3.8.1.7 Reporting of results

Report the following:

(a) The percentage passing individual sieves to the nearest 1%;

(b) If required, the cumulative percentage passing each sieve plotted on a semi-logarithmic graph (see Figure 9 for a simplified example);

(c) State that the percentage passing the finest sieve was obtained by difference.

State the following:

(d) The date of the test;

(e) The source and description of the field sample;

(f) The sampling method used, including the clause number and description, if known. For example, 'NZS 4407, method 2.4.7 Sampling from freshly spread layers';

(g) The condition of the field sample as received for testing;

(h) That the result was obtained in accordance with this test method.

3.8.1.8 Notes on Test Method 3.8.1

The following notes should be read in conjunction with this test method but are informative only:

(a) Choice of sizes of test sieves. The sizes of sieves used for the test should adequately cover the range of sieves required for testing road aggregates within the following list of sieves:

(i) Large: (such as 450 mm or 300 mm diameter) sieves: 63.0 mm, 53.0 mm, 37.5 mm, 26.5 mm, 19.0 mm, 13.2 mm, 9.50 mm, 4.75 mm, or as appropriate

(i) Small: (such as 200 mm diameter) sieves: 4.75 mm, 2.36 mm, 1.18 mm, 0.600 mm, 0.425 mm, 0.300 mm, 0.150 mm, 0.075 mm, or as appropriate;

(b) Where large numbers of tests are to be carried out, it may be advantageous to have two 4.75 mm sieves and two of the finest sieves, one for the wet, and one for the dry sieving processes;

(c) The water used in the washing procedure of this test should be of drinkable quality. It is not necessary to use distilled water;

(d) With experience it may be found that, provided the drying oven is not overloaded and that sufficient water can be removed after washing, samples can be dried to constant mass in approximately 18 hours;

(e) Take care during the shaking process to ensure that undue particle breakdown does not occur during the sieving process;

(f) If the mass of material passing the 19.0 mm or the 4.75 mm sieve is sufficient to continue without further division, or if there is less than the minimum required mass passing these sieves, the splitting procedure may be omitted and the splitting ratio for that particular split equals unity. Test sieve sizes of 19.0 mm and 4.75 mm have been specified as convenient points for splitting samples, but the sample may be split on any convenient sieve.

Table 6 – Size of test sample for sieving

Nominal aggregate size (mm)	Minimum mass of sample to be taken for sieving (kg)
100	50
65	25
40	10
20	5
10	0.5
5	0.2
NOTE – Minimum sample masses are dry masses.	

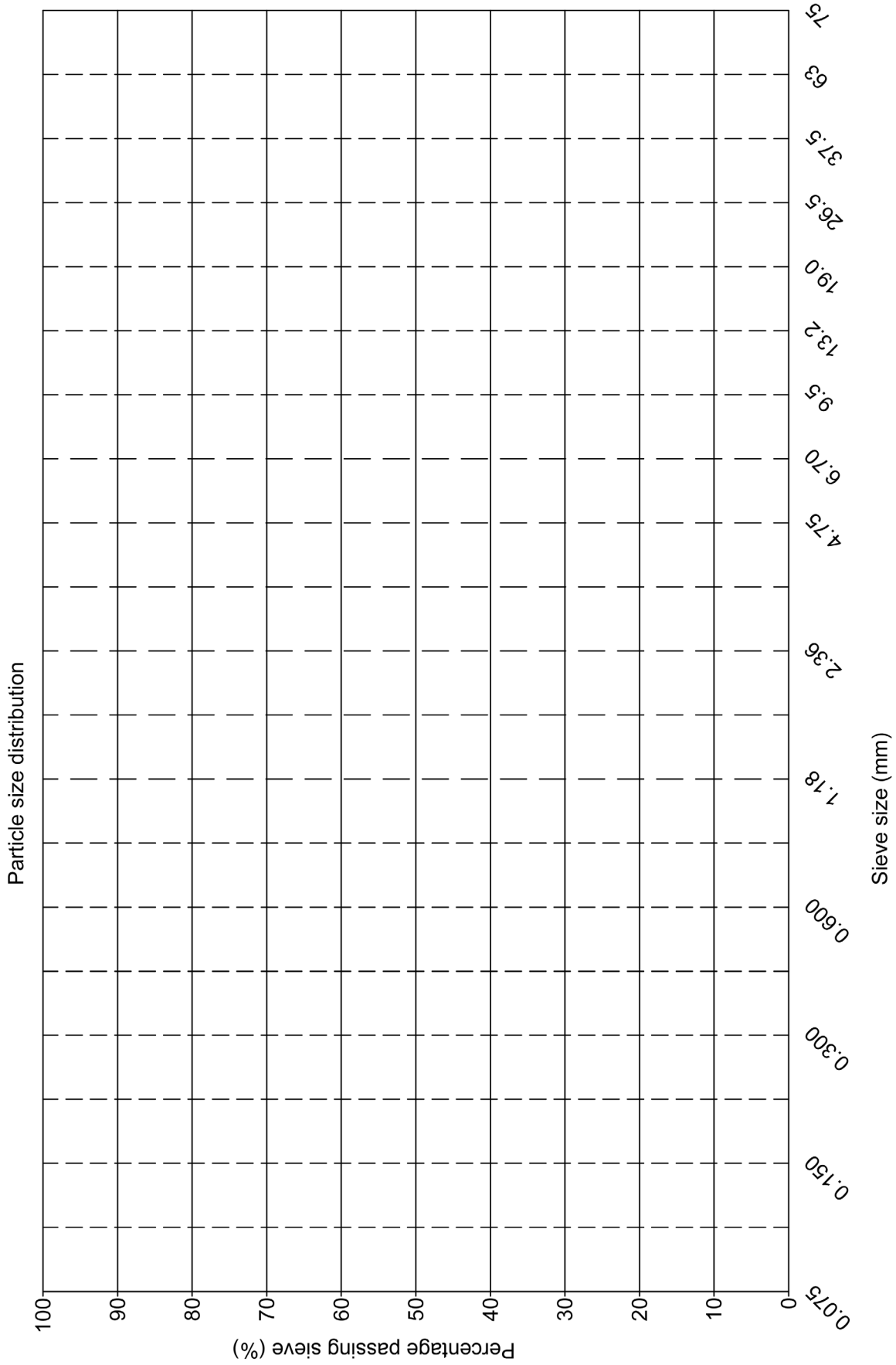

Figure 9 – Example chart for plotting particle size distribution

Form 7 – Determination of the particle size distribution – wet sieve method

Determination of water content	Test 1	Test 2
Container number		
Mass of container (g)		
Mass of container and wet aggregate (g)		
Mass of container and dried aggregate: 1 (g)		
Mass of container and dried aggregate: 2 (g)		
Mass of container and dried aggregate: 3 (g)		
Mass of water (g)		
Mass of dried aggregate (g)		
Individual water content (%)		
Average water content w (%)		

Particle size distribution		
Mass of container (g)		
Mass of container and wet test sample (g)		
Mass of wet test sample M_w (g)		
Total dry mass of test sample M_T (g)	$M_T = \frac{100M_w}{100+M_w}$	
Mass of dried sample retained on finest sieve M_d (g)		
Mass passing 19.0 mm sieve M_1 (g)		
Mass passing 19.0 mm sieve after quartering M_2 (g)		
Splitting ratio SR_1	$SR_1 = \frac{M_1}{M_2}$	
Mass passing 4.75 mm sieve M_3 (g)		
Mass passing 4.75 mm sieve after quartering M_4 (g)		
Splitting ratio SR_2	$SR_2 = \frac{M_3}{M_4}$	

Form 7 – Determination of the particle size distribution – wet sieve method (continued)

Test sieve aperture (mm)	**Individual mass retained M** (g)	**Corrected mass retained** M_c (g)	**Cumulative mass retained** M_R (g)	**Cumulative mass passing** (g) $M_P = M_T - M_R$	**Cumulative per cent passing** (%) $(M_P / M_T) \times 100$
63.0					
53.0					
37.5					
26.5					
19.0					
Passing 19.0		Mass retained x SR_1			
13.2					
9.5					
6.70					
4.75					
Passing 4.75		Mass retained x SR_1 x SR_2			
2.36					
1.18					
0.600					
0.425					
0.300					
0.150					
0.075					
Pan					
Total corrected mass retained (g)					
Loss on sieving (%)					

3.8.2 Subsidiary method by dry sieving – Test Method 3.8.2

3.8.2.1 Scope

This method covers the determination of the particle size distribution of an aggregate down to 0.075 mm by dry sieving. It is applicable to materials which do not contain significant amounts of cohesive fines (see 3.8.2.6(a)).

The use of Test Method 3.8.1 (preferred method by wet sieving) is recommended unless it can be shown by comparative testing that this procedure gives the same results.

NOTE – A similar test method for soils is included in NZS 4402.2.8.2. The two methods are essentially the same.

3.8.2.2 Apparatus

The following apparatus is required:

(a) An appropriate range of test sieves and receivers to cover the size fractions present in the sample under test (see 3.8.2.6(b));

(b) Balances or other weighing devices of appropriate capacity and accuracy. For fine aggregate balance accurate to 0.1 g or 0.1% of the test load whichever is greater, at any point within the range of use. For coarse aggregate, or mixtures of fine and coarse aggregates, accurate to 0.5 g or 0.1% of the test load, whichever is greater, at any point within the range of use;

(c) Sample dividers of appropriate size (riffle boxes, see 2.7.3);

(d) A drying oven of appropriate size complying with the requirements of 1.6.2;

(e) Sufficient non-corrodible metal trays of appropriate size to contain each of the size fractions of the test sample;

(f) Scoops, brushes, sieve brushes;

(g) A mechanical sieve shaker (optional).

3.8.2.3 Test procedure

Use the following test procedure:

(a) By means of the sample divider or by quartering obtain from the field sample a test sample of sufficient size to comply with the requirements of Table 6;

(b) Oven dry the test sample and weigh to 0.1% of its total mass and record (M_T), (Form 8 provides an example of how to record this);

(c) Place the oven dried material on the largest required test sieve (see 3.8.2.6(b));

(d) Agitate the test sieve so that the material rolls in an irregular motion over the test sieve for at least 2 min – backwards, forwards, left to right, clockwise, and anti-clockwise with frequent jarring of the sieve. Do not attempt to force particles through the mesh, but on sieves coarser than 19.0 mm testing individual particles to see if they will fall through is permitted. Brush individual particles retained on the sieve to remove any adhered fine particles. Continue to shake the sieve until only individual particles are retained on the sieve. Weigh to 0.1% of the total mass of the sample, the material retained on the sieve and record its mass as ($M_{\text{sieve aperture}}$). If a mechanical shaker is used, the shaking period shall be at least 10 min unless ➤

experience with a particular material has shown that a lesser time will give the same result as hand shaking for 2 min;

(e) Transfer the material passing the larger sieve to the next smaller sieve and repeat the procedure of (d). Continue this procedure down to the 19.0 mm sieve ensuring that the mass retained on each sieve does not exceed the maximum amount permitted by Table 1. Record the individual masses of the material retained on each sieve as ($M_{\text{sieve aperture}}$);

(f) Determine to 0.1% the mass of material passing the 19.0 mm test and record (M_1). By quartering or by means of a sample divider, obtain from the material passing the 19.0 mm sieve a specimen of at least 2.0 kg (see 3.8.2.6(c)). Record to 0.1% the mass of the specimen (M_2) and determine the splitting ratio (SR_1);

(g) Sieve the specimen of material passing the 19.0 mm test sieve over the appropriate finer sieves down to 4.75 mm, employing the same sieving motion as for the coarser sieves. Do not attempt to force material through the mesh, but on sieves larger than 4.75 mm, individual particles may be checked by hand. Ensure that the masses retained do not exceed those permitted in Table 1. Weigh to 0.1% of the total mass of the specimen passing the 19.0 mm sieve, the mass retained on each sieve and record ($M_{\text{sieve aperture}}$);

(h) Determine to 0.1% the mass of material passing the 4.75 mm test sieve and record (M_3). If required, obtain from the material passing the 4.75 mm sieve a specimen of at least 200 g by quartering or by means of a sample divider (see 3.8.2.6 (c)). Record to 0.1% the mass of the specimen (M_4) and determine the splitting ratio (SR_2);

(i) Sieve the specimen passing the 4.75 mm sieve over the appropriate finer sieves and record the masses shown on each sieve as in (d) and (e) recording the masses retained on each sieve as ($M_{\text{sieve aperture}}$). Ensure that all particles on each sieve are brushed to remove any adhering particles.

3.8.2.4 Calculations

To calculate the particle size distribution using the dry-sieving method (Form 8 provides an example of how to record this):

(a) Calculate the splitting ratios as follows:

$$SR_1 = M_1 / M_2$$

$$SR_2 = M_3 / M_4;$$

(b) Calculate the corrected mass retained (M_c) on each sieve finer than 19.0 mm down to and including the 4.75 mm sieve to 0.1% of the total mass sieved from the formula:

$$M_C = M_{\text{sieve aperture}} \times SR_1 \text{ ...(g);}$$

(c) Calculate the corrected mass retained (M_c) on each sieve finer than 4.75 mm to 0.1% of the total mass sieved from the formula:

$$M_C = M_{\text{sieve aperture}} \times SR_1 \times SR_2 \text{ ...(g);}$$

(d) Calculate the cumulative mass retained on each sieve by adding the mass retained on each sieve to the masses retained on the sieves coarser than the sieve under test (M_R);

(e) Calculate the cumulative mass passing (M_P) each sieve and record to 0.1% from the formula:

$M_P = M_T - M_R$...(g);

(f) Calculate the cumulative percentage passing each sieve by mass including the finest sieve and record to the nearest 1% from the formula:

$M_P / M_T \times 100$;

(g) Add the corrected masses retained for each sieve, including the corrected mass passing the finest sieve and record as M_{sieved}. Calculate the loss (or gain) on sieving using the formula

$$Loss = \frac{M_T - M_{sieved}}{M_T} \text{ x } 100 \ldots \%$$

Reject the particle size distribution test results if the loss (or gain) on sieving exceeds 1.0%.

3.8.2.5 Reporting of results

Report the following:

(a) The percentage passing individual sieves to the nearest 1%;

(b) If required, the cumulative percentage passing each sieve plotted on a semi-logarithmic graph (see Figure 9 for a simplified example);

(c) State that the results were obtained from an oven dry test sample.

State the following:

(d) The date of the test;

(e) The source and description of the field sample;

(f) The sampling method used, including the clause number and description, if known. For example, 'NZS 4407, method 2.4.7 Sampling from freshly spread layers';

(g) The condition of the field sample as received for testing;

(h) That the results were obtained in accordance with this test method.

3.8.2.6 Notes on Test Method 3.8.2

The following notes should be read in conjunction with this test method but are informative only:

(a) The presence of significant amounts of cohesive fines may cause aggregations of fine particles which act as coarser particles when dry-sieved. Wet sieving (Test Method 3.8.1) is strongly recommended under these conditions, since the aggregations tend to break down under the washing action used. For any specific aggregate, comparative wet and dry sieving can be used to establish whether the dry method gives acceptable results;

(b) Choice of sizes of test sieves. The sizes of sieves used for the test should adequately cover the range of sieves required for testing road aggregates within the following list of sizes:

  (i) Large (such as 450 mm or 300 mm diameter) sieves: 63.0 mm, 53.0 mm, 37.5 mm, 26.5 mm, 19.0 mm, 13.2 mm, 9.50 mm, 4.75 mm, or as appropriate

  (ii) Small (such as 200 mm diameter) sieves: 4.75 mm, 2.36 mm, 1.18 mm, 0.600 mm, 0.425 mm, 0.300 mm, 0.150 mm, 0.075 mm, or as appropriate;

(c) If the mass of material passing the 19.0 mm or the 4.75 mm sieve is sufficient to continue without further division, or if there is less than the minimum required mass passing these sieves, the splitting procedure can be omitted and the splitting ratio for that particular split equals unity. Test sieve sizes of 19.0 mm and 4.75 mm have been specified as convenient points for splitting samples, but the sample can be split on any convenient sieve.

Form 8 – Determination of particle size distribution – dry sieve method

Particle size distribution					
Mass of container (g)					
Mass of container and test sample (g)					
Mass of test sample M_T (g)					
Mass passing 19.0 mm sieve M_1 (g)					
Mass passing 19.0 mm sieve after quartering M_2 (g)					
Splitting ratio SR_1			$SR_1 = \frac{M_1}{M_2}$		
Mass passing 4.75 mm sieve M_3 (g)					
Mass passing 4.75 mm sieve after quartering M_4 (g)					
Splitting ratio SR_2			$SR_2 = \frac{M_3}{M_4}$		
Test sieve aperture (mm)	**Individual mass retained** (g)	**Corrected mass retained** M_c (g)	**Cumulative mass retained** M_R (g)	**Cumulative mass passing** (g) $M_P = M_T - M_R$	**Cumulative per cent passing** (%) $(M_P / M_T) \times 100$
63.0					
53.0					
37.5					
26.5					
19.0					
Passing 19.0		Mass retained x SR_1			
13.2					
9.5					
6.70					
4.75					
Passing 4.75		Mass retained x SR_1 x SR_2			
2.36					
1.18					
0.600					
0.425					
0.300					
0.150					
0.075					
Pan			$\sum M_C$		