), (c) 7.3 7.4
3.	Materials deficient in fines	Sieve Analysis Plasticity Index Linear Shrinkage Sand Equivalent	Air Dry The sample must be used for the sieve analysis test. Representative samples for plasticity and sand equivalent tests are obtained after Separation of the minus 4.75 mm material in the grading test. Prepare as in (2).	7.1 7.3
4.	Materials containing very soft particles	Sieve Analysis Plasticity Index Linear Shrinkage	Air Dry Consult client for direction regarding method of preparation.	7.1
5.	Clean sands Clean gravels Clean crushed material	Sieve Analysis Flakiness Index Colour Test Los Angeles Value ASI	Air Dry Split out sieve analysis, colour test, ASI and Los Angeles Value samples.	7.1 7.3
6.	Spalls	Los Angeles Value Degradation Factor ASI Texas Ball Mill Secondary Minerals Inherent Plasticity	Crush If spalls are coated with clay wash and air dry before crushing. Sieve out particles of required sizes. Inherent plasticity material is prepared from fines obtained after crushing, as in (2) above.	
7.	Subgrades and pavement materials	Compaction Soil Strength Tests, e.g. CBR Stabilization Tests	Air Dry Break up clods. Split out sieve analysis and plasticity samples. Treat as in (1) above.	7.1 7.2 (a), (d), (g) 7.3

3. Securing Bulk Samples

Each bulk sample shall be obtained according to the appropriate procedure as laid down in AS 1141.3.1 or Test Method RC 300.04.

4. Sample Identification

Each bulk sample shall be identified by a Laboratory number which shall be written on suitable cards or tickets. One of these cards or tickets bearing the laboratory number shall accompany each test sample, portion and sub-portion throughout the processing and testing of the material.

5. Methods of Preparation

The tests usually required and the preferred procedure for the preparation of various materials for these tests are listed in Table 1. Other procedures should be used only when detailed by the test method. Detailed descriptions of the various procedures are given in this method.

6. Quantity of Material to be Prepared

The initial quantity of material to be split out for preparation must include an allowance for the elimination of oversize materials where appropriate.

Before commencing to prepare a material, the operator should estimate the total quantity he/she must deal with in order to obtain the required final quantities for each test.

The final quantities of material required for tests are listed in AS 1289.1 and AS 1141.

7. Procedure

7.1. Drying of Bulk Samples

It is neither necessary nor desirable to dry out the material to a completely dry condition in the preparation stage. Milling and sieving may be done on an air dry sample whilst splitting is preferably done on a moist sample. Drying may be carried out in a low temperature oven but temperatures in excess of 50°C must not be used. Sunlight and forced draughts of warm air may also be used to accelerate drying.

Total drying times may frequently be shortened by first drying the bulk sample to a moist condition, then splitting it and finally drying the reduced quantity to the air dry state required for milling and sieving.

7.2. Removal of Coatings from Coarse Particles and Breaking Up of Clods

Aggregates are usually clean and can be sieved without special preparation. Pavement materials generally include stone particles with a coating of fines. These coatings must be separated from the stones by use of the rumbler, by brushing the stones or by washing the sample and evaporating the wash liquor to dryness; these alternatives are given in their order of relative convenience. Subgrade materials generally consist of clods with some free fines.

(a) Preparation by Rumbler.

Inspect the rumbler and, if necessary, clean the cage and/or pan. Weigh the air dry bulk sample and then place in the rumbler cage. If required, add the chains or balls. The use of chains or balls is to be avoided whenever feasible but where the stones in the sample are coated with clay an inspection of the sample after five minutes rumbling will show whether a charge must be used. Secure the lid tightly to the cage. The period of time required to process the sample in the apparatus cannot be specified but must be sufficient to ensure that the coatings have been cleaned off the stones and that all aggregations of fine material have been broken down.

If breakdown of individual particles starts to occur or, if after a considerable period in the machine the coatings are not being adequately removed, discontinue the machine treatment and substitute hand brushing or washing. After an adequate time in the rumbler, remove the sample. Add the stones retained inside the cage to the fine material in the pan by taking off the cage lid and rotating the cage. Remove any stones actually caught in the cage sides by manipulating or gently knocking them back into the cage. Carefully mix the fine and coarse portions of the sample before obtaining representative samples for each test. (See Clause 7.3.) Alternatively, the coarse and fine fractions may be weighed and tested separately for sieve analysis, the results being combined arithmetically. The portion of the fine fraction not required for mechanical analysis is used to provide material for other tests.

(b) Preparation by Hand Brushing

Where rumbler equipment is not available and the action of sieving is insufficient to clean the stones, an alternative is to pass the bulk sample through the nest of sieves and then brush the stones retained on each sieve. Use a stiff bristle brush for hard stone and a soft brush for soft stone.

Separate the air-dry bulk sample on the 4.75 mm sieve and put aside the portion passing while the portion retained is passed through a nest of appropriate sized sieves. Hand brush the individual stones retained on each sieve and break down by hand any aggregations. Retain the coatings loosened from the stones and the aggregations which are broken down by passing them down through the sieve nest. Add all material passing the last sieve in the nest to the material which earlier had passed the 4.75 mm sieve. Carefully mix the fine and coarse portions of the sample before obtaining representative samples for each test. (See Clause 7.3.)

(c) Preparation by Washing

This method is the lengthiest but as it is probably the most accurate it may be used as a referee method. There is no need to dry the bulk sample before the process commences.

Soak the bulk sample for a sufficient time to soften lumps and coatings and then hand wash to clean the individual particles and to break and disperse the lumps. Pour the whole sample through the 4.75 mm sieve, wash the fines through and collect the wash water. In the case of large samples it will be necessary to wash the sample in several portions. Separate out the clean particles retained on the 4.75 mm sieve and oven dry at 105°C. Evaporate the water from the residual material at a temperature not exceeding 50°C, stirring occasionally during the drying process to prevent the formation of hard lumps.

Carefully mix the fine and coarse portions of the sample before obtaining representative samples for each test. (See7.3 below.)

(d) Preparation by Mallet

The foregoing methods of preparation are not expeditious for subgrade materials, which are usually fine-grained and sometimes contain some larger particles. By the use of a wooden or rubber mallet the large clods or aggregations can be broken down to a reasonable size for splitting and further preparation.

The best results are obtained when the moisture content of the bulk sample at the start of the preparation process is such that the sample is soft and crumbly. Care should be taken to see that clay soils are not baked hard. Oven drying temperatures in excess of 50°C must not be used.

Process the partially dry soil with the mallet, breaking down clods and aggregations until they can be passed through a medium sized sieve, such as the 13.2 mm. When dealing with samples containing soft stone the experience of the operator will dictate how hard and for how long the mallet is used.

If there is stone retained on the sieve, remove the coatings of fines by brushing and add to the sample.

Carefully inspect the cleaned stone to see whether it is 'foreign' to the sample (e.g. stone from the pavement or seal which has been included by accident), in which case it is discarded, or is a naturally occurring part of the sample (e.g. gravel or mudstone in a subgrade), in which case the process is continued in the manner given under 7.1, 7.2 or 7.3.

With subgrade samples where the amount of stone present is so small (up to 5 percent of the sample) or so large in size compared to the sizes present in the remainder of the soil that it is ju dged to have no effect upon the bearing value of the soil, it may be discarded.

From the material passing the sieve, obtain representative samples for each test. (See 7.3 below.)

(e) Preparation by Mortar and Rubber-covered Pestle

The mortar and pestle may be used as an alternative to a mallet where the amount of bulk sample is small or in the milling process (see clause 7.3) when a lined mill is unavailable. In both cases the aim is to break down all aggregations and remove all surface coatings from the particles without grinding them down.

(f) Preparation by Jaw Crusher

Where samples of heavy clay have become very dry and hard it will be more expeditious to use a small crusher in lieu of a mallet for the purpose of breaking up clods. Care should be taken to ensure that there is no appreciable quantity of stone in the sample which may shatter and produce erroneous results.

(g) Preparation by Hammer Mill

Where a large quantity of a subgrade material is required for compaction or soil strength, e.g. CBR testing, a hammer mill is invaluable, again with the proviso that there is little stone present.

7.3. Obtaining Representative Samples for Specified Tests

Refer to the respective test methods for the soil fraction required and the quantity of material needed for each test. Split or quarter the bulk sample into representative samples for the various tests. Do not scoop or pour out material for testing. The use of a sample splitting device is preferred. However, hand-quartering is acceptable if carefully performed.

(a) Splitting bulk samples with cone type (VicRoads pattern) splitter

The cone type splitter is most convenient where a large quantity of material is to be drastically reduced to the correct amount of representative sample required or where a number of representative samples of the same material are required. The VicRoads pattern splitter contains eight segments in the revolving drum thus a sample can be split into eight parts in one pass through the splitter.

Precautions necessary to ensure efficient and accurate splitting are:

(i) Try to avoid segregation when placing the sample in the hopper.

(ii) Do not over fill the hopper.

(iii) Ensure that the drum is rotating before opening the gate.

(b) Splitting bulk samples with riffle type splitters

The splitting device should have openings sufficiently wide to permit easy passage of the largest particles in the sample and yet not so wide that a non-representative separation is obtained. Generally the width of openings should be approximately 25 percent larger than the largest particles in the sample to be split (see AS 1289.1 and AS 1141.2).

Thoroughly mix the sample and spread it evenly across the pan or hopper. The pan or hopper used with a riffle type splitter shall be equal in width to the overall width of the chutes and it shall be used so that the material will pour in equal amounts into each chute.

(c) Hand quartering bulk samples over 50 kg mass

(i) Mix and pile the sample on the quartering sheet. Shovel the material into the centre to form a cone. In order to mix the sample place each shovelful so that the material spills over the cone equally in all directions. Before proceeding with the following steps, dampen samples which tend to segregate.

(ii) Flatten the cone with a shovel, spreading the material to a circular layer of uniform thickness.

(iii) Insert a stick or pipe beneath the sheet and under the centre of the pile, then lift both ends of the stick, dividing the sample into two equal parts. Remove the stick leaving a fold of the sheet between the divided portions.

(iv) Insert the stick under the centre of the pile at right angles to the first division and again lift both ends of the stick, dividing the sample into four parts.

In lieu of dividing by use of a stick a shovel may be used to divide the sample into four equal parts.

(v) Remove two diagonally opposite quarters, being careful to clean the fines from the sheet.

(vi) Remix the remaining material by taking alternate shovelfuls from each remaining quarter and placing each one in the centre so that a cone is formed as before. Repeat the quartering process until the sample is reduced to the desired size.

(d) Hand quartering bulk samples from 10 to 50 kg mass

(i) Pile the sample on a quartering sheet and mix byalternately lifting each corner of the sheet and pullingit over the sample toward the diagonally oppositecorner causing the material to be rolled.Dampen material which tends to segregate.

(ii) Flatten and quarter as specified in (c) above.

(e) Hand quartering bulk samples less than 10 kg mass

(i) Place the sample on a quartering sheet or on a clean sheet of heavy paper. Mix thoroughly with a trowel and form the material into a conical pile. Dampen material which tends to segregate.

(ii) Flatten the cone by pressing it down with a trowel.

(iii) Separate into quarters with the trowel and remove diagonally opposite quarters.

(iv) Repeat the above process until the sample is reduced to the desired size.

After the required test samples have been removed save the remainder of the sample for possible future check tests.

7.4. Preparation of Material for Plasticity and Shrinkage Tests

(a) Preparation of Normal Materials

Air dry and prepare the material as in Clause 7.2. Obtain a representative sample passing the 4.75 mm sieve as in Clause 7.3. Complete the breakdown of small clods or aggregations and remove the coatings from small stones by the use of the lined mill. Since the presence of the larger stone chips will interfere with the milling process and will also result in damage to the lining of the mill, run the material through the 2.36 mm sieve before milling. Carefully clean any stones retained of all surface coatings by brushing and rubbing on the sieve; any fines obtained must be included in the milled material whilst the clean stones are discarded. Break down any aggregations. After the mill is started, observe it for a short time to see that it is operating correctly. Mill the sample for about 10 minutes (some heavy clays require much longer times).

When a mill is not available a mortar and pestle may be used. Care must be taken that all aggregations are broken down and surface coatings removed BUT no stone is ground down.

After removal from the mill, thoroughly sieve the sample in the nest of sieves comprising a pan, the 425 µm sieve and a guard sieve a little coarser, generally a 1.18 mm. Take the material passing the 425 µm sieve (i.e. in the pan) for the plasticity tests.
Inspect the material retained on the 425 µm sieve to ensure that no more than a nominal amount of uncrushed aggregations of clayey particles remain. If a significant quantity of clayey particles is found, still uncrushed, the material retained on the sieves should be milled again, perhaps in a mortar and pestle. This is particularly important when only a small amount of passing 425 µm sieve material has been produced and also where the main part of the passing 425 µm material is of markedly different nature to the aggregations. After the remilling, sieve the material and add the further material in the pan to, and mix well with, that material earlier obtained.

In all cases the final product passing the 425 µm sieve must be thoroughly mixed. In difficult cases wet preparation may be used.

(b) Wet Preparation

Sieve the sample on a 425 µm sieve, suitably protected by larger sieves. Retain all material passing the 425 µm sieve. Wash the material retained on the 425 µm sieve and all protecting sieves over that sieve and collect all wash water. Evaporate the water at a temperature not exceeding 50°C, rub the dried material in a mortar with a pestle and sieve through the 425 µm sieve. Add the material to that previously obtained, mix thoroughly and obtain a sufficient sample by riffling or quartering.

NOTE: An alternative wet preparation method, which has been found satisfactory for some coarse-grained and medium-grained soils, is to use a fine water-spray for washing of the dry-sieved-retained 425 µm sieve material, keeping the wash water to the minimum consistent with washing the material. Add the dry-sieved passing 425 µm sieve material to the wash water and mix thoroughly. Some air drying of the material may be required if there is too much wash water, but usually it is possible to proceed with the plasticity tests after a 24 hour curing period.

(c) Preparation of Organic Soils

With certain highly organic soils, oven drying, milling or sieving produce a considerable alteration in the plasticity characteristics of the material and can lead to most misleading results.

In these cases, the soil is tested in the state in which it was sampled except that it is squeezed through a 425 µm sieve by means of a spatula to eliminate any grit. Any drying out needed during the tests is done by allowing the wet soil to stand in air. In other respects the plasticity tests are carried out as usual.

The plasticity results of highly organic soils are characterized by very high plastic limits, irrespective of the actual plasticity index. Such soils are dark in colour, generally black, and frequently malodorous. Certain soils have a texture which can be adequately described, in a self-explanatory manner, as 'birds-nest'. An occasional soil is so fibrous in this fashion that the step of squeezing through the 425 µm sieve has to be omitted.

8. Hazards

Dust, noise, careless lifting and improper operation of equipment are serious health and accident hazard sources encountered in sample preparation. It is not possible to completely eliminate these hazards but it is possible to minimize them.

Safety glasses, respirators and ear muffs should be used when necessary.

Proper lifting methods must be used to reduce the chance of strain or rupture. The use of table-high trolleys to move materials can eliminate much lifting.

Keep the work place clear of obstructions to avoid tripping.

Wear rubber-soled shoes to prevent slipping on polished floors.

Test Method - Revision Summary

RC 301.01 Initial Preparation from Disturbed Samples

Date	Clause Number	Description of Revision	Authorised by
November 2012	Full document	Re-styled with minor corrections made	Principal Advisor – Pavements & Materials