Designation: D 1560 – 92 (Reapproved 2000)

Standard Test Methods for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus[1]

This standard is issued under the fixed designation D 1560; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These test methods cover the determination of (*1*) the resistance to deformation of compacted bituminous mixtures by measuring the lateral pressure developed when applying a vertical load by means of the Hveem stabilometer and (*2*) the cohesion of compacted bituminous mixtures by measuring the force required to break or bend the sample as a cantilever beam by means of the Hveem cohesiometer.[2]

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.3 The values stated in acceptable metric units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1561 Practice for Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor[3]

D 3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials[3]

2.2 *California Department of Transportation Standards:*

Test 306 Method of Test for Cohesiometer Value[2]

Test 366 Method of Test for Stabilometer Value[2]

3. Significance and Use

3.1 The results of the deformation and cohesion tests can be used for specification purposes or for mix design purposes or both. For example, these values can be used for specification compliance testing of aggregate properties. They can also be used for specification compliance testing of the mix. The cohesion test is sometimes used for fine mixes such as sand mixes wherein cohesion, or tensile strength, is of major or primary importance. The cohesion test is also sometimes used for the design of cold mixes containing emulsified asphalt.

RESISTANCE TO DEFORMATION

4. Apparatus

4.1 *Stabilometer*— The Hveem stabilometer (Fig. 1 and Fig. 2) is a triaxial testing device consisting essentially of a rubber sleeve within a metal cyclinder containing a liquid which registers the horizontal pressure developed by a compacted test specimen as a vertical load is applied.

4.2 *Testing Machine*— A compression testing machine having a minimum capacity of 44.5 kN (10 000 lbf). Fig. 3 shows the stabilometer in a testing machine. The 22-kN (50 000-lbf) capacity compression testing machine specified in Practice D 1561, is normally used to perform the stabilometer test.

4.3 *Test Specimen Push-Out Device*—A device, to push the specimen out of the mold (see Fig. 4 for an example).

4.4 *Oven*—An oven capable of maintaining a temperature of 60 ± 3°C (140 ± 5°F).

4.5 *Calibration Cylinder*—A hollow metal cylinder 101.6 ± 0.13 mm (4 ± 0.005 in.) in outside diameter by 140 ± 6.4 mm (5.5 ± 0.25 in.) high (for calibration purposes).

4.6 *Rubber Bulb*—For introducing air into the stabilometer.

4.7 *Follower*—One solid wall metal follower 101.2 mm (3.985 in.) in diameter by 140 mm (5½ in.) high (see Fig. 5 and Fig. 6).

5. Test Specimens

5.1 Test specimens shall be mixed and compacted in accordance with those procedures normally used. The procedure described in Practice D 1561 is a suitable procedure.

6. Adjustment of Stabilometer

6.1 Adjust the stabilometer base so that the distance from the bottom of the upper tapered ring (see Fig. 1) to the top of the base is 89 mm (3.5 in.).

6.2 Place the calibration cylinder (preheated to 60°C (140°F)) in place in the stabilometer. Seat it firmly on the stage, hold it in place with either the hand or a vertical load of 0.45 kN (100 lbf) in the testing machine, and apply a horizontal pressure of exactly 34.5 kPa (5 psi). When applying the 34.5-kPa pressure, always start below or drop below this value, then bring the pressure up to 34.5 kPa (5 psi) and gently tap the dial to remove any slack in the system. Adjust the turns

[1] These methods are under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and are the direct responsibility of Subcommittee D04.20 on Mechanical Tests of Bituminous Mixes.

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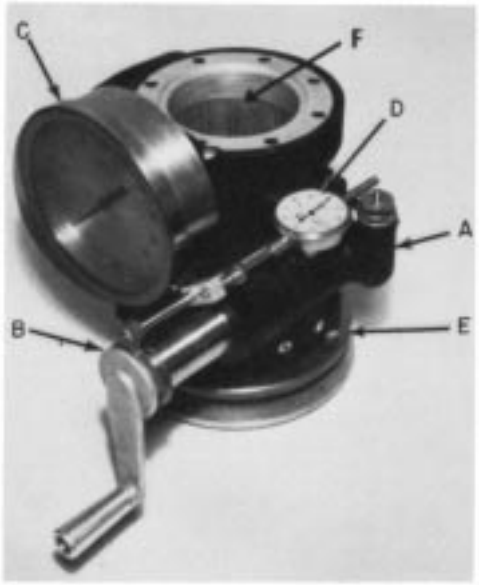
[2] A more detailed description of the procedures for performing the tests is available on request from the California Dept. of Transportation, 5900 Folsom Blvd., Sacramento, CA 95819. Also available is a procedure containing details regarding the operation and calibration of the stabilometer and the replacement of the stabilometer diaphragm.

[3] *Annual Book of ASTM Standards,* Vol 04.03.

TABLE 1



A—Air cell.
B—Displacement pump.
C—200-psi pressure gage.
D—Ames dial.
E—Base adjustment nut.
F—Bottom of upper tapered ring.

FIG. 1 Hveem Stabilometer

indicator dial to zero. Turn the pump handle at an approximate rate of two turns per second until the stabilometer dial reads 689 kPa (100 psi). The turns indicator dial shall read 2.00 ± 0.05 turns. If it does not, the air in the cell must be adjusted. Remove or add air by means of the valve and the rubber bulb, then repeat the displacement measurement. Continue to adjust the amount of air in the system until the proper number of turns is obtained. Release the horizontal pressure and remove the calibration cylinder.

6.3 With the stabilometer and stage base in position on the platen, adjust the testing machine so that the load will be applied at the rate of 1.3 mm (0.05 in.)/min.

7. Procedure

7.1 Heat the specimen to be tested in an oven at 60 ± 3°C (140 ± 5°F) for 3 to 4 h.

NOTE 1—Bring the specimen to room temperature in the case in which it is desired to test with whatever moisture may be present in the mixture.

7.2 Transfer the compacted specimen from the mold to the stabilometer by means of a suitable push-out device. Make sure that the specimen goes into the stabilometer straight, with the tamped end up, and that it is firmly seated level on the base. Place the follower on top of the specimen and apply a horizontal pressure until exactly 34.5 kPa (5 psi) is recorded on the stabilometer gage. If the testing machine has a spherically seated type of upper head, the locking shims used during the fabrication of the test specimen must be removed before performing the stabilometer test. Start the vertical movement of the press (speed of 1.3 mm (0.05 in.)/min) and record the stabilometer gage readings when the vertical load is 13.4, 22.3, and 26.7 kN (3000, 5000, and 6000 lbf). Stop the vertical movement of the press when the total load reaches 26.7 kN (6000 lbf). Immediately reduce the vertical load to 4.45 ± 0.45 kN (1000 ± 100 lbf), and then adjust the horizontal pressure to 34.5 kPa (5 psi). This will result in a further reduction of the vertical load to less than 4.45 kN (1000 lbf). This is normal and no compensation need be made. Measure the number of turns of the pump handle required to raise the horizontal pressure from 34.5 to 689 kPa (5 to 100 psi) with the specimen in place. Turn the pump handle at approximately two turns per second when applying this pressure. The number of turns measured is the displacement reading, *D*. In measuring the displacement, the vertical load will increase and at times exceed 4.45 kN (1000 lbf). As before, these changes in load are characteristic and no adjustment or compensation is required.

8. Calculation

8.1 Determine the stabilometer value of the specimen as follows:

$$S = \frac{22.2}{[(P_h \cdot D)/(P_v - P_h)] + 0.222} \quad (1)$$

where:
S = stabilometer value,
P_h = horizontal pressure for corresponding P_v in kPa (or psi),
D = displacement of specimen, and
P_v = vertical pressure (typically the 2800 kPa (400 psi) being applied when the vertical load is 22.3 kN (5000 lbf).

NOTE 2—Test specimens shall be 102 mm (4 in.) in diameter. The height of the test specimens should be 64 ± 3 mm (2.5 ± 0.1 in.). If this height cannot be obtained, the stabilometer value shall be corrected as indicated by Fig. 7.

9. Report

9.1 Report the following information:
9.1.1 Stabilometer value,
9.1.2 Test temperature, and
9.1.3 Bitumen content.

COHESION

10. Apparatus

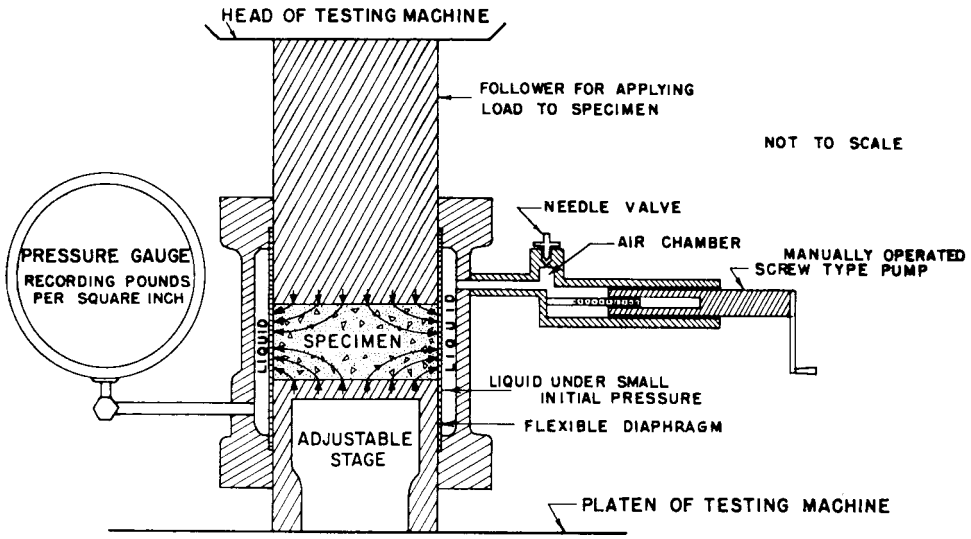
10.1 *Cohesiometer*— A Hveem cohesiometer, as shown in Fig. 8 and Fig. 9.[4] The steel shot loading system may be replaced by any load delivery system that applies the load at the rate of 1800 ± 20 g/min.

10.2 *Steel Shot*—2000 g of steel shot, size No. 10, all passing a 2.00-mm (No. 10) sieve and retained on a 1.40-mm (No. 14) sieve.

10.3 *Oven*—An oven capable of maintaining a temperature of 60 ± 3°C (140 ± 5°F).

10.4 *Balance*—A balance having a capacity of 10 kg and sensitive to 1 g or less.

[4] Detailed working drawings of the apparatus illustrated in Fig. 9 are available at a nominal cost from ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428–2959. Request Adjunct No. ADJD156001.



NOTE 1—The specimen is given lateral support by the flexible sidewall, which transmits horizontal pressure to the liquid. The magnitude of the pressure can be read on the gage.

FIG. 2 Diagrammatic Sketch of the Hveem Stabilometer

FIG. 3 Hveem Stabilometer Placed in the Testing Machine

11. Test Specimens

11.1 *Preparation of Specimen*—The test specimen will normally be the compacted specimen used after completion of the stabilometer test. If the sample is taken from a compressed pavement slab by means other than coring, it should be cut to size with a suitable saw.

11.2 *Size of Specimens*—The cohesiometer is designed to test specimens up to 127 mm (5 in.) in width and from 25 to 76 mm (1 to 3 in.) high.

12. Procedure

12.1 Heat the specimen to be tested in an oven at 60± 3°C (140 ± 5°F) for 3 to 4 h.

12.2 Preheat the cohesiometer to 60 ± 3°C (140 ± 5°F). Clamp the test specimen firmly in the cohesiometer with the tamped surface up, being certain that it is well centered with the top plates parallel with the surface of the specimen. Tighten the clamp nuts until snug using the fingers only. Delay starting the test until the temperature within the cohesiometer cabinet returns to 60 ± 3°C (140 ± 5°F). Allow the shot to flow into the receiver at the end of the lever arm at a rate of flow of 1800 ± 20 g/min. Stop the flow of shot when the specimen breaks or when the lever arm deflects 13 mm (½ in.) from the horizontal, if that occurs before the specimen breaks. Weigh and record the weight of shot in grams.

13. Calculation

13.1 Calculate the cohesiometer value as follows:

SI Units:

$$C = \frac{L}{W(0.031H + 0.0027H^2)} \quad (2)$$

Inch-Pound Units:

$$C = \frac{L}{W(0.20\,H + 0.044H^2)} \quad (3)$$

where:

C = cohesiometer value (g/25 mm (1 in.) of width corrected to 76-mm (3-in.) height);
L = weight of shot, g;
W = diameter or width of specimen, cm (or in.); and
H = height of specimen, cm (or in.).

14. Report

14.1 Report the following information:
14.1.1 Cohesiometer value,
14.1.2 Test temperature, and
14.1.3 Bitumen content.

15. Precision and Bias

15.1 *Precision*—Precision estimates based on five pairs of

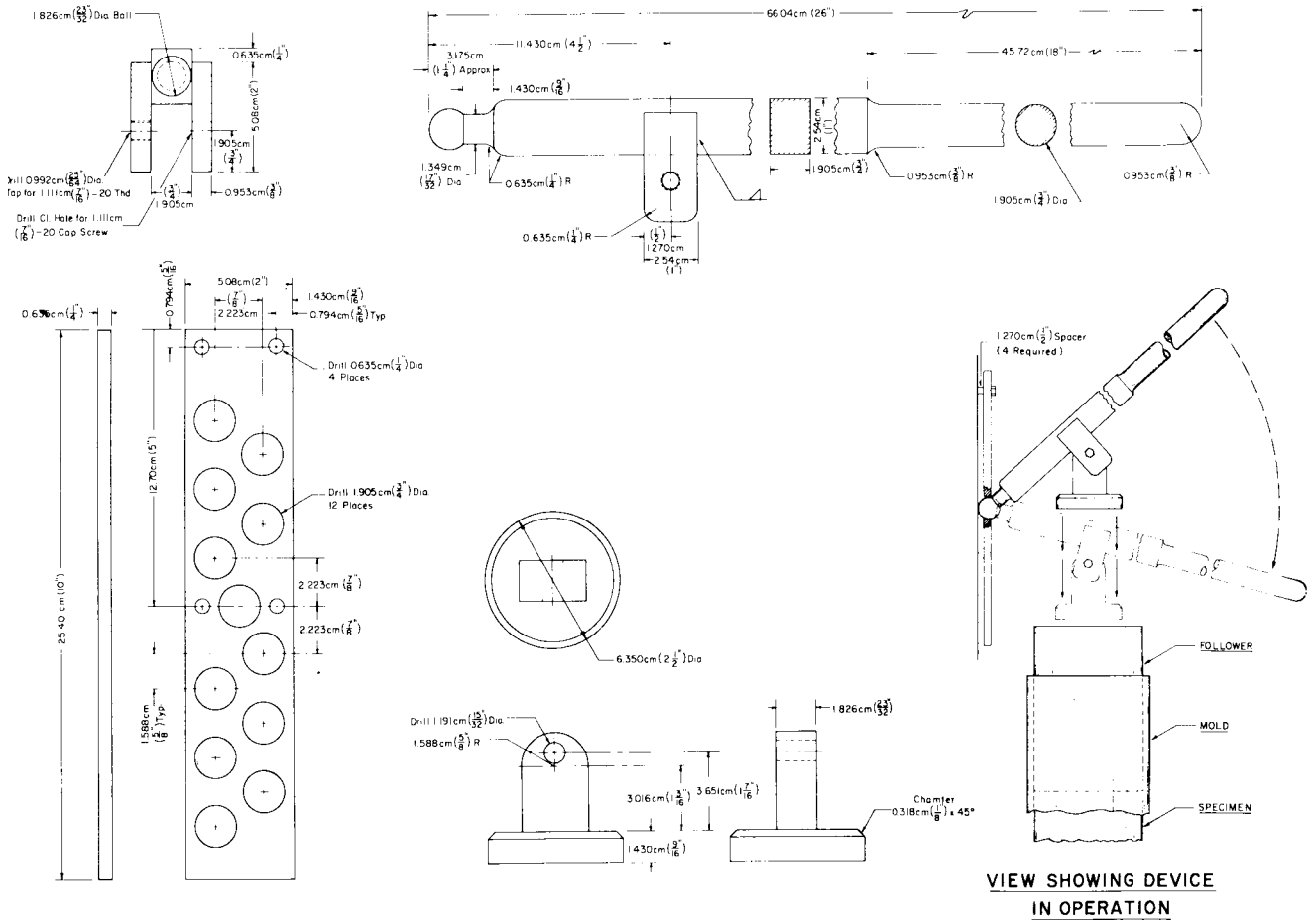


FIG. 4 Detailed Drawings of the Test Specimen Push-Out Device

FIG. 5 Specimen Follower

AMRL bituminous concrete design proficiency samples have been developed. The samples included 9.5- and 19-mm (⅜- and ¾-in.) maximum size aggregate gradations.

Test	Type Index	Coefficient of Variation, 1s %	Acceptable Range of Two Test Results, d2s %
Resistance to Deformation	single operator	9	25
	multilaboratory	21	59
Cohesion	single operator	20	57
	multilaboratory	38	108

15.2 The precision of these test methods depends on the ability of the personnel performing them and the competency of the equipment used. A method to check this can be found in Specification D 3666.

15.3 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in Test Methods D 1560 for measuring the resistance to deformation and the cohesion of bituminous mixtures, no statement on bias is being made.

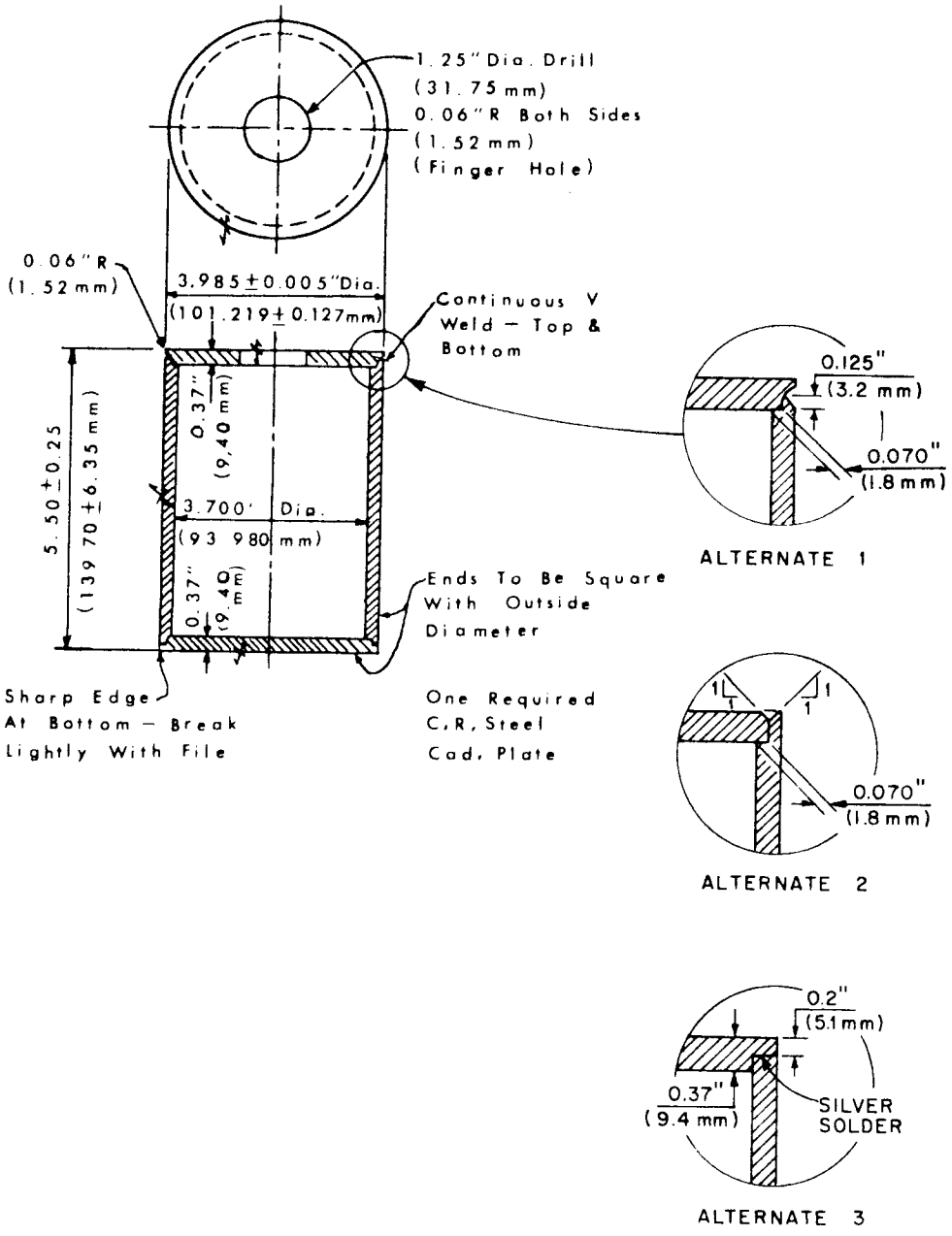


FIG. 6 Detailed Drawing of the Specimen Follower

CHART FOR CORRECTING STABILOMETER VALUES
TO SPECIMEN HEIGHT OF 2.50"(64mm)

Height correction should be made using
the table and chart below.

Example: Overall height of 2.74"(69mm),
select correction curve "B". Stabilometer
value uncorrected = 35
Stabilometer value corrected = 38.

Overall Specimen Ht.	Correction Curve
2.80" to 3.00"(71mm to 76mm)	A
2.60" to 2.79"(66mm to 70mm)	B
2.40" to 2.59"(61mm to 65mm)	C
2.20" to 2.39"(56mm to 60mm)	D
2.00" to 2.19"(51mm to 55mm)	E

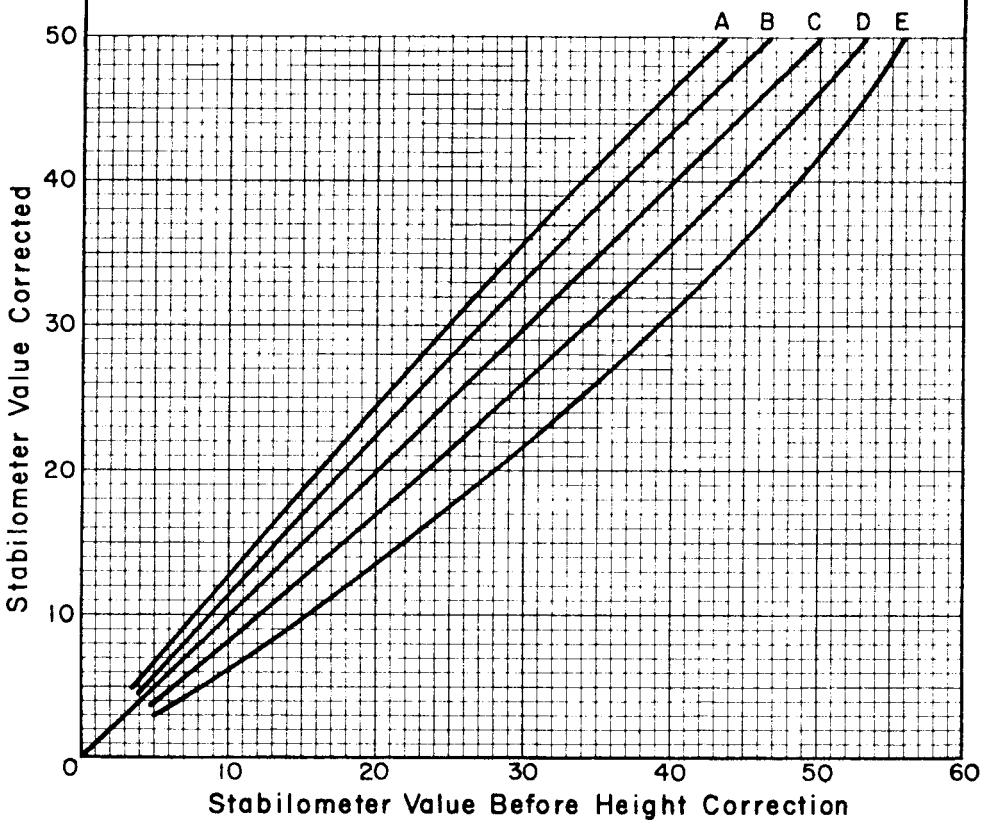


FIG. 7 Chart for Correcting Stabilometer Values to Specimen Height of 2.5 in. [64 mm]

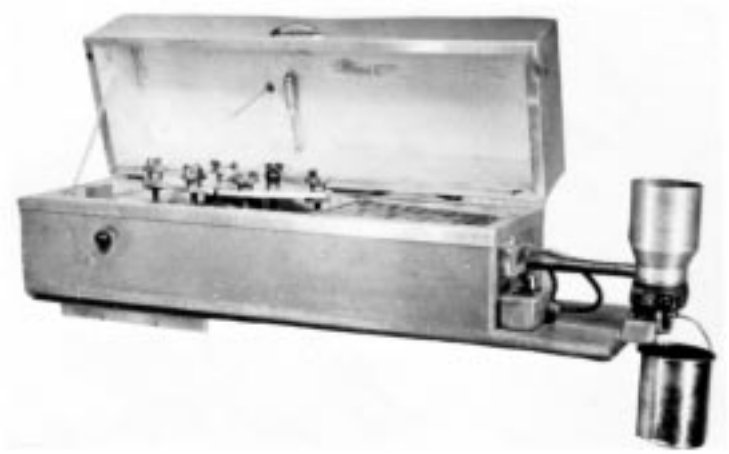


FIG. 8 Hveem Cohesiometer

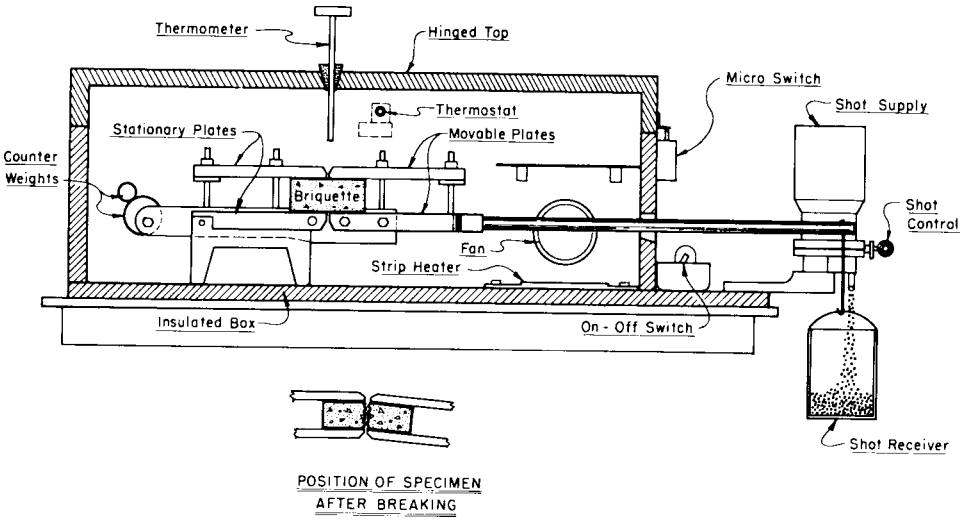


FIG. 9 Detailed Drawing of the Hveem Cohesiometer