Transport Roads & Maritime Services

NSW GOVERNMENT

Test method T225

Petrographic examination of granular material

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Revision Summary

Ed/Rev Number	Clause Number	Description of Revision	Authorisation	Date
		Reformatted and Revision Summary Added	D.Dash	May 1999
		Date on Test Method Revised to Agree with Date on Revision Summary	D.Dash	Feb 2001
Ed 2/ Rev 0	All	Reformatted RMS template	J Friedrich	October 2012

Note that Roads and Maritime Services is hereafter referred to as 'RMS'.

The most recent revision to Test method T225 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T225

Petrographic examination of granular material

1. Scope

This test method sets out the procedure for the petrographic examination by means of optical microscopes of granular road making materials to identify, describe and classify mineral and other constituents of a sample, and to determine relative amounts of any constituents which may have a bearing on the quality of the material.

These procedures may also be applied to the residue obtained by the Sedimentation and Declination Method described in Test Method T107.

2. Definition

Term	Definition
Primary minerals	(a) Are those minerals, including certain deleterious minerals which were deposited in the original rock-forming episode.
Deleterious secondary minerals	(a) Are those minerals which have been altered or restructured from primary minerals, by weathering, thermal and chemical agents, and are known to affect material in which it is contained adversely. Deuteric minerals for the purpose of this Test Method are classed as secondary minerals. Table 1 lists the common deleterious minerals

3. Apparatus

3.1 Apparatus for the Preparation of Specimens

(a) Glass micro slides 76 mm × 25 mm (Standard) and 47 mm × 27 mm (half-slides).

(b) Microscope glass cover slips 22 mm × 22 mm and 45 mm × 22 mm cover glasses.

(c) 75.0 mm, 63.0 mm, 53.0 mm, 37.5 mm, 26.5 mm, 19.0 mm, 13.2 mm, 9.50 mm, 6.60 mm, 4.75 mm, 2.36 mm, 1.18 mm, 850 μm, 600 μm, 300 μm, 150 μm and 75 μm, AS sieves.

(d) Sieve brushes.

3.2 Apparatus for the Examination of Specimens

(a) A petrological (polarising) microscope - fitted with low, medium and high power objectives; transmitted and incident light capacity; measuring analyser; compensates and retardation plates; revolving vernier read stage; and a Bertrand lens system capable of being centred.

(b) An interchangeable binocular phototube, with final magnifications from 40× to 1250× for use with the petrological microscope

(c) Stereoscopic microscope with objectives and eyepiece to give final magnifications from 6× to 60×

(d) Point counter for the modal analysis of thin sections of mineral aggregate

(e) Immersion oils with refractive indices of n = 1.515 and n = 1.410 to n = 1.785 in steps of 0.005 as required

4. Test Portion

The sample submitted for testing shall be reduced, as required, by quartering or riffling to provide at least the minimum mass listed below according to the nominal maximum size of the aggregate.

Nominal Maximum Size of Aggregate: mm	Minimum Mass of Dry Test Portion: g
75	25 000
40	16 000
30	12 000
20	8 000
14	6 000
10	2 000
7	1 000
Fine Aggregates	500

5. Procedure

(a) Sieve the test portion in accordance with Test Method T201 to provide fractions of each sieve size and record the quantity of material retained on each sieve for the calculation of the weighted percentage of each mineral constituent.

(b) Examine each fraction separately as outlined below using the stereoscopic microscope and/or the petrographic microscope, depending upon the size of the particles and the ease of identification.

(i) Coarse aggregate fractions (over 600 μm). Quarter or riffle each fraction separately to obtain a test portion of each sieve fraction containing at least 300 particles. Use the stereoscopic microscope and examine each particle in each test portion to identify its constituents. (see *Calculations*) and to contain the proportions of each constituent present. Grains which cannot be identified using the stereoscopic microscope or are suspected of consisting of or containing substances known to react deleteriously during use should be examined with the petrological microscope. (See Test method T226)

(ii) Fine aggregate fractions (less than 600 μm)

Mount a representative portion of each size fraction in immersion oil on a glass slide and cover with a glass cover slip. A correctly chosen index of immersion oil should enable the identification of the important constituents. Use the automatic point counter apparatus to estimate quantities of constituents

(c) Describe the aggregate mass in detail, including rock type, particle shape, particle surface texture, grain size, colour, mineralogy, modal composition, microtexture, micro structure and the general physical condition. (Particle shape and surface texture groups are described in Tables 2 and 3).

(d) Record the presence of any constituents known to cause deleterious effects in its proposed use. This examination shall establish if exterior coatings are present and if present, whether such coatings will be deleterious.

(e) For grains coarser than 600 μm which require preparation of thin sections for their identification, using a petrological microscope, see Test Method T226.

6. Calculations

(a) Calculate the composition of each sieve fraction of a heterogeneous sample and the weighted average composition of the whole sample as follows:

(i) Express the composition of each sieve fraction by summing the total number of particles of that fraction counted, and calculating each constituent in each condition (eg weathering or shape) as a percentage of that total amount (as number of particles in percent, in each sieve fraction). It is convenient to calculate and record the percentages to the nearest 0.1% at this stage. An example of these calculations is given in the upper half of Table 4.

(ii) Obtain the weighted percentage of the sieve fraction in the whole sample (individual percentages retained on consecutive sieves) from the grading of the sample as determined by Method T201.

(iii) By multiplying the percentage of the constituent in the sieve fraction, determined as described in (i) by the percentage of the sieve fraction in the whole sample, obtained as described in (ii), calculate the percentage in the whole sample of that constituent in that size (weighted percentage of constituents in sieve fraction, Table 4). It is convenient to calculate and record these percentages to the nearest 0.1%.

(iv) By adding the weighted percentages of each constituent in each sieve fraction, obtain the weighted percentage of each constituent in the whole sample (see under weighted composition of sample in Table 4).

(v) Construct a table to show the composition of each sieve fraction and the weighted composition and condition of the whole sample. Report values to the nearest whole number. Report constituents amounting to 0.5 percent or less of a sieve fraction or of the whole sample as traces. Table 5 is an example constructed from the data obtained in Table 4. As a convention, the total in each sieve fraction and the total in the whole sample shall each be 100 percent without the traces.

(b) Calculate the modal compositions from data obtained by the point counting procedure.

7. Reporting

(a) **Summary Report**
Report the essential information required to identify the material as to its source, proposed use and hand specimen description. Nominate the type of rock from the list in Table 6.

(b) **Detailed Report**
Report the composition and features of the material. Tables and photomicrographs may be used to adequately present information gained from the examination. Recommendations concerning additional petrographic, physical or geological examinations should also be included.

Table 1

Some known Deleterious Primary, Secondary and Deuteric Minerals

Montmorillonite (Smectites)	Montmorillonite Beidellite Nontronite Saponite Hectorite
Mixed-Layer Clays	Chlorite Swelling Chlorite/Vermiculite Montmorillonite
Dicalcium Silicate	
Chalcedony	
Chlorite Group	Swelling Chlorite Chlorite
Mica	Illite Glauconite Others
Kaolinite Group (Kandites)	Kaolinite Dickite Nacrite Halloysite Antigorite Chrysoltile
Vermiculites	
Zeolites	Natrolite Harmotome Chabazite Faujasite Mordenite Heulandite Groups
Iddingsite	
Oxides and Hydroxides of Iron	
Gibbsite Brucite } (Bauxite)	
Pyrite Marcasite Other Sulphides	
Carbonate Barite Fluorite Magnesite	

Table 2
Particle Shape

Classification	Description
Rounded	Fully water-worn or completely shaped by attrition.
Irregular	Naturally irregular, or partly shaped by attrition and having rounded edges.
Angular	Possessing well-defined edges formed at the intersection of roughly planar faces.
Flaky	Materials of which the thickness is small relative to the other two dimensions
Elongated	Material, usually angular, in which the length is considerably larger than the other two dimensions.
Flaky & Elongated	Material having the length considerably larger than the width, and the width considerably larger than the thickness.

Table 3
Surface Texture

Group	Surface Texture	Characteristics
1	Glassy	Conchoidal Fracture
2	Smooth	Water-worn, or smooth due to fracture of laminated or fine-grained rock.
3	Granular	Fracture showing more or less uniform rounded grains.
4	Rough	Rough fracture of fine-grained or medium grained rock containing no easily visible crystalline constituents.
5	Crystalline	Containing easily visible crystalline constituents.
6	Honeycombed	With visible pores and cavities.

Notes

1. The above surface texture grouping is broad, being based on the impression that would be gained by a visual examination of hand specimens. It does not purport to be a precise petrographical classification.

2. Different specimens of the same rock type may not fall into the same group in Table 2.

Table 4
Calculation of Results of Particle Counts[a]
Composition of Fractions Retained on Sieves Shown Below

Constituents[b]	19.0 mm		13.2 mm		9.5 mm		4.75 mm	
	Number of Particles	percent	Number of Particles	percent	Number of Particles	percent	Number of Particles	percent
A_1	250	50.0	200	40.0	150	30.0	50	10.0
A_2	50	10.0	100	20.0	125	25.0	100	20.0
A_3	10	2.0	50	10.0	75	15.0	100	20.0
B_1	107	21.4	70	14.0	62	12.4	32	6.4
B_2	76	15.2	53	10.6	19	3.8	87	17.4
B_3	...	...	20	4.0	43	8.6	96	19.2
C_1	5	1.0	5	1.0	20	4.0	20	4.0
C_2	2	0.4	2	0.4	6	1.2	10	2.0
C_3	...	...	...	...	...	...	5	1.0
Totals	500	100	500	100	500	100	500	100
Individual percentage retained on sieve		17.4		32.6		29.5		20.5

Weighted Percentages of Constituents in Each Sieve Fraction

	19.0 mm	13.2 mm	9.5 mm	4.75 mm	Weighted Composition of Sample
A_1	8.7	13.0	8.9	2.1	32.7 64.6 (Total A)
A_2	1.7	6.5	7.4	4.1	19.7
A_3	0.4	3.3	4.4	4.1	12.2
B_1	3.7	4.6	3.7	1.3	13.3 31.8 (Total B)
B_2	2.6	3.5	1.1	3.6	10.8
B_3	...	1.3	2.5	3.9	7.7
C_1	0.2	0.3	1.2	0.8	2.5 3.6 (Total C)
C_2	0.1	0.1	0.3	0.4	0.9
C_3	...	...	...	0.2	0.2
Total in Sieve Fraction	17.4	32.6	29.5	20.5	
Total in sample, condition 1					48.5
Total in sample, condition 2					31.4
Total in sample, condition 3					20.1

[a] This table indicates a convenient method of setting up a work sheet for recording results and calculations. The results developed here are entered in the forme indicated by Table 5. Table 5 is included in the petrographic report. Table 4 is not.

[b] Letters (A, B, C) refer to the various constituents found, subscript numbers (1, 2, 3) refer to the various conditions in which each constituent has been found, such as relative degree of weathering.

Table 5

Composition and Condition of an Aggregate Sample
(Table Constructed from Calculations Shown in Table 4)

Constituents	Amount, as Number of Particles in percent							
	In Fractions Retained on Sieves Shown Below[a]				In Whole Sample[b]			
	19.0mm	13.2mm	9.5mm	4.75mm	1	2	3	Totals
A B C	62 37 1	70 29 1	70 25 5	50 43 7	33 13 2	20 11 1	12 8 t r	65 32 3
Total	100	100	100	100	...	...	...	100
Weighted average, condition 1 Weighted average, condition 2 Weighted average, condition 3					48	... 32 ...	 20	... ...

[a] Based on count of 500 particles in each sieve fraction. (The number of particles of each sieve fraction counted should be shown in the report and this may conveniently be done as a footnote to the table.)

[b] Based on graduation of the sample as received, and on the distribution of constituents by sieve fractions shown at the left above.

Table 6

Rock Groups

Granite	Gabbro	Quartzite
Microgranite	Dolerite	Hornfels
Rhyolite	Basalt	Arkose
Diorite	Quartz	Greywacke
Microdiorite	Breccia	Concretionary rocks
Andesite	Slate	Limestone
	(including indurated shale)	Chert
Syenite		Conglomerate
Microsyenite	Foliated Rocks	Sandstone
	(Schist, Serpentinite etc)	Siltstone
		Shale
Trachyte		Mudstone

These major rock groups, into which the majority of natural rocks fit, shall be used for classifying rock types. (The rock groups are defined in Test Method T226 - Appendix 1)