DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
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METHOD OF TEST FOR DURABILITY INDEX

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Section H of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

The durability index test provides a measure of the relative resistance of an aggregate to producing clay-sized fines when subjected to prescribed methods of interparticle abrasion in the presence of water. Four procedures are provided for use with materials with various nominal sizes and specific gravities.

Procedure	Designation	Type of Method	Section
A	D_c	Retained 4.75 mm sieve	F-1
B	D_c modified	Light weight or porous, retained 4.75 mm sieve	F-2
C	D_f	Passing 4.75 mm sieve	F-3
D	D_f modified	4.75 by 1.18 mm sieve (pea gravel, chips)	F-4

B. APPARATUS

The following equipment is required to perform this test. Detailed descriptions and specifications are included as necessary to assure standardization. Detailed plans are available for those items bearing a Transportation Laboratory (TL) drawing number.

1. Agitator. A mechanical device designed to hold the wash vessel in an upright position while subjecting it to a lateral reciprocating motion at a rate of 4.75 ± 0.17 Hz. The reciprocating motion shall be produced by means of an eccentric located in the base of the carrier and the length of the stroke shall be 44.4 ± 0.6 mm. The clearance between the cam and follower of the eccentric shall be 0.025 to 0.102 mm.

   The Tyler portable sieve shaker meets these requirements when modified according to TL drawing number D-536 (Figure 1).

2. Mechanical Sand Equivalent Shaker. A mechanical device designed to hold a graduated plastic cylinder in a horizontal position while subjecting it to a reciprocating motion parallel to its length (Figure 2). The motion shall provide a stroke length of 203.2 ± 1.27 mm. The device shall operate at a speed of 175 ± 2 complete cycles per min. Prior to use, the shaker shall be fastened securely to a firm and level mount (TL drawing number D-256).

3. Sand Equivalent Test Apparatus. A graduated plastic cylinder, rubber stopper, irrigator tube, weighted foot assembly and siphon assembly, all conforming to the specifications and dimensions shown in TL drawing number C-218 (Figures 3 and 4).

   A 3.8 L minimum size glass or plastic container with cover and fitted with a siphon assembly or a discharge tube near the bottom shall be used to dispense the working calcium chloride solution. The container shall be placed on a shelf or suspended above the work area in such a manner that the level of the solution is

maintained between 920 and 1160 mm above the work surface.

4. Measuring Tin. A tin measuring approximately 57 mm in diameter has a capacity of 85 ± 5 mL.

5. Wash Vessel. A flat bottomed, straight-sided cylindrical vessel equipped with a watertight removable lid conforming to the dimensions and tolerances shown (Figure 5).

6. Collection Pot. A round pan or container having vertical or nearly vertical sides and equipped as necessary to hold the wire mesh of an 203 mm diameter sieve at least 76 mm above the bottom. An adapter which will not allow loss of fines or wash water may be used to nest the sieve with the container, or the sieve may nest with a blank sieve frame resting in the bottom of the pan.

7. Graduated Cylinder. A graduated cylinder having a capacity of 1000 mL.

8. Rubber Stopper. A stopper to fit the plastic cylinder.

9. Funnels.

   a. A wide mouth funnel suitable for directing water or aggregate into the plastic cylinder.

   b. A wide mouth funnel large enough to hold a 203 mm diameter sieve while directing water into the plastic cylinder.

10. Balance. A balance or scale accurate to 0.2 % of the mass of the sample to be tested.

11. Oven. An oven or other suitable thermostatically controlled heating device capable of maintaining a temperature of 110 ± 5°C.

12. Timer. A clock or watch reading in minutes and seconds.

13. Sieves. Standard Sieves, 19.0 mm, 12.5 mm, 9.5 mm, 4.75 mm, 2.36 mm, and 75 µm. The 2.36 mm and 75 µm sieves shall be in the standard 203 mm diameter frames.

14. Flexible Hose.

C. MATERIALS

1. Stock Calcium Chloride Solution.

   a. "Sand Equivalent Stock Solution" Office of Purchasing and Warehousing catalog number 6810-0090-3.

   b. Solution may be prepared from the following: 120 g technical grade anhydrous calcium chloride, 542 g USP glycerin (95 %). Dissolve the calcium chloride in 500 mL of distilled or deionized water. Cool the solution to room temperature, then filter through Watman No. 2V or equivalent filter paper. Add the glycerin to the filtered solution, mix well, and dilute to 1 L with distilled or deionized water.

2. Working Calcium Chloride Solution. Prepare the working calcium chloride solution by diluting 85 ± 5 mL of the stock calcium chloride solution with 3700 mL of water. Thoroughly mix the solution.

3. Water. Use distilled or deionized water for the normal performance of this test, including the preparation of the working calcium chloride solution. If it is determined, however, that the local tap water is of such quality that it does not affect the test results, it is permissible to use it in lieu of distilled or deionized water.

D. CONTROL

The temperature of all solutions and water should be maintained at 22.2 ± 2.8°C during the performance of this test. Individual test results that meet the minimum durability index value, when the temperature is below the recommended range are acceptable.

E. SAMPLE PROCESSING

1. Obtain a representative sample of the material to be tested.

2. Process the sample according to the procedures in California Test 201. The material passing the 4.75 mm sieve is then tested independently from the material retained on the 4.75 mm sieve. If either of these primary size portions amounts to less than 15 % of the total sample, that portion should not be tested. The durability index of the tested portion will represent the entire sample.

3. Separate the retained 4.75 mm material on the 19.0, 12.5 and 9.5-mm sieves.

4. Calculate the size distribution of the 19.0 by 4.75 mm portion of the material. Do not include the material retained on the 19.0 mm sieve or the material passing the 4.75 mm sieve in this calculation.

5. Materials with a minimum nominal size larger than 19.0 mm shall be crushed to pass the 19.0-mm sieve and then processed as described above. The portion of the crushed material, which passes the 4.75-mm sieve, shall not be tested for durability index.

F. TEST PROCEDURE

1. PROCEDURE A, coarse durability (D_C) for material retained on a 4.75 mm sieve.

   a. Process the material to be tested as described in Section E "Sample Processing."

   b. Prepare a test specimen having an air-dry mass of 2550 ± 25 g by combining the graded fractions as specified below.

      (1) For materials, which have a minimum of 10 % in each of the specified fractions, prepare the test specimen according to the masses listed in Table No. 1.

Table No. 1
Basic Test Specimen Grading

Sieve Size		Air-Dry
Passing	Retained	Mass g
19.0 mm	12.5 mm	1070 ± 10
12.5 mm	9.5 mm	570 ± 10
9.5 mm	4.75 mm	910 ± 5
Total Test Specimen Mass		2550 ± 25

      (2) For materials with less than 10 % in any of the fractions specified in Table No. 1, prepare the test specimen using the actual calculated percentage for the deficient fraction and proportionally increase the masses of the remaining fractions to obtain the 2550 g test specimen.

Example 1
Less than 10 % of 19.0 mm by 12.5 mm aggregate

Aggregate Sieve Size	% Each Size	Calculations	Air-Dry Mass in Grams
19.0 by 12.5mm	6	0.06 x 2550	153 ± 10
12.5 by 9.5 mm	26	$\frac{570\ (2550-153)}{570+\ 910}$	923 ± 10
9.5 by 4.75 mm	68	$\frac{910\ (2550-153)}{570\ +\ 910}$	1474 ± 5
Totals	100		2550 ± 25

Example 2
Less than 10 % of 19.0 mm by 12.5 mm
and 12.5 mm by 9.5 mm aggregate

Aggregate Sieve Size	% Each Size	Calculations	Air-Dry Mass in Grams
19.0 by 12.5mm	4	0.04 x 2550	102 ± 10
12.5 by 9.5 mm	7	0.07 x 2550	179 ± 10
9.5 by 4.75 mm	89	2550 - (102 + 179)	2269 ± 25
Totals	100		2550 ± 25

   c. Wash the test specimen using the following procedure.

      (1) Place the test specimen in the wash vessel.

      (2) Add 1000 ± 5 mL water, clamp the lid in place and secure the vessel in the agitator.

      (3) At 1 min ± 10 s after adding the water to the specimen, start the agitator and shake the vessel for 2 min ± 5 s.

      (4) Pour the contents of the vessel into a 4.75-mm sieve and rinse with fresh water until the water passing through the sieve is clear.

   d. Transfer the material to a pan, dry at 110 ± 5°C to a constant mass, and cool to room temperature.

      (1) When testing reclaimed aggregates containing asphalt concrete particles, the oven drying temperature shall not exceed 38°C.

   e. Abrade the test specimen using the following procedure.

(1) Place the washed and dried test specimen in the wash vessel.

(2) Add 1000 ± 5 mL water, clamp the lid in place and secure the vessel in the agitator.

(3) At 1 min ± 10 s after adding the water to the specimen, start the agitator and shake the vessel for 10 min ± 15 s.

f. Separate the aggregate and water on the 75 μm sieve.

(1) Remove the lid from the wash vessel and bring the fines into suspension by holding the vessel in an upright position while moving it vigorously in a horizontal circular motion 5 or 6 times, causing the contents to swirl inside.

(2) Immediately pour the contents of the vessel into 2.36 mm and 75 μm sieves nested over the collection pot.

(3) Tilt the 2.36-mm sieve to promote drainage, then discard the material retained on the 2.36-mm sieve.

(4) Collect all of the wash water and minus 75-μm sieve material in the collection pot. To assure that all material finer than the 75-μm sieve is washed through the procedure:

a. As the wash water is draining through the 75-μm sieve, apply a jarring action to the sieve by lightly bumping the side of the sieve frame with the heel of the hand.

b. When a concentration of material is retained on the 75-μm sieve, re-rinse the fine material by pouring the wash water through the sieve again, using the following procedure.

(1) Allow the wash water to stand undisturbed in the collection pot for a few moments to permit the heavier particles to settle to the bottom.

(2) Set the 75-μm sieve aside and pour the upper portion of the wash water into a separate container.

(3) Place the 75-μm sieve back on the collection pot and pour the water back through the material on the 75-μm sieve. (If two collection pots are available, the specimen may be rinsed by alternately placing the sieve on one and then the other while pouring the wash water through the material on the sieve. Before each rinsing allow the heavier particles to settle to the bottom and pour only the upper portion of the water through the material.)

(4) Repeat this procedure as necessary until all of the minus 75 μm material has been washed through the sieve. When the material has been rinsed sufficiently the material on the sieve will be free of visible streaks of clay and the wash water will flow freely through the sieve and accumulated material.

g. Pour all of the wash water and passing 75-μm sieve material into a graduated cylinder. Use fresh water as necessary to flush all the fines from the collection pot and adjust the volume to 1000 ± 5 mL.

h. Return the wash water to the collection pot taking care to include all water and fines.

i. Fill the graduated plastic cylinder to the three unit mark with stock calcium chloride solution and place the funnel on the cylinder.

j. Stir the wash water vigorously with one hand to bring all fines into suspension. Use a circular motion allowing the fingers to rub the sides and bottom of the collection pot.

k. Immediately fill the graduated plastic cylinder to the 150 unit mark with the turbulent water.

l. Stopper the cylinder and thoroughly mix the wash water and calcium chloride solution by inverting the cylinder 20 times in approximately 35 s. Allow the air bubble to completely transverse the length of the cylinder each time.

m. Immediately place the cylinder on a workbench or table free of vibrations, remove the stopper, and allow the cylinder to stand undisturbed for 20 min ± 15 s.

n. Immediately read the top of the sediment column to the nearest 1 unit.

o. Determine the coarse durability index (D_C) from Table No. 2.

2. PROCEDURE B, course durability (D_c) "modified" (for light weight or porous aggregates).

Because of the low specific gravity and/or high absorption rate of some aggregates, the proportions of aggregate to wash water are too great to permit the intended interparticle abrasion. Testing of these materials will require adjustment of the test specimen mass and volume of test water. All materials which are not completely inundated when 1000 mL water are added to 2550 g test specimen, shall be tested according to Method A with the following modifications.

a. Determine the bulk, oven-dry specific gravity and the absorption of the aggregate in accordance with California Test 206.

b. Adjust the total mass of the test specimen specified in F.1.b using the formula:

Adjusted Specimen Mass (g) =
[(Specific Gravity of Aggregate) / 2.65)] x 2550.

c. Adjust the mass of material in each size fraction proportionally to the mass specified in F.1.b.

d. Adjust the volume of test water specified in F.1.c and F.1.e using the formula shown below except that the volume of water shall always be at least 1000 mL.

Adjust Water = 1000 + (A x M) - 50

Where:

A = Absorption of Aggregate % x 0.01

M = Mass of Test Specimen

3. PROCEDURE C, fine durability (D_f) for material passing a 4.75-mm sieve.

a. Process the material to be tested as described in Section E "Sample Processing."

b. Split or quarter 500 ± 25 g of material from the passing 4.75 mm portion of the sample.

c. Dry to a constant mass at 110 ± 5°C and cool to room temperature.

(1) When testing reclaimed aggregates containing asphalt concrete particles, dry to a constant mass at 38 ± 2°C.

d. Wash the dried material by the following procedure:

(1) Place the material in the wash vessel.

(2) Add 1000 ± 5 mL of water, clamp the lid in place, and secure the vessel in the agitator.

(3) At 10 min ± 30 s after adding water to the material, start the agitator and shake the vessel for 2 min ± 5 s.

(4) Pour the contents of the vessel into a 75 mm sieve and rinse with fresh water until the water passing through the sieve is clear. Use a flexible hose attached to a faucet to direct water onto the material.

e. Transfer the material to a pan, dry to a constant mass at 110 ± 5°C, and cool to room temperature.

(1) Use water from the flexible hose as necessary to rinse the material from the sieve into the pan.

(2) Free water can be removed by tilting the pan and then, after the fines have settled, carefully pouring off the clear water.

(3) When testing reclaimed aggregates containing asphalt concrete particles, dry to a constant mass at 38 ± 2°C.

f. A 500 g fine sieve analysis test specimen which has been tested in accordance with California Test 202 may be utilized in lieu of the material prepared according to steps b. through e. above. If the fine sieve analysis test specimen is used, all of the material separated during sieving, including that portion retained in the sieve pan, shall be thoroughly recombined before proceeding to step g. below.

g. Split or quarter the washed and dried material to provide a test specimen of sufficient size to fill the measuring tin to level full. Predetermine the exact amount of material to be split using the following procedure:

(1) Fill the measuring tin to overflowing with the prepared material.

(2) Consolidate the material in the tin by tapping the bottom edge with a hard object.

(3) Strike off to level full using a straight edge and determine the mass of the material.

h. Fill the graduated plastic cylinder to 40 ± 1 units with working calcium chloride solution.

i. Pour the prepared test specimen into the plastic cylinder.

(1) Use the funnel to avoid spillage.

(2) Release air bubbles and promote thorough wetting by bumping the base of the cylinder against a firm object while the test specimen is being poured into the cylinder or by tapping the cylinder sharply on the heel of the hand several times after the test specimen has been poured in.

j. Allow the wetted material to stand undisturbed for 10 ± 1 min.

k. Abrade the test specimen by the following procedure:

(1) At the end of the 10-min soaking period, stopper the cylinder, then loosen the material from the bottom by shaking the cylinder while holding it in a partially inverted position.

(2) Secure the cylinder in the mechanical sand equivalent shaker.

(3) Start the shaker and allow it to operate for 10 min ± 15 s.

l. Irrigate the test specimen to flush the abraded fines from the sand using the following procedure:

(1) At the end of the shaking period, remove the cylinder from the shaker and set it upright on the work bench. Insert the irrigator tube in the cylinder, start the flow of working calcium chloride solution, and rinse the material from the sides of the cylinder as the irrigator is lowered.

(2) With the cylinder remaining in an upright position and the solution flowing from the tip, apply a twisting action to the irrigator and force it to the bottom of the cylinder. The flow of solution will flush the clay-size particles upward and into suspension. Withdraw the irrigator from the sand as necessary to change position and again force it to the bottom. The most effective technique for penetrating the test sample with the irrigator is to hold the irrigator between the palms of both hands and rotate it by rubbing the hands back and forth while applying a downward pressure.

(3) Continue twisting and forcing the irrigator to the bottom of the cylinder until the fines have been flushed from all areas of the sample. Rotate the

cylinder with each penetration of the irrigator and visually inspect the test specimen for pockets of fine material.

(4) When the solution reaches the 150 unit mark in the cylinder, slowly withdraw the irrigator without shutting off the flow. Regulate the flow just before the irrigator is entirely withdrawn and adjust the final level to 150 units.

m. Immediately place the cylinder on a workbench or table free of vibrations and allow the cylinder and contents to stand undisturbed for 20 min ± 15 s from the time the irrigation is completed.

n. Determine the "clay reading."

(1) At the end of the 20-min period, read and record the level of the top of the sediment column. This is the clay read.

(2) When the clay reading falls between graduations, record the level of the higher graduation.

(3) If a clearly defined line of demarcation does not form between the sediment and the liquid above it in the specified 20-min period, allow the cylinder to stand undisturbed until the clear demarcation line does form. Then immediately read and record the time and the height of the column. If tap water was used, retest an untested portion of the sample using distilled or demineralized water.

(4) If the liquid immediately above the line of demarcation is still darkly clouded at the end of 20 min, and the demarcation line, although distinct, appears to be in the sediment column itself, read and record the level of this line at the end of the specified 20-min period. If tap water was used, retest an untested portion of the sample using distilled or demineralized water.

o. Determine the "sand reading."

(1) After the clay reading has been taken, gently lower the weighted foot assembly into the cylinder until it comes to rest on the sand. Do not allow the indicator to hit the mouth of the cylinder as the assembly is being lowered.

(2) As the weighted foot comes to rest on the sand, tip the assembly toward the graduation on the cylinder so that the position of the indicator is visible. Take care not to press down on the assembly.

(3) Read the level of the top edge of the indicator.

(4) Subtract 100 units from the observed reading. This is the sand reading.

(5) When the sand reading falls between graduations, record the level of the higher graduation.

p. Calculate the fine durability index (D_f) using the formula:

D_f = (sand reading/clay reading) x 100

(1) If the calculated durability index is not a whole number, report it as the next higher whole number.

4. PROCEDURE D, fine durability (D_f) "modified," for pea gravel or chips having a nominal minimum size no smaller than a 1.18-mm sieve.

a. Process the material to be tested as described in Section E "Sample Processing."

b. Split or quarter out 500 ± 25 g of material from the passing 4.75 mm portion of the sample.

c. Wash the test specimen by the following procedure:

(1) Place the material in the wash vessel.

(2) Add 1000 ± 5 mL of water, clamp the lid in place, and secure the vessel in the agitator.

(3) At 10 min ± 30 s after adding water to the material, start the agitator and shake the vessel for 2 min ± 5 s.

(4) Pour the contents of the vessel into a 75-mm sieve and rinse with fresh water until the water passing through the sieve is clear. Use a flexible hose attached to a faucet to direct water onto the material.

d. Transfer the material to a pan, dry to constant weight at 110 ± 5°C, and cool to room temperature.

(1) Use water from the flexible hose as necessary to rinse the material from the sieve into the pan.

(2) Free water can be removed by tilting the pan and then, after the fines have settled, carefully pour off the clear water.

e. Split or quarter the washed and dried material to provide a test specimen of sufficient size to fill the measuring tin to level full.

(1) When filling the measuring tin, consolidate the material in the tin by tapping the bottom edge on a hard object such as the workbench.

(2) Fill the measuring tin too slightly round above the brim and then strike off to level full using a straightedge.

f. Fill the graduated plastic cylinder to 40 ± 1 units with water.

g. Pour the prepared test specimen into the plastic cylinder.

(1) Use the funnel to avoid spillage.

(2) Release air bubbles and promote thorough wetting by bumping the base of the cylinder against a firm object while the test specimen is being poured into the cylinder or by tapping the cylinder sharply on the heel of the hand several times after the test specimen has been poured.

h. Allow the wetted material to stand undisturbed for 10 ± 1 min.

i. Abrade the test specimen by the following procedure:

(1) At the end of the 10 min soaking period, stopper the cylinder, then loosen the material from the bottom by shaking the cylinder while holding it in a partially inverted position.

(2) Secure the cylinder in the mechanical sand equivalent shaker.

(3) Start the shaker and allow it to operate for 30 ± 1 min.

j. Transfer the water and passing 75-µm sieve size material to a second graduated plastic cylinder.

(1) Fill an empty graduated plastic cylinder to the 3 unit mark with stock calcium chloride solution.

(2) Place a 75-µm sieve into a funnel that empties into the cylinder containing the calcium chloride solution.

(3) Tip the stoppered cylinder containing the test specimen upside down and shake to loosen the material from the bottom.

(4) Hold the mouth of the inverted cylinder over the sieve and remove the stopper, allowing the test specimen and water to pour onto the sieve.

(5) Collect the water and passing 75-µm material in the second cylinder.

(a) Rinse the remaining fines from the first cylinder onto the sieve with a small amount of fresh water.

(b) Rinse the material retained on the sieve with additional fresh water to ensure that the minus 75-µm portion passes through the sieve. Take care not to fill the cylinder above the 150 unit mark.

(c) Adjust the level of the liquid to the 150 unit mark with fresh water.

k. Stopper the cylinder and thoroughly mix the wash water and calcium chloride solution by inverting the cylinder twenty times in approximately 35 s. Allow the air bubble to completely traverse the length of the cylinder each time.

l. Place the cylinder on a work bench or table free of vibrations, remove the stopper and allow to stand undisturbed for 20 min ± 15 s.

m. Immediately read the top of the sediment column to the nearest one unit.

n. Determine the Fine Durability Index (D_f) "Modified" from Table No. 2.

G. REPORTING

When both D_c and D_f are determined for a material, report the lowest of the two values. In no case shall the D_c and D_f be averaged or otherwise combined.

H. SAFETY AND HEALTH

This test may involve hazardous materials, operation, and equipment. This test does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever chooses this test method to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

This test involves the handling of hot materials, objects and tools. Use proper gloves and handling equipment to prevent burns.

Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

REFERENCES
California Tests 201, 202 and 206

End of Text (California Test 229 contains 14 pages)

TABLE NO. 2

DURABILITY INDEX OF COARSE AGGREGATE AND CHIPS

Sediment height (units)	Dura-bility index	Sediment height (units)	Dura-bility index	Sediment height (units)	Dura-bility index	Sediment height (units)	Dura-bility index	Sediment height (units)	Dura-bility index
00	100	30	53	60	39	90	29	120	18
01	96	31	52	61	38	91	29	121	18
02	93	32	52	62	38	92	28	122	18
03	90	33	51	63	38	93	28	123	17
04	87	34	51	64	37	94	28	124	17
05	85	35	50	65	37	95	27	125	16
06	82	36	49	66	37	96	27	126	16
07	80	37	49	67	36	97	27	127	15
08	78	38	48	68	36	98	26	128	15
09	76	39	48	69	36	99	26	129	14
10	74	40	47	70	35	100	26	130	14
11	73	41	47	71	35	101	25	131	13
12	71	42	46	72	35	102	25	132	13
13	70	43	46	73	34	103	25	133	12
14	68	44	45	74	34	104	24	134	12
15	67	45	45	75	34	105	24	135	11
16	66	45	44	76	33	106	24	136	11
17	65	47	44	77	33	107	23	137	10
18	63	48	43	78	33	108	23	138	9
19	62	49	43	79	32	109	23	139	9
20	61	50	43	80	32	110	22	140	8
21	60	51	42	81	32	111	22	141	7
22	59	52	42	82	31	112	22	142	7
23	59	53	41	83	31	113	21	143	6
24	58	54	41	84	31	114	21	144	5
25	57	55	40	85	30	115	20	145	4
26	56	56	40	86	30	116	20	146	4
27	55	57	40	87	30	117	20	147	3
28	54	58	39	88	29	118	19	148	2
29	54	59	39	89	29	119	19	149	1
								150	0

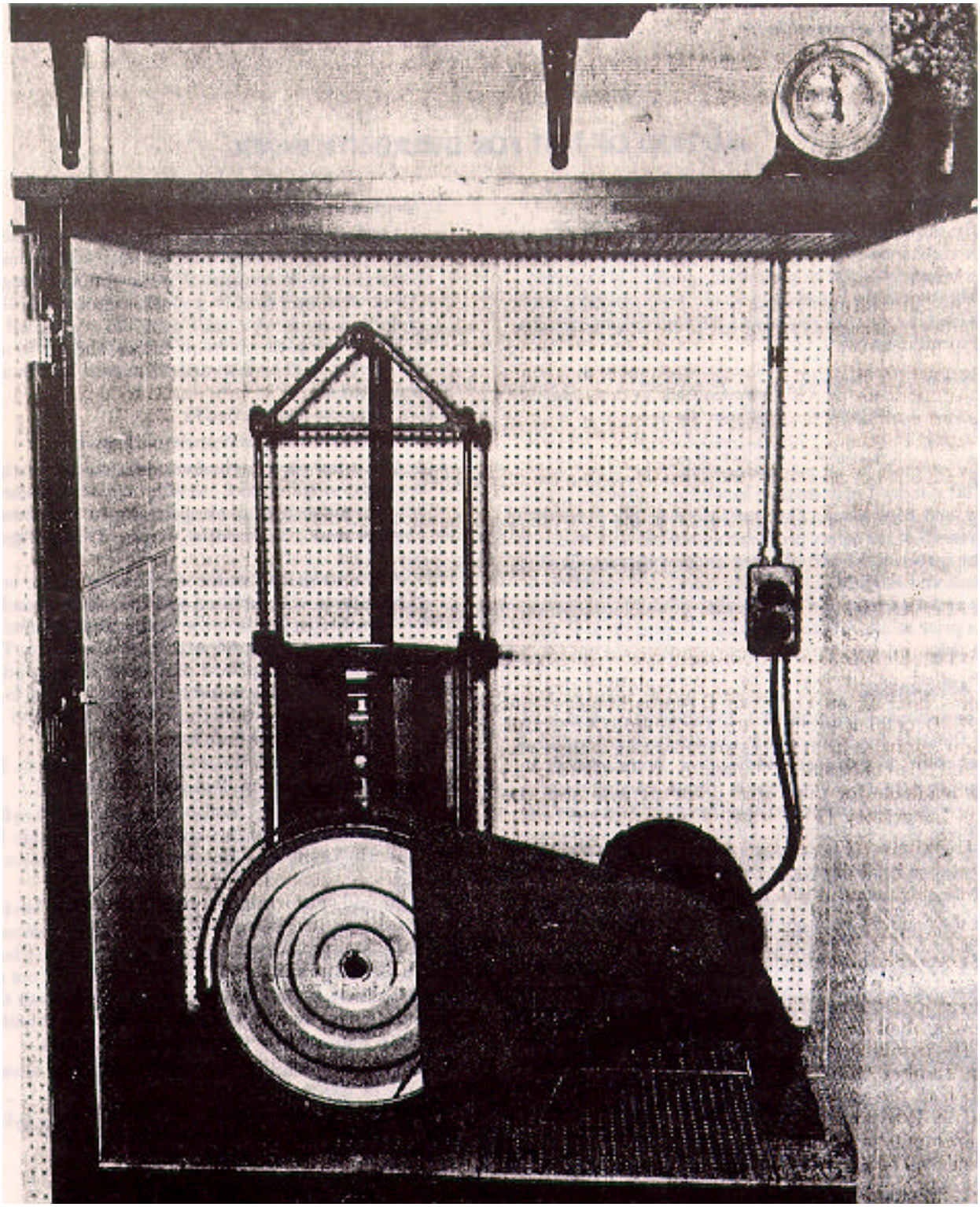

FIGURE 1

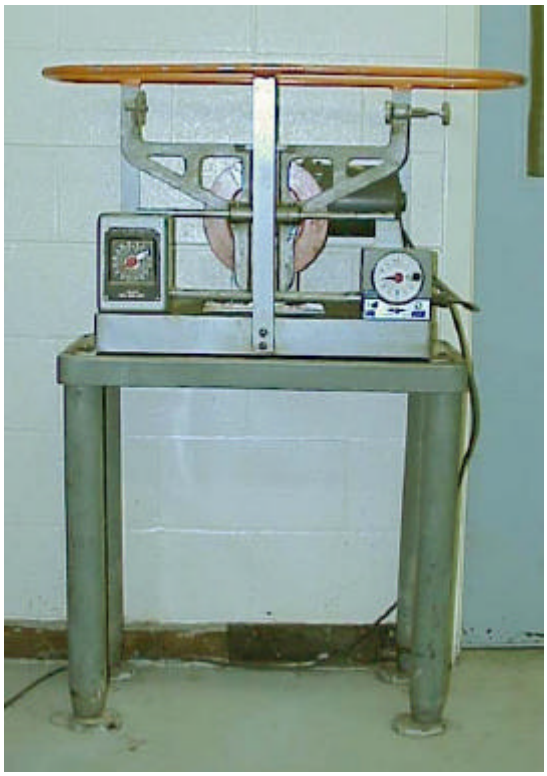

FIGURE 2

FIGURE 3

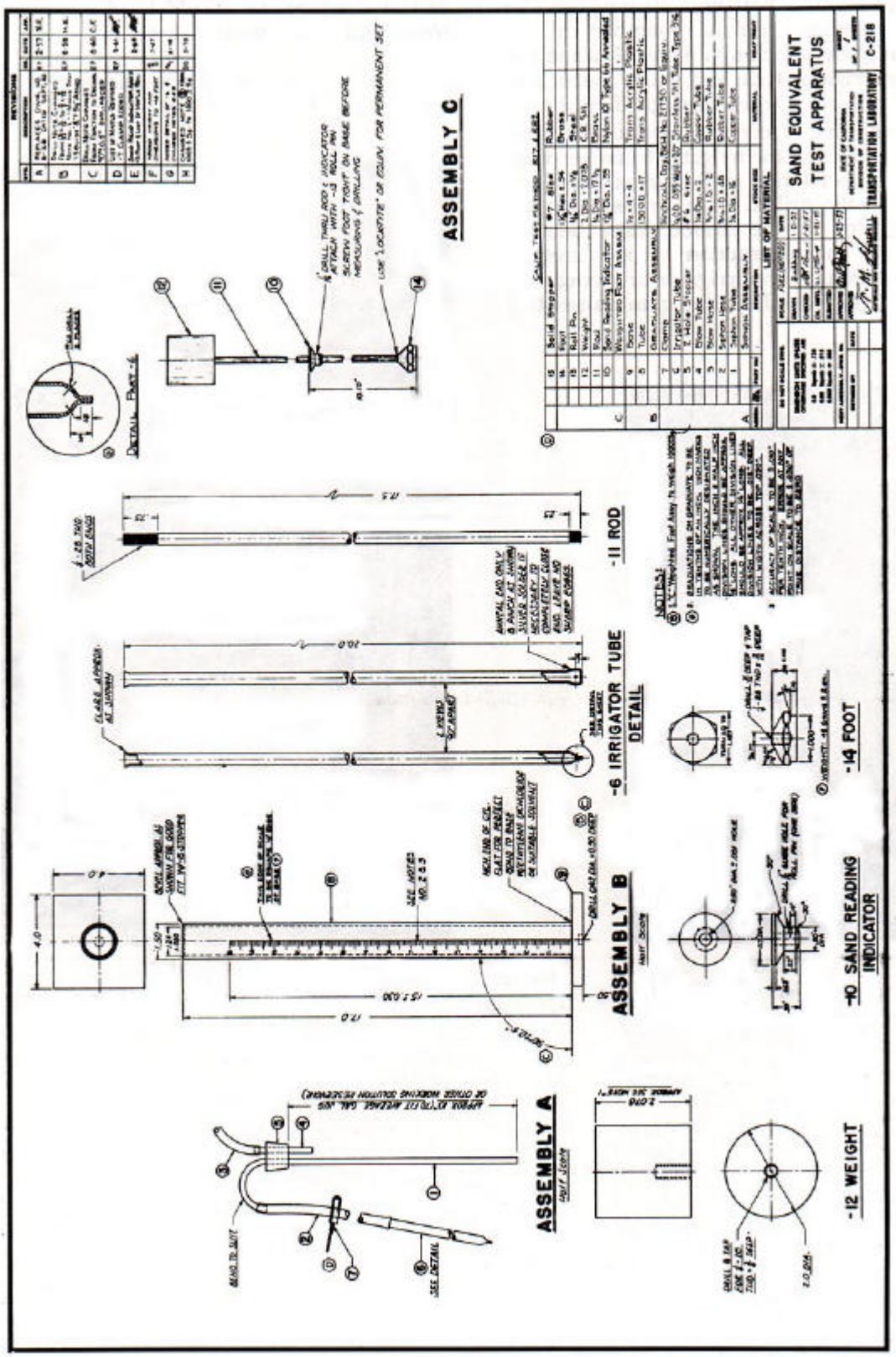
ASSEMBLY C
-11 ROD
-6 IRRIGATOR TUBE DETAIL
ASSEMBLY B
-14 FOOT
-10 SAND READING INDICATOR
ASSEMBLY A
-12 WEIGHT
SAND EQUIVALENT TEST APPARATUS
C-218

FIGURE 4

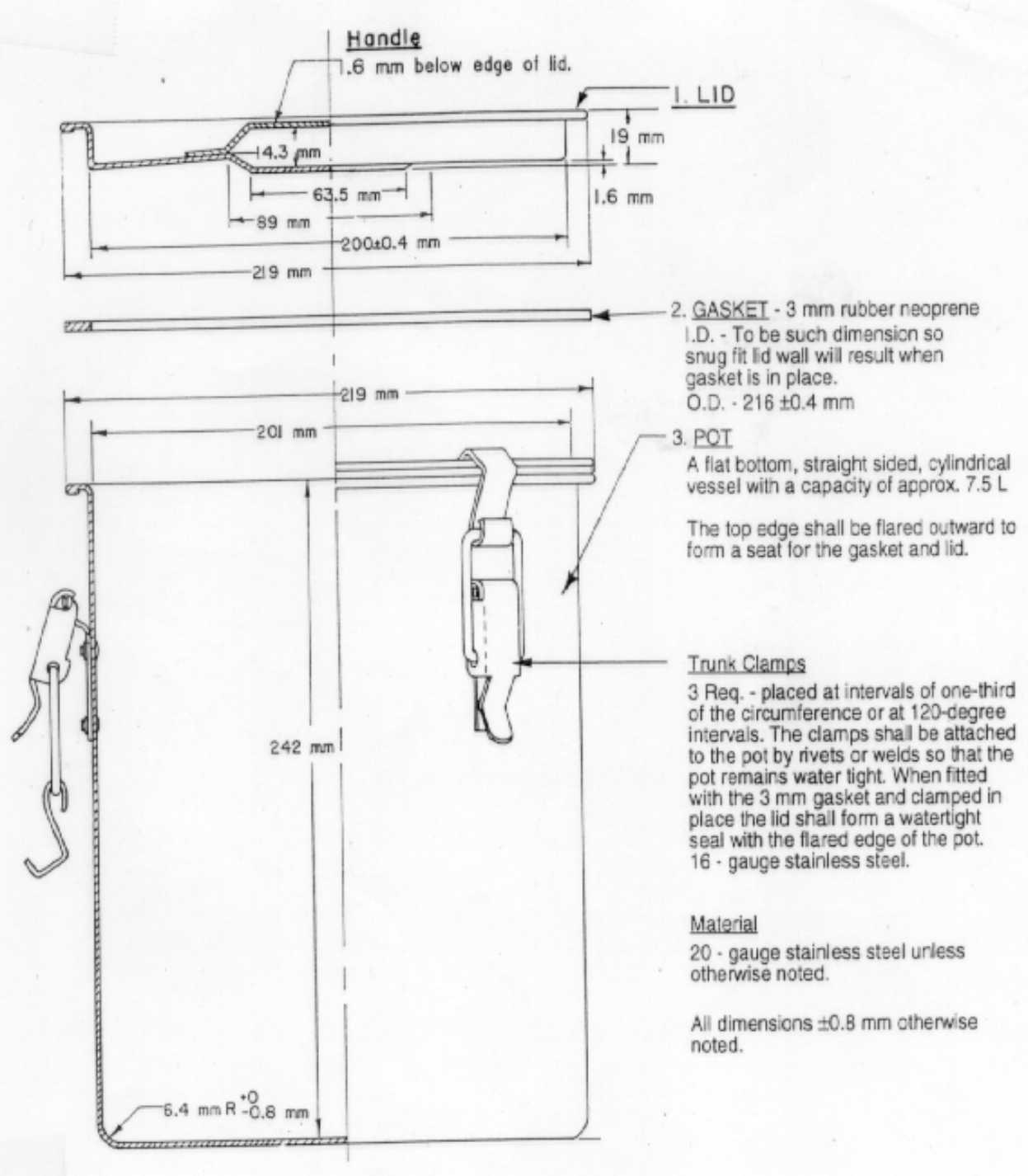

FIGURE 5
Mechanical Washing Vessel