

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
 Transportation Laboratory
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METHOD OF CALIBRATION OF COMPACTION TEST EQUIPMENT

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read **“SAFETY AND HEALTH”** in Section F 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

This test method describes the calibration procedure for the California impact compaction apparatus. Procedures for the use of the California impact compaction apparatus for determining the test maximum density are described in California Test 216.

B. APPARATUS

1. Weighing scale of 5-kg capacity, sensitive to 1 g.
2. Variable diameter metal plug with rubber o-rings. (Figure 1)



FIGURE 1

3. Containers for pouring water: 200-mL and 5-L capacities.
4. Shatter resistant, flat, transparent nonpliable plate, 4 in. by 4 in.

5. Water insoluble, heavy-duty grease.
6. Machinist's scale – minimum 40 inches in length, 0.01 in. divisions or a dial indicator and stand. (Figure 2)
7. Steel straight edge.



FIGURE 2

8. Calipers or micrometer with at least a 3-in. capacity, graduated to 0.01 in.
9. Eyedropper.

10. A fixed depth "T" bar capable of measuring 12 inches. (Figure 3)
11. Fixed-length, hooked bar for measuring 23.3 inches. (Figure 4)
12. Metric feeler gauge.
13. Metric radius gauge.

C. CALIBRATING PROCEDURE

1. Remove the base plate and cap section from the mold. (Figure 5)
2. Examine joints and machined surfaces to ensure that they are smooth and will not show visible openings. Examine the clamps for missing bolts and/or wing nuts.
3. Place a thin bead of grease on the joint surfaces of the cap section. This grease bead seals the seam between the cap section and the mold when the mold is reassembled. A grease seal is also necessary around the metal plug to prevent water leakage.
4. Examine the mold to see if it is out of round. If the diameter is more than 0.04 in. out of round, the mold should not be calibrated and should be discarded.
5. Place the plug in the mold 12 in. from the base of the mold by using the fixed depth "T" bar, as shown in Figure 6. The placement of the plug at 12-in. depth is critical. Then replace the greased cap section on the mold proper, clamp in place, and clean excess grease from the inside of the mold.
6. Place the mold on end with the base facing upward. The 12-in. section to be calibrated is now in an upright position. Make a final check of the 12 in. depth setting of the plug and make sure that the clamps are finger-tight.
7. Fill the water containers with approximately 3000 g of water. Determine the mass of the water,

containers, and eyedropper to the nearest gram. Record this gross initial mass on line (a) of the Calibration Impact Compaction Test Mold Calibration Form.

8. Grease the base of the mold and place the clear plate flat over the base so that about a ½ in. opening is left (Figure 7). Carefully pour the 3000 g of water into the sealed mold section. As the water level nears the top of the sealed section, complete the filling of the mold with the eyedropper. If the mold leaks water during the pour, empty the water, adjust the diameter of the plug, retighten the wing nuts and start the test over. If the mold continues to leak, it may be out of round.



Figure 3

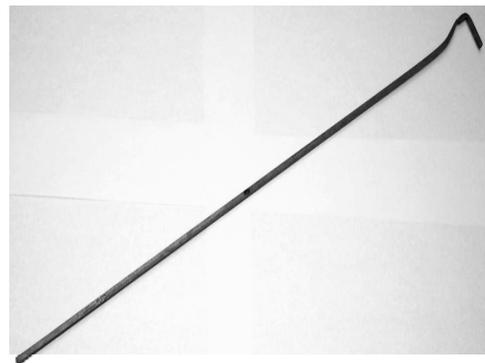


Figure 4

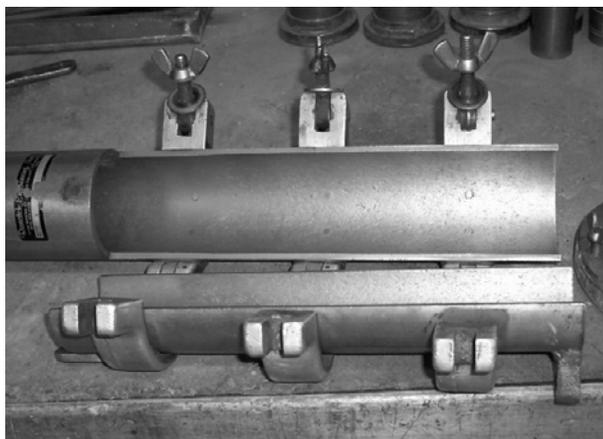


Figure 5



Figure 7

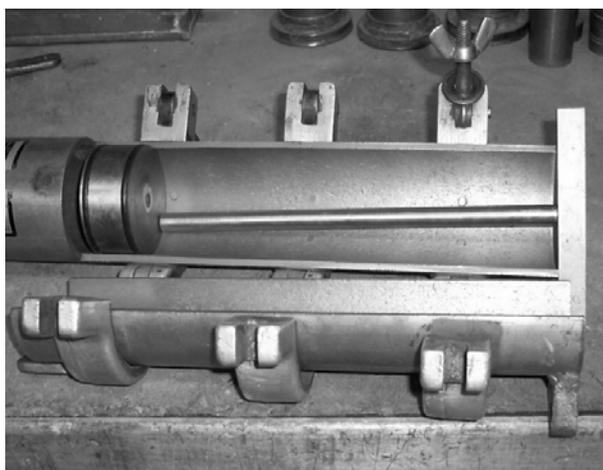


Figure 6

9. The water not used in the pouring must be recovered for an accurate calibration.
10. The difference between the initial mass of water and the remaining mass of water is also the volume of the measured section in mL. Perform three trials and record the measurements on lines (a) through (c) of the Calibration Form. Record the average of the three trials on line (d). Refer to Table 1 for the mold length corresponding to the measured volume and record it on Line 2. This is the overall length of the mold excluding the base plate.

11. Measure the present overall length of the mold with the machinist scale or dial indicator, and record on line 3. The dial indicator is set to read 0.5 in. with the calibration rod and plate as shown in Figure 8. Determine the difference in length between Lines 2 and 3 and record on Line 4. If the present measured length is within 0.02 in. of the indicated calibration length from Table 1, no adjustment is necessary. If the mold is too short or distorted and out of round, the mold must be discarded. In some cases, a short mold can be built up by welding and machining to the proper length.

D. CHECKING ACCESSORY EQUIPMENT

The tamper shall be checked when the mold is calibrated to be sure that the wearing face of the tamping foot is not excessively worn. Using the steel square and feeler gage, measure the flatness of the tamper foot. The foot shall be within a flatness of 0.05 in. Using radius gages, measure the bottom edge of the tamper foot. The radius shall not exceed 0.13 in. If either of these tolerances is exceeded, the tamping rod shall be repaired or replaced.

The overall length of the tamper is to be adjusted to give a total mass for the

tamper of $10 \pm 1/10$ pounds. Regardless of the overall length of tamper, the distance from the tamping face to the graduation marked 10 is to be 23.3 ± 0.03 in.

The leveling piston shall be checked when the mold is calibrated for adherence to length and flatness specification. Using the calipers, measure the length of the piston. The piston shall be 3.4 ± 0.03 in. long. Using a steel straight edge and feeler gage, measure the flatness of the piston top and bottom. The piston shall be within a flatness of 0.02 in. The diameter is adjusted to fit the tube.

Check the hooked rod supplied for measuring the tamper height drop to be sure that the distance from hook to top outer edge of ring is $18 \pm 1/16$ in.

The hooked bar, shown in Figure 9, is used to accurately check the required length from the tamper foot to the graduation marked "10." If the tamper foot is replaced, the new tamper must meet the given mass and length criteria.

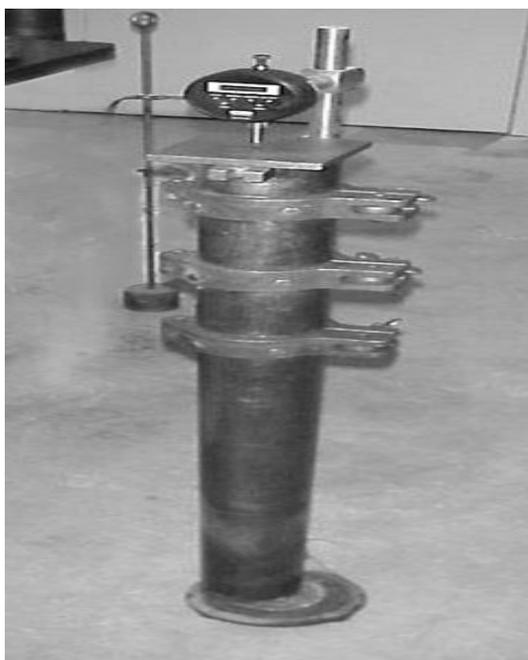


Figure 8

E. NOTES

1. The impact compaction apparatus should be checked once a year, or more often, depending on the frequency the equipment is used.
2. The temperature correction for water is small and, therefore, is not included in this part of the test method.



Figure 9

F. SAFETY AND HEALTH

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.

REFERENCE
California Test 216

End of Text
(California Test 110 contains 6 Pages)

TABLE 1

CALIFORNIA IMPACT COMPACTION MOLD CALIBRATION CONVERSIONS

Mold		Mold	
Volume (L)	Length (in)	Volume (L)	Length (in)
1.256.....	36.10	1.279.....	35.87
1.257.....	36.09	1.280.....	35.86
1.258.....	36.08	1.281.....	35.85
1.259.....	36.07	1.282.....	35.84
1.260.....	36.06	1.283.....	35.83
1.261.....	36.05	1.284.....	35.82
1.262.....	36.04	1.285.....	35.81
1.263.....	36.03	1.286.....	35.80
1.264.....	36.02	1.287.....	35.79
1.265.....	36.01	1.288.....	35.78
1.266.....	36.00	1.289.....	35.77
1.267.....	35.99	1.290.....	35.76
1.268.....	35.98	1.291.....	35.75
1.269.....	35.97	1.292.....	35.74
1.270.....	35.96	1.293.....	35.73
1.271.....	35.95	1.294.....	35.72
1.272.....	35.94	1.295.....	35.71
1.273.....	35.93	1.296.....	35.70
1.274.....	35.92	1.297.....	35.69
1.275.....	35.91	1.298.....	35.68
1.276.....	35.90	1.299.....	35.67
1.277.....	35.89	1.300.....	35.66
1.278.....	35.88	1.301.....	35.65

NOTES: Referring to the Calibration Form, the volume in mL pertains to the average of three water volume measurements of the lower 12-inch length of the mold (Item “d”). Mold length in inches refers to the finished overall length of the mold (Item “3”).

The relationship between volume of the lower 12 inches of the mold and the overall length of the mold is based on a tamper length of 23.3 inches.

EXAMPLE: If the volume of the lower 12 inches of the mold is found to be 1.265 L, 36.01 inches is the total length of the mold to record for Item 2.

CALIFORNIA IMPACT COMPACTION TEST MOLD CALIBRATION RECORD

MOLD NO. _____ DATE _____ DISTRICT _____ CALIBRATED BY _____

1. Volume of water to fill 305 of mold in mL

	<u>Trial 1</u>	<u>Trial 2</u>	<u>Trial 3</u>
(a) Initial mass of water, in g	_____	_____	_____
(b) Remaining mass of water, in g	_____	_____	_____
(c) Mass of water to fill mold (a-b), in g	_____	_____	_____
(d) Average mass of water, in g			
$\frac{\text{Trial 1} + \text{2} + \text{3}}{3} = (\text{Volume, in mL})$			_____

2. Indicated Overall Mold Length from Table 1, in inches _____

3. Measured Overall Mold Length, in inches _____

4. Length Difference (2 - 3) (Spec. Max. ± 0.02 in. of No. 2), in inches _____

5. Length Condition Satisfactory _____ Long _____ Short _____

6. If out of specifications,

(a) How much to cut off, in inches _____

(b) How much to build up, in inches _____

Accessory Equipment

Specifications

Tamper Mass	_____ lb.	$10 \pm 1/10$ lb.
Tamper Length (Face to graduation mark "10")	_____ in.	23.3 ± 0.03 in.
Tamper Foot Flatness	_____ in.	0.05 in. maximum
Tamper Foot Radius	_____ in.	0.13 in. maximum
Piston Length	_____ in.	3.4 ± 0.03 in.
Hooked Rod	_____ in.	$18 \pm 1/16$ in.