Form 3.8.1, 3.8.2
DETERMINATION OF THE PARTICLE-SIZE DISTRIBUTION

Job:
Source and description of sample:
Sampling method used:
Condition of sample as received: Natural/air dried/unknown
Date received:

Sample no.:
Tested by:
Date:
Checked by:
Date:

Determination of water content

Container number					
Mass of container and wet aggregate					
Mass of container and dried aggregate	(1)	g			
	(2)	g			
	(3)	g			
Final mass of container and dried aggregate		g			
Mass of container		g			
Mass of water		g			
Mass of dried aggregate		g			
Water content		%			

w ..... %

Mass of container and wet test sample = g
Mass of container = g
Mass of wet test sample, M_w = g

Total dry mass of test sample, $M_T = \frac{100M_w}{100+w}$ = g

Mass of dried test sample retained on finest sieve, M_d = g
Mass passing 19.0 mm sieve, M_1 = g
Fraction passing 19.0 mm after quartering, M_2 = g
Splitting ratio, $SR_1 = M_1/M_2$ =
Mass passing 4.75 mm sieve, M_3 = g
Fraction passing 4.75 mm after quartering, M_4 = g
Splitting ratio, $SR_2 = M_3/M_4$ =

Test sieve	*Individual mass retained (g)*	*Corrected mass retained* M_C *(g)*	*Cumulative mass passing* $M_P = M_T - M_C$	*Cumulative % passing* (M_P/M_T) *X 100*	*Maximum sieve load (see table 1.1)*	*Sieve diameter used*
63.0 mm						
53.0 mm						
37.5 mm						
26.5 mm						
19.0 mm						
Passing 19.0 mm M_1		Mass retained X SR_1				
13.2 mm						
9.50 mm						
4.75 mm						
Passing 4.75, M_3		Mass retained X SR_1 X SR_2				
2.36 mm						
1.18 mm						
600 µm						
425 µm						
300 µm						
150 µm						
75 µm						

Total	
Mass retained on finest sieve, M_d	
Mass passing finest sieve, $M_T - M_d$	

TEST 3.9
THE CLEANNESS VALUE OF COARSE AGGREGATE

3.9.1
Scope

3.9.1.1
This method specifies the procedure for determining the cleanness of coarse aggregate less than 26.5 mm in size in terms of a "cleanness value" which is a function of the amount, fineness and character of the clay-like material present, with or on the coarse aggregate particles, for example sealing chips.

NOTE – A similar method for determining the cleanness value of coarse aggregate for concrete is included in NZS 3111 as section 13. The two methods are essentially the same.

3.9.2
Related documents

3.9.2.1
The provisions of Parts 1 and 2 of this Standard are applicable to, and shall be read in conjunction with, this method of test. Reference is made to Test 3.6 of this Standard.

3.9.2.2
Reference is made in this method of test to the following British Standards:

BS 604:1982	Graduated glass measuring cylinders
BS 5404:- - - -	Plastics laboratory ware
Part 2:1977	Graduated measuring cylinders

3.9.3
Apparatus

3.9.3.1
The following apparatus is required:

(a) Washing vessels. A flat-bottomed, straight-sided cylindrical vessel made of stainless steel. The inside diameter of the vessel shall be 200 ±5 mm. The top of the vessel shall be fitted with a gasket and lid which will form a watertight seal when the lid is clamped in place. Clamps shall be provided for attaching the lid securely to the vessel.

(b) A pan suitable for collecting the wash water from the washed test sample.

(c) A mechanical agitator with a horizontal throw of 45 ±5 mm and a frequency of 4 to 5 Hz.

(d) Graduated transparent measuring cylinders of 10 ml and 1 litre capacity complying with BS 604 or BS 5404:Part 2.

(e) A sand equivalent cylinder as described in the method set out in Test 3.6.

(f) A wide mouth funnel 100 mm nominal in diameter at the mouth.

(g) Test sieves 75 µm and larger protective sieves, each 200 mm minimum in diameter.

(h) A balance readable to 0.2 % of the mass of the test sample and accurate to ±0.2 % of the mass of the test sample.

(j) A timing watch or clock graduated in minutes and seconds.

3.9.4
Materials

3.9.4.1
The following materials are required:

(a) Stock calcium chloride solution as used in the sand equivalent test (see the method set out in Test 3.6);

(b) Water. Distilled water shall be used.

3.9.5
Preparation of test samples

3.9.5.1
Proceed as follows:

(a) By quartering or by means of a sample divider obtain from the field sample a test sample of mass 2500 ±125 g.

(b) The aggregate shall be tested in the moisture condition in which it is received, except that when very wet it may be drained of excess water before being weighed. No artificial drying shall be allowed.

3.9.6
Quantity of wash water

3.9.6.1
The quantity of wash water shall be 1000 ±5 ml.

3.9.7
Test procedure

3.9.7.1
Use the following test procedure:

(a) Place the sand equivalent cylinder on a work table which shall be free of vibration during the sedimentation phase of the test. Place the funnel in the cylinder and pour 7 ±0.1 ml of the stock calcium chloride solution into the cylinder. Nest the sieves, with the larger sieves uppermost, to protect the 75 µm sieve, in the pan or vessel provided to collect the wash water.

(b) Place the prepared test sample in the mechanical washing vessel. Add the wash water, clamp the lid in place and secure the vessel in the agitator. Switch on and agitate the vessel for 2 ±15 s.

(c) Immediately following the agitation period, take the vessel from the agitator and remove the lid. Then agitate the contents of the vessel by moving the upright vessel vigorously in a horizontal circular motion five or six times in order to bring the fines into suspension. Immediately pour the contents of the vessel into the nested protective and 75 μm sieves placed in the pan provided to collect the wash water.

(d) Re-measure the wash water and add enough water to bring the volume back to 1000 ±5 ml. Transfer the wash water to a vessel suitable for stirring and pouring.

3.9.7.2
Method of mixing wash water and reading sediment column. Use the following procedure:

(a) Place the funnel in the sand equivalent cylinder. Agitate the wash water to bring the fines into suspension. While the water is still turbulent pour enough into the cylinder to bring the level of the liquid to the 400 mm mark.

(b) Remove the funnel and place the stopper in the end of the cylinder.

(c) Mix the contents of the cylinder by alternately turning the cylinder upside down and right side up (one cycle), allowing the bubble to completely traverse the length of the cylinder and return. Repeat this cycle 20 times in 35 ±5 s. It is important that both the required number of cycles and the specified time be rigidly observed. It may be found necessary, in order to make the bubble move fast enough for complete traverse of the cylinder length, to impart to the cylinder a vertical jolt each time it is turned end for end.

(d) At the completion of the mixing process, place the cylinder on the work table and remove the stopper. Allow the cylinder to stand undisturbed for 20 min ±15 s. Then immediately read and record to the nearest graduation the height (H_{20}) in millimetres of the column of sediment.

(e) There are two unusual conditions that may be encountered in this phase of the test procedure:

(i) Condition A. A clearly defined line of demarcation does not appear between the sediment and the liquid above it in the specified 20 min period. Eventually, however, the liquid clears and a definite line of demarcation is quickly formed. If, at this point, the height of the sedimented column H_1, and the time of sedimentation t are noted, the 20 min value for the column height may be estimated from the formula:

$$H_{20} = 400 - \frac{20\,(400-H_1)}{t} \quad \text{....(Eq. 3.9)}$$

where H_{20} and H_1 are expressed in millimetres and t in minutes. This calculated value of H_{20} may then be used to determine the cleanness value (CV).

(ii) Condition B. The liquid immediately above the line of demarcation is still darkly clouded at 20 min and the demarcation line, although distinct appears to be in the sediment column itself. There is still much material above the demarcation line at 20 min so that a reading of its height at this time gives a false impression of cleanness. As the suspended material settles out, the demarcation line moves up the cylinder and, at the point at which the liquid clears, the demarcation line appears to be immersed in the sediment column, readings of height should be continued at intervals of one minute until a decrease is detected. The maximum height H_1 and the time t at which it occurs should be noted, and the value of H at 20 min calculated from equation 3.9 as in Condition A, this H_{20} then being used to determine the cleanness value.

3.9.8
Calculation (see Form 3.9)

3.9.8.1
Determine the cleanness value by reference to table 3.9.

3.9.9
Reporting of results

3.9.9.1
Report the cleanness value

3.9.9.2
State the following:

(a) The date of the test;

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

(c) The sampling method used (e.g. in accordance with clause 2... of this Standard), or not known;

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

(e) That the result was obtained in accordance with this Standard Test Method.

Table 3.9
CLEANNESS VALUES (CV) FOR 0 to 400 mm HEIGHT READINGS (H_{20})

Height reading	*Cleanness value*	*Height reading*	*Cleanness value*	*Height reading*	*Cleanness value*	*Height reading*	*Cleanness value*	*Height reading*	*Cleanness value*
mm		mm		mm		mm		mm	
0	100	80	45	160	24	240	12	320	5
2	98	82	45	162	23	242	12	322	5
4	95	84	44	164	23	244	12	324	5
6	93	86	43	166	23	246	12	326	4
8	91	88	43	168	22	248	11	328	4
10	89	90	42	170	22	250	11	330	4
12	87	92	41	172	22	252	11	332	4
14	85	94	40	174	21	254	11	334	4
16	83	96	40	176	21	256	10	226	4
18	82	98	39	178	21	258	10	338	4
20	80	100	38	180	20	260	10	340	4
22	78	102	38	182	20	262	10	342	3
24	77	104	37	184	20	264	10	344	3
26	75	106	37	186	19	266	9	346	3
28	73	108	36	188	19	268	9	348	3
30	72	110	35	190	19	270	9	350	3
32	71	112	35	192	18	272	9	352	3
34	69	114	34	194	18	274	9	354	3
36	68	116	34	196	18	276	9	346	2
38	67	118	33	198	18	278	8	358	2
40	65	120	33	200	17	280	8	360	2
42	64	122	32	202	17	282	8	362	2
44	63	124	32	204	17	284	8	364	2
46	62	126	31	206	16	286	8	366	2
48	60	128	31	208	16	288	7	368	2
50	59	130	30	210	16	290	7	370	2
52	58	132	30	212	16	292	7	372	2
54	57	134	29	214	15	294	7	374	1
56	56	136	29	216	15	296	7	376	1
58	55	138	28	218	15	298	7	378	1
60	54	140	28	220	15	300	6	380	1
62	53	142	27	222	14	302	6	382	1
64	52	144	27	224	14	304	6	384	1
66	51	146	27	226	14	306	6	386	1
68	50	148	26	228	14	308	6	338	1
70	50	150	26	230	13	310	6	390	0
72	49	152	25	232	13	312	6	392	0
74	48	154	25	234	13	314	5	394	0
76	47	156	25	236	13	316	5	396	0
78	46	158	24	238	12	318	5	398	0
								400	0

FORM 3.9
CLEANNESS VALUE OF COARSE AGGREGATE

Job: Sample no:

Sample: Tested by:

Depth: Date:

Test details: Checked by:

SAMPLE HISTORY: Natural/air dry/oven dry

State if sample for accelerated weathering test: .....

.....

STANDARD REQUIREMENTS:

Date of stock solution: .....
Temp of water ..... °C Temp of stock solution ..... °C
Water used: Distilled/tap water
Test conducted at room/standard temperature

(Delete one of each)

Shaking time: 20 times in approximately 35 seconds
Standing time: ..... minutes

Condition observed: Normal/condition A/condition B
(Delete two of the above)
Normal condition: Height of sediment column H_1 = ... mm
For condition A or B: Height of sediment column H_1 = ... mm
Time for line of demarcation to form t_1 = ... mins

$$H_{20} = 400 - \frac{20\,(400 - H_1)}{t}$$

= ..... mm

From chart: CV = [ ]

TEST 3.10
THE CRUSHING RESISTANCE OF COARSE AGGREGATE UNDER A SPECIFIED LOAD

3.10.1
Scope

3.10.1.1
This method specifies a procedure for determining the crushing resistance of aggregates. It measures the percentage of fines generated by the application of a specified load (see Note (1)).

NOTE – A similar test method is included in NZS 3111 as section 14. However that method measures the load required to produce 10 % fines.

3.10.2
Related documents

3.10.2.1
The provisions of Parts 1 and 2 of this Standard are applicable to and shall be read in conjunction with, this method of test.

3.10.2.2
Reference is made in this method of test to the following New Zealand Standard:

NZS 6507:- - - - Materials testing machines and force verification equipment
Part 1:1986 Specification for the grading of the forces applied by materials testing machines

3.10.3
Apparatus

3.10.3.1
The following apparatus is required:

(a) An open-ended steel cylinder, plunger and square base plate complying with the dimensions indicated in fig. 3.10 for a nominal 150 mm diameter cylinder. The surfaces in contact with the aggregate shall be machined and case-hardened, or otherwise treated, so as to resist wear.

(b) A round straight steel rod of 16 mm nominal diameter and 450 mm to 600 mm long with one end rounded to a hemispherical tip.

(c) A balance, readable and accurate to 0.2 % of the mass of the test sample.

(d) Test sieves of aperture sizes 13.2 mm, 9.50 mm and 2.36 mm.

(e) A compression testing machine capable of applying a load of 500 kN and complying, as regards accuracy, with the requirements of Grade 2.0 of NZS 6507, Part 1. The machine shall have a means of loading rate control which will allow the application, at uniform rate, of the specified load in 10 ±1 min.

3.10.4
Specimen preparation

3.10.4.1
Prepare the test specimens as follows:

(a) By quartering or by means of a sample divider obtain a test sample sufficient to produce a test specimen as required in (d) below.

(b) Wash the test sample thoroughly and allow to dry. Any heating shall be at a temperature not exceeding 115 °C.

(c) Ensure that the aggregate to be tested is at room temperature, and surface-dry or drier.

(d) Sieve from the test sample sufficient material passing a 13.2 mm sieve and retained on a 9.50 mm sieve (see Note (2)) to provide, after tamping as described in 3.10.5.1, a depth of 100 ±5 mm in the cylinder. During this sieving ensure that the mass retained on each sieve does not exceed that permitted in table 1.1 of Part 1.

3.10.5
Test procedure

3.10.5.1
Use the following test procedure:

(a) Place the cylinder of the test apparatus centrally on the baseplate. Add the test specimen in three approximately equal portions, each third being subjected to 25 strokes from the tamping rod. Carefully level the surface of the aggregate and insert the plunger so that it rests horizontally on this surface.

(b) Place the apparatus, with the specimen and plunger in position, between the platens of the testing machine. Apply load at a uniform rate so that the specified load is reached in 10 ±1 min.

(c) After the specified loading has been reached return the machine to zero, and remove the specimen from the apparatus without further breakage. Weigh the total specimen and sieve it on the 2.36 mm sieve until not more than 0.25 % of the mass of the residue passes in one minute. Weigh the fraction passing the 2.36 mm sieve and express this mass as a percentage of the total specimen.

3.10.6
Reporting of results (see Form 3.10)

3.10.6.1
Report the following:

(a) The nominal aggregate size, if other than standard (see Note (2));

(b) The specified load;

(c) The percentage fines (passing 2.36 mm) achieved at the specified load;

(d) Whether the crushing resistance to produce 10 % fines is less than or greater than the specified load.

State the following:

(a) The date of the test;

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

(c) The sampling method used (e.g. in accordance with clause 2... of this Standard), or not known;

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

(e) That the result was obtained in accordance with this Standard Test Method.

NOTES ON TEST 3.10

(1) The crushing resistance is the load required to produce 10 % fines under the conditions specified in this test method. To enable the checking of pass or failure by means of a single test, the result is reported in terms of the fines generated by the application of a specified load.

(2) If aggregate of the standard size (–13.2 mm, +9.50 mm) is not available, the test may be applied to larger or smaller sized aggregate. The results will not necessarily be comparable with those obtained in the standard test.

The procedure for testing sizes other than the standard size shall be the same as that for the standard size except that the test conditions shall be those given in table 3.10 for the appropriate sizes, and the apparatus shall have the dimensions appropriate to the size of aggregate. A compression testing machine capable of applying a load greater than that specified in 3.10.3.1(e) is required to test the larger sizes of aggregate.

Table 3.10
TEST CONDITIONS FOR VARIOUS AGGREGATE SIZES

Nominal size of aggregate		*Nominal diameter of cylinder to be used*	*Depth of test portion in cylinder after tamping*	*Aperture size sieve for separating fines*
Passing (mm)	*Retained* (mm)	(mm)	(mm)	(mm)
53.0	37.5)			9.50
37.5	26.5)	300	200 ± 10	6.70
26.5	19.0)			4.75
19.0	13.2)			3.35
13.2	9.50)	150	100 ± 5	2.36
9.50	6.70)			1.70
6.70	4.75)			1.18
4.75	3.35)	75	50 ± 3	850 µm
3.35	2.36)			600 µm

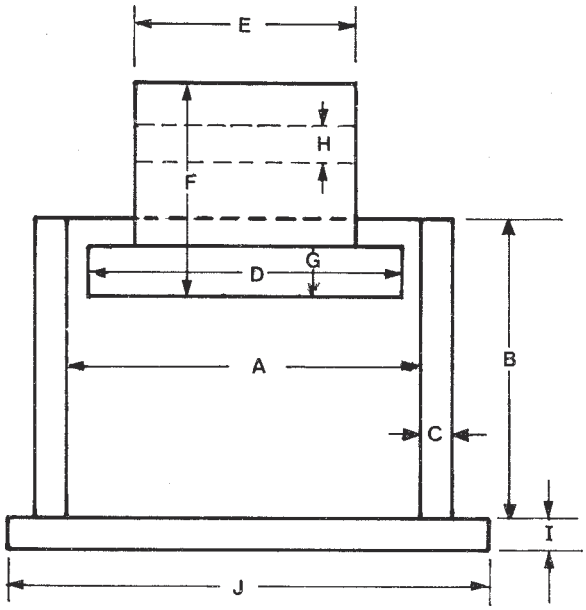

TABLE OF DIMENSIONS

Identification	*Dimension for*	*Nominal cylinder diameter (mm)*		
		75	*150*	*300*
	CYLINDER			
A	Internal diameter*	78+1–0	153+1.5–0	303+1.5–0
B	Internal depth	70 to 80	120 to 140	240 to 260
C	Wall thickness	<8	<16	<25
	PLUNGER			
D	Diameter of piston*	76+1–0	151+1.5–0	301+1.5–0
E	Diameter of stem	40 to 50	95 to 120	220 to 250
F	Overall length of piston plus stem	65 to 75	95 to 115	200 to 230
G	Depth of piston	<15	<20	<40
H	Diameter of hole	8 to 10	16 to 19	25 to 30
	BASEPLATE			
I	Thickness	<10	<12	<16
J	Length of each side	110 to 120	210 to 230	400 to 420

*The difference between A and D shall be between 1 mm and 3 mm

Fig. 3.10
APPARATUS FOR DETERMINING CRUSHING RESISTANCE OF COARSE AGGREGATE

Form 3.10
DETERMINATION OF CRUSHING RESISTANCE OF COARSE AGGREGATE UNDER A SPECIFIED LOAD

Job:	Sample no:
Location:	Tested by:
Material:	Date of test:
Date sampled:	Checked by:

Specified load (obtained in 10 ±1 min)	=	kN
Mass of test specimen	=	kg
Mass of material passing 2.36 mm sieve	=	kg
Percentage of material passing 2.36 mm sieve	=	%

Crushing resistance less than* /greater than* specified load

* Delete inappropriate words