STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
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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

4. 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.

5. Variable diameter metal plug with rubber o-rings (Figure 1).

FIGURE 1

6. Containers for pouring water: 200-g and 5-g capacities.

7. Shatter resistant, flat, transparent nonpliable plate, 4 in. by 4 in.
8. Water insoluble, heavy-duty grease.
9. Machinist's scale – minimum 40 inches in length that is accurate to within .01 in division or dial indicator, readable to 0.001 in. complete with a stand and 36 in. rod that is accurate to within 0.003 in. (Figure 2) and plate 4 in. by 4 in. by ½ in. thickness accurate to within 0.003 in (Figure 3).

10. Steel square

FIGURE 2

FIGURE 3

11. Calipers with at least a 3-in capacity, graduated to 0.01 in or micrometer with an accuracy of 0.0005 in.

12. Eyedropper.

13. A fixed depth "T" bar capable of measuring 12 in accurate to within 0.001 in. (Figure 4).

14. Fixed-length, hooked bar for measuring 23.3 in ± 0.03 in. (Figure 5).

15. English feeler gauge.

16. English radius gauge.

C. CALIBRATING PROCEDURE

1. Remove the base plate and cap section from the mold (Figure 6).

2. Examine joints and machined surfaces to ensure that they are smooth and will not show visible openings. Examine the clamps for loose or missing bolts and/or wing nuts.

3. 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 or repaired.

4. 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. Place a thin bead of grease on the metal plug's rubber o-ring to prevent water leakage.

5. Place the plug in the mold 12 in. from the base of the mold by using the fixed depth "T" bar (Figure 7).

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.

7. Place the mold on end with the base facing upward. Make a final check of the 12 in. depth setting of the plug and make sure that the clamps are finger-tight.

8. 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* (attached).

9. Grease the base of the mold and place the clear plate flat over the base so that about a ½ inch opening is left (Figure 8). Carefully pour the container with 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 4

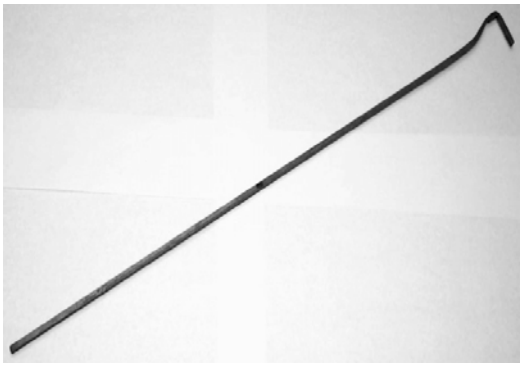

FIGURE 5

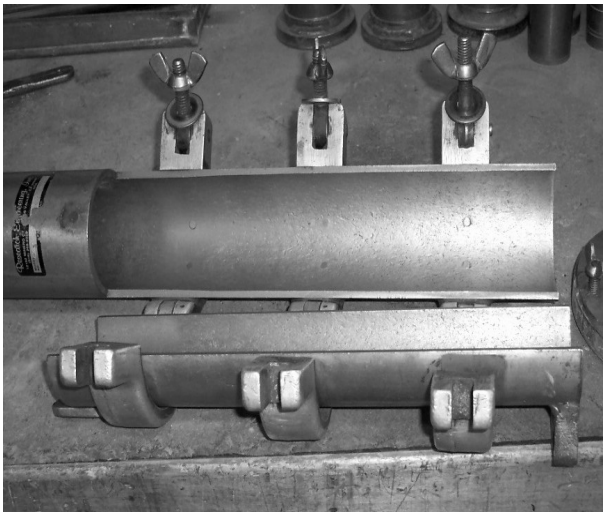

FIGURE 6

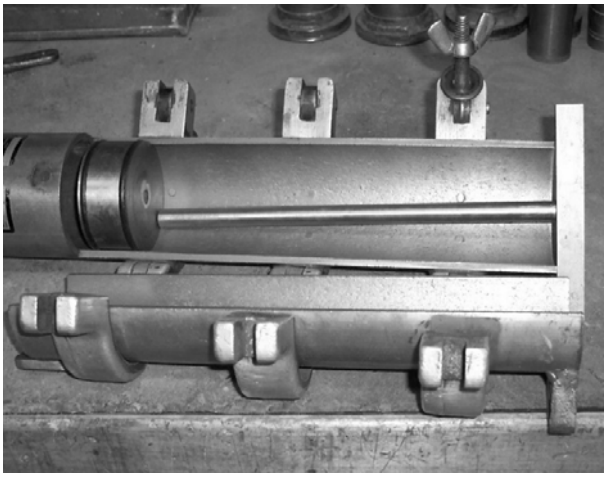

FIGURE 7

10. Gently slide the clear plate across the opening while applying a slight downward pressure. This technique aids in determining whether the mold is completely filled with water. If, while the plate is being slid across the surface of the opening, the viscous seal of the water shows an air bubble forming, stop sliding the plate. This shows that not enough water is in the mold section, so use the eyedropper to add a few drops to the exposed pouring surface. Resume sliding the plate across the opening. If the plate is pushing an excess of water in front as it is slid across the opening, carefully remove the excess water from the opening with the eyedropper. Do not spill or lose any of this water.

    Once the plate is slid completely across the opening and shows no air bubbles or spilled water, weigh the remaining water to the nearest gram and record on line (b) of the *Calibration Impact Compaction Test Mold Calibration Form*. The water not used in the pouring must be recovered for an accurate calibration.

11. The difference between the initial mass of water and the remaining mass of water is also the volume of the measured section, in *g*. Perform three trials and record the measurements on lines (a) through (c) of the *Calibration Impact Compaction Test Mold 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.

FIGURE 8

12. Measure the overall length of the mold with the machinist scale or dial indicator, and record on line 3 *of the Calibration Impact Compaction Test Mold Calibration Form.* The dial indicator is set to read 0.5 in. with the calibration rod and plate as shown in Figure 9. Determine the difference in length between Lines 2 and 3 and record on Line 4. If the measured length is within 0.02 in. of the indicated calibration length from Table 1, no adjustment is necessary. If the mold is too long, the excess length must be machined down. If the mold is too short 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 either micrometer or the caliper, measure the outside diameter of the tamper foot. The foot shall have an outside diameter of 2 in accurate to within 1/16 radius. Using the steel square and feeler gage, measure the flatness of the tamper foot. The foot shall be within a flatness of 0.02 in. Using radius gauge, measure the bottom edge of the tamper foot. The radius shall not exceed 0.0625 in. If either of these tolerances is exceeded, the tamping rod shall be repaired or replaced and if the outside diameter is under tolerance, it should be repaired or replaced.

The overall length of the tamper is to be adjusted to give a total mass for the tamper of 10 ± 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 hooked bar, shown in Figure 10, 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.

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 2.70 ± 0.03 in. long. Using a steel square and feeler gauge, 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 the inside of the hook to top outer edge of ring is 18 ± 1/16 in.

FIGURE 9

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 10

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 7 Pages)

TABLE 1

CALIFORNIA IMPACT COMPACTION MOLD CALIBRATION CONVERSIONS

Mold Volume (g)	Mold Length (in)	Mold Volume (g)	Mold Length (in)
1256	36.10	1279	35.87
1257	36.09	1280	35.86
1258	36.08	1281	35.85
1259	36.07	1282	35.84
1260	36.06	1283	35.83
1261	36.05	1284	35.82
1262	36.04	1285	35.81
1263	36.03	1286	35.80
1264	36.02	1287	35.79
1265	36.01	1288	35.78
1266	36.00	1289	35.77
1267	35.99	1290	35.76
1268	35.98	1291	35.75
1269	35.97	1292	35.74
1270	35.96	1293	35.73
1271	35.95	1294	35.72
1272	35.94	1295	35.71
1273	35.93	1296	35.70
1274	35.92	1297	35.69
1275	35.91	1298	35.68
1276	35.90	1299	35.67
1277	35.89	1300	35.66
1278	35.88	1301	35.65

NOTES:

Referring to the Calibration Form, the volume in g 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 1265 g, then 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 a 12-inch section of mold, in g

	Trial 1	Trial 2	Trial 3
(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			

$$\frac{\text{Trial 1} + 2 + 3}{3} = \text{(Volume, in g)}$$

_____

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 ± 1/10 lb.
Tamper Length (Face to graduation mark “10”)	_____in.	23.3 ± 0.03 in.
Tamper foot Outside Diameter	_____in	2.00 in ± 1/16 radius
Tamper Foot Flatness	_____in.	0.02 in. max
Tamper Foot Radius	_____in.	0.0625 in. max
Piston Length	_____in.	2.70 ± 0.03 in.
Hooked Rod	_____in.	18 ± 1/16 in.