DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
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METHOD OF TEST FOR SURFACE ABRASION OF COMPACTED BITUMINOUS MIXTURES

A. SCOPE

The surface abrasion test measures the ability of a compacted bituminous mixture to resist surface abrasion or raveling in the presence of water.

B. REFERENCES

CT 304	METHOD OF TEST FOR PREPARATION OF HMA FOR TEST SPECIMENS
CT 308	METHOD OF TEST FOR DETERMINING BULK SPECIFIC GRAVITY AND DENSITY OF COMPACTED HOT MIX ASPHAL

C. PRECAUTIONS

The mass of the steel balls will change with usage. Periodically weigh each ball and discard those not within the specified tolerance. Routinely check the mechanical shaker for compliance to the stroke and frequency requirements.

D. APPARATUS

1. An oven capable of maintaining temperatures up to 110 ± 3°C.
2. A mechanical shaker, with attachments to contain the mold and sample, having a 25 ± 3 mm vertical stroke, and able to operate at 20 ± 0.2 Hz. See Figure 1.
3. Eight steel balls. Each ball shall have a mass of 4.5 ± 0.3 g and an approximate diameter of 10.3 mm.
4. Rubber gaskets having an outside diameter of 101 ± 0.6 mm, an inside diameter of 82.6 ± 0.6 mm and approximately 1.6 mm thick.
5. A steel surface abrasion test mold assembly having a diameter of 101.6 ± 0.13 mm, a height of 127 ± 0.3 mm, and a built-in shoulder that provides a constant "bounce" space of 76.2 ± 3.2 mm. See Figures 2 through 6.

6. A base assembly fixture which will hold the mold during base installation and removal. See Figure 5.
7. A graduated cylinder having a capacity of 250 mL.
8. Circular aluminum pans having a nominal diameter of 190 mm and a depth of 63.5 mm.
9. A polyethlylene wash bottle having a minimum capacity of 500 mL.
10. A balance having a capacity of 4500 g and a sensitivity of 0.1 g.
11. A compactor assembly including the following: a compactor, steel molds, a mold holder, cardboard discs, a testing machine, a follower ram, a mechanical spader or feeding trough, a flat metal scoop, a 12.5-mm sieve and a height measuring device as described in California Test 304.

E. MIXING AND FABRICATION

Batch four 1-kg samples as follows:

1. Mix and cure the asphalt and aggregate in accordance with California Test 304, Part 1.
2. Bring the mixture to a temperature of 110 ± 3°C for compaction.
   NOTE: If a liquid asphalt is used, bring the mixture to a temperature of 60 ± 3°C prior to compaction
3. Place a mold, preheated to the compaction temperature, in the mold holder. Position the mold assembly in the mechanical spader. Place a 6-mm thick shim under the mold adjacent to the base portion of the mold holder that extends up into the mold. Place a 100-mm diameter cardboard disc on top of the mold holder base.
   NOTE: In lieu of using a mechanical spader in Section C-3, hand spading may be used as described in California Test 304, Part 2.
4. Weigh 1000 g of mixture as a pilot sample to determine the quantity of material needed to achieve the required specimen height.
5. Separate the mixture by screening the fine material through a 12.5-mm sieve onto a flat metal scoop.
6. Arrange the separated material into two parallel rows across the width of the scoop.
7. Place the mix on the feeder belt of the mechanical spader, exercising care to not disrupt the size arrangement from the previous step.
8. Start the mechanical spader and continue until all the material has been distributed into the compaction mold.
9. Place the mold holder, containing the mix and the mold, into position in the mechanical compactor.

10. Apply 100 tamps at 2.41 MPa using the procedure described in California Test 304, Part 2.
11. Remove the mold and specimen from the holder and place them on the press.
12. Apply a leveling-off load of 56 kN at a rate of 6.4 ± 0.05 mm/min. When this is achieved, release the load immediately.
    NOTE: If the testing machine has a spherically seated upper head, use proper shims to lock the device in place. Make sure the contact face is firmly positioned in a horizontal plane.
13. Measure and record the height of the test specimen to the nearest 0.1 mm, and calculate the mass necessary to achieve a 50.8 ± 3-mm high specimen.
14. Eject the test specimen from the mold, allow it to cool to room temperature, and determine the specific gravity as described in California Test 308, Method B.
15. Prepare the remaining three specimens for testing as follows:
    a. Using the mass established in Section C-13, prepare and compact the mix according to Sections C-5 through C-12.
    b. Let the compacted specimen remain at 25 ± 2°C for a minimum of 1 h prior to the soaking period.
    c. Place the mold in an aluminum pan and pour 500 mL of water on the specimen. Allow the items to stand undisturbed at room temperature 25 ± 2°C for 16 ± 1 h.

F. TEST PROCEDURE

1. After the soaking period, pour off and save the water and remove the specimen from the mold.
2. Invert the abrasion test mold and place the rubber gasket against the build-in shoulder.
3. Insert the bottom of the specimen against the rubber ring so that it will be abraded.
4. Screw the base on the bottom of the mold to firmly hold the specimen, then place the mold in an upright position.
5. Pour 250 mL of the retained water on the specimen.
6. Place eight clean steel balls in the mold assembly.
7. Fasten the mold in place on the mechanical shaker.
8. Shake the sample at 20 ± 0.2 Hz for 15 min ± 5 s at 25 ± 2°C, then remove it from the mechanical shaker.

9. Remove the steel balls and pour the contents from the testing mold into a tared aluminum pan. Using the wash bottle, wash all loosened fines into the dry, clean pan.
10. After 1 h, decant as much of the clear water as possible.
11. Place the pan in an oven at 110 ± 3°C and dry the contents to a constant mass.
12. Weigh the pan with the abraded material, subtract the pan tare and record the difference as grams of abrasion loss.
13. Repeat Sections D-1 through D-12 for the remaining test specimens. Average the results of the three tests.

G. CALCULATIONS

$$\text{Reported Loss} = \left[\frac{\text{L}}{5270\ \text{mm2}}\right]$$

Where: L = Average abrasion loss of three tests

H. REPORTING OF RESULTS

Report the abrasion loss to the nearest 1 g/mm^2 and L to the nearest 1 g. See Section D-13

I. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Personnel should use heat resistant gloves when working with hot materials. Use proper lifting techniques when handling bags of aggregate. Reasonable care should be exercised to avoid being burned by hot asphalt, aggregate or equipment.

Caution must be exercised in the operation of the compactor to prevent any object, other than the sample itself, from interceding between the compactor foot and the mold at any time while the ram is in motion. The clearance between the edge of the mold and the compactor foot is approximately 2 mm. The applied shearing force on the test specimen could cause severe injury to body extremities or damage to equipment.

Caution should be exercised in the operation of the press to keep any objects other than the sample and testing apparatus clear of the loading head during the testing operation.

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. Requirements for proper safety equipment and disposal of solvents are discussed in the above-noted references. Users of this method do so at their own risk.

Refer to the Safety Manual for your Laboratory.

References:
California Tests 304 and 308
(California Test 360 contains 11 pages)

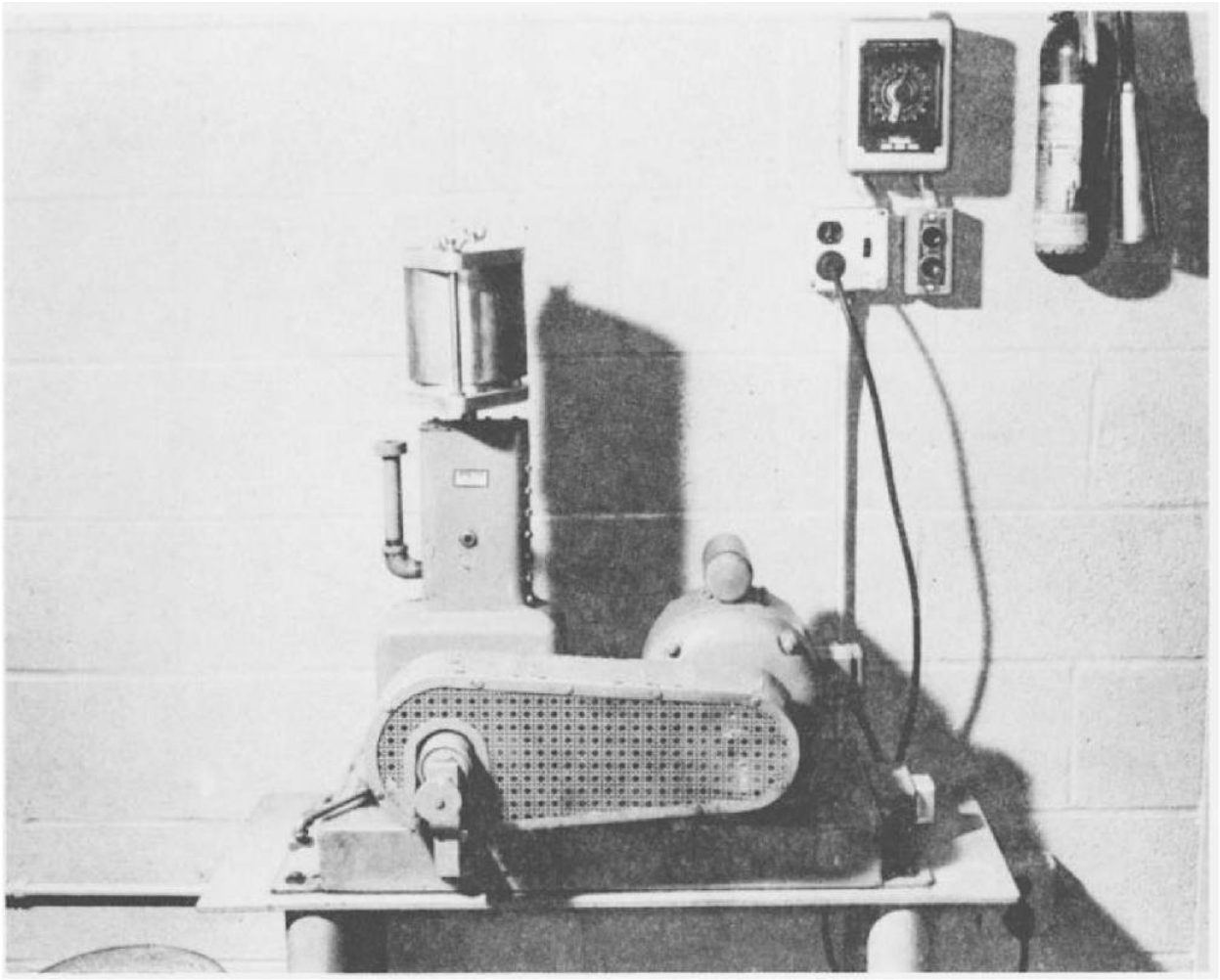
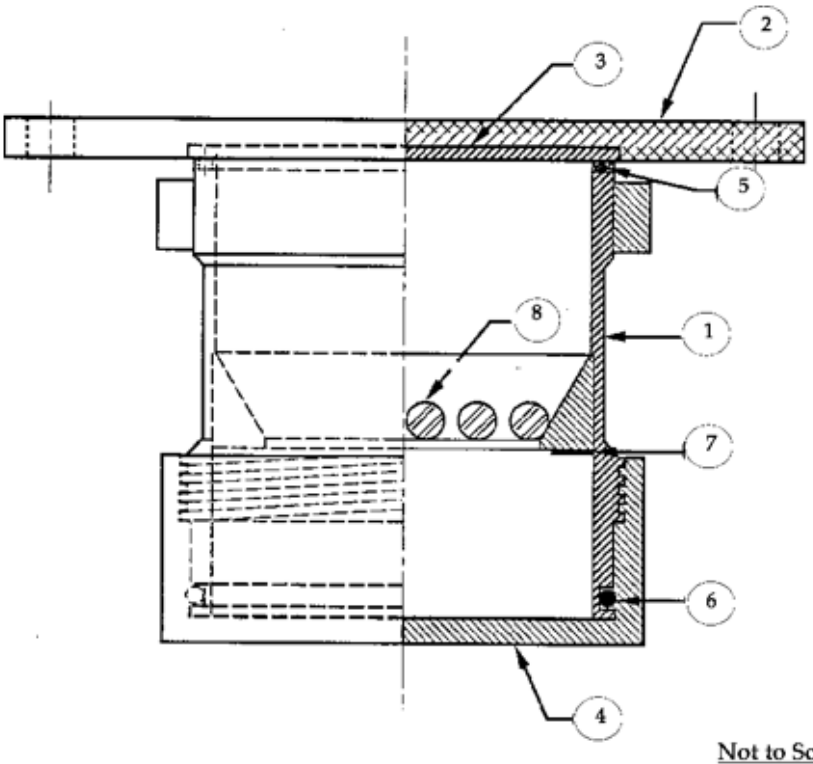


FIGURE 1. MECHANICAL SHAKER



Not to Scale

ASSEMBLY SECTION

LIST OF MATERIALS

No. Required	Part No.	Description	Material
1	1	Body	Nickel Plated Steel
1	2	Cover	Aluminum
1	3	Wear Plate	Neoprene, Type A Shore Durometer 60 ± 5, 114 mm Dia., 3.2 mm Thick
1	4	Base	Nickel Plated Steel
1	5	"O" Ring	Neoprene 104 mm ID by 110.4 mm OD by 3.2 mm Dia. (Fabricated)
1	6	"O" Ring	Neoprene 104.8 mm ID by 114.3 mm OD by 4.8 mm Dia.
1	7	Gasket	Neoprene, Type A Shore Durometer 60 ± 5 mm
8	8	Ball Bearing	Steel 10.3 mm, 4.5 ± 0.3 g

FIGURE 2. ABRASION TEST MOLD

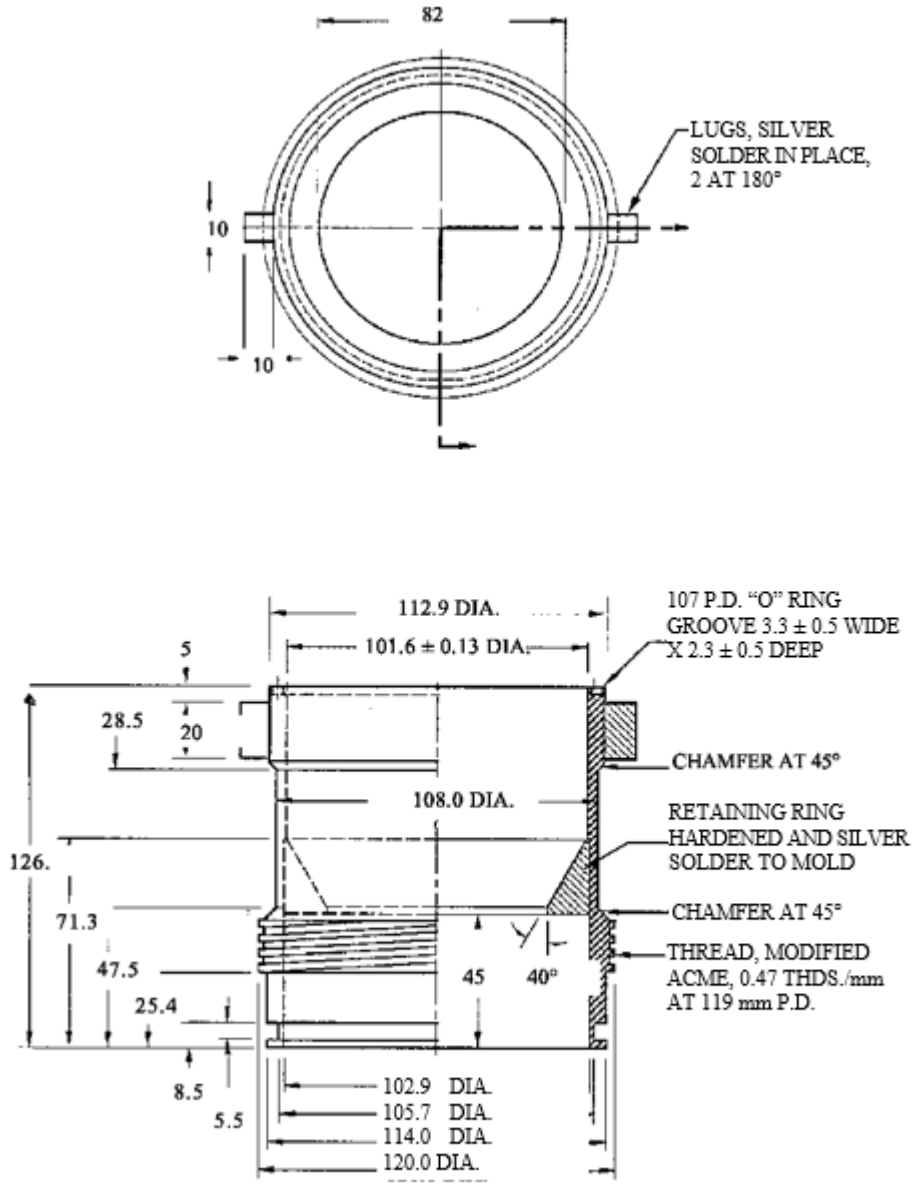
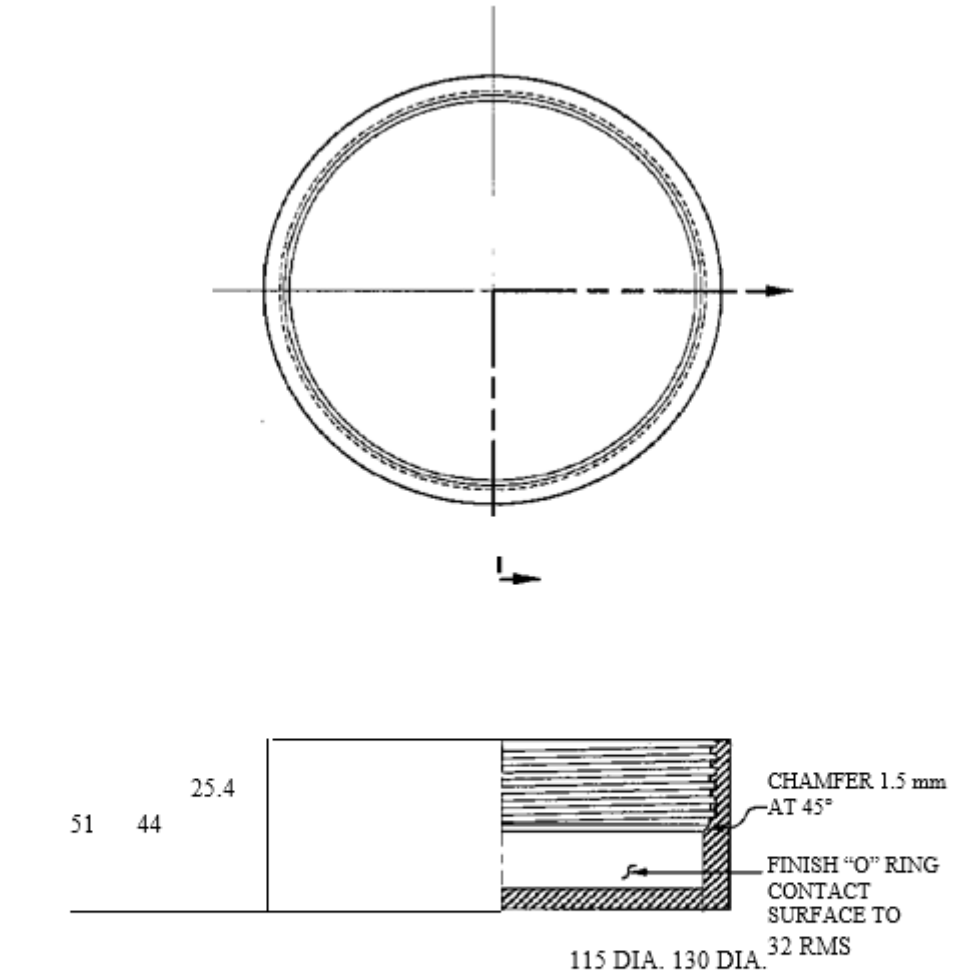


FIGURE 3. BODY



NOTE: All dimensions within
± 2 mm, unless otherwise stated.

FIGURE 4. BASE

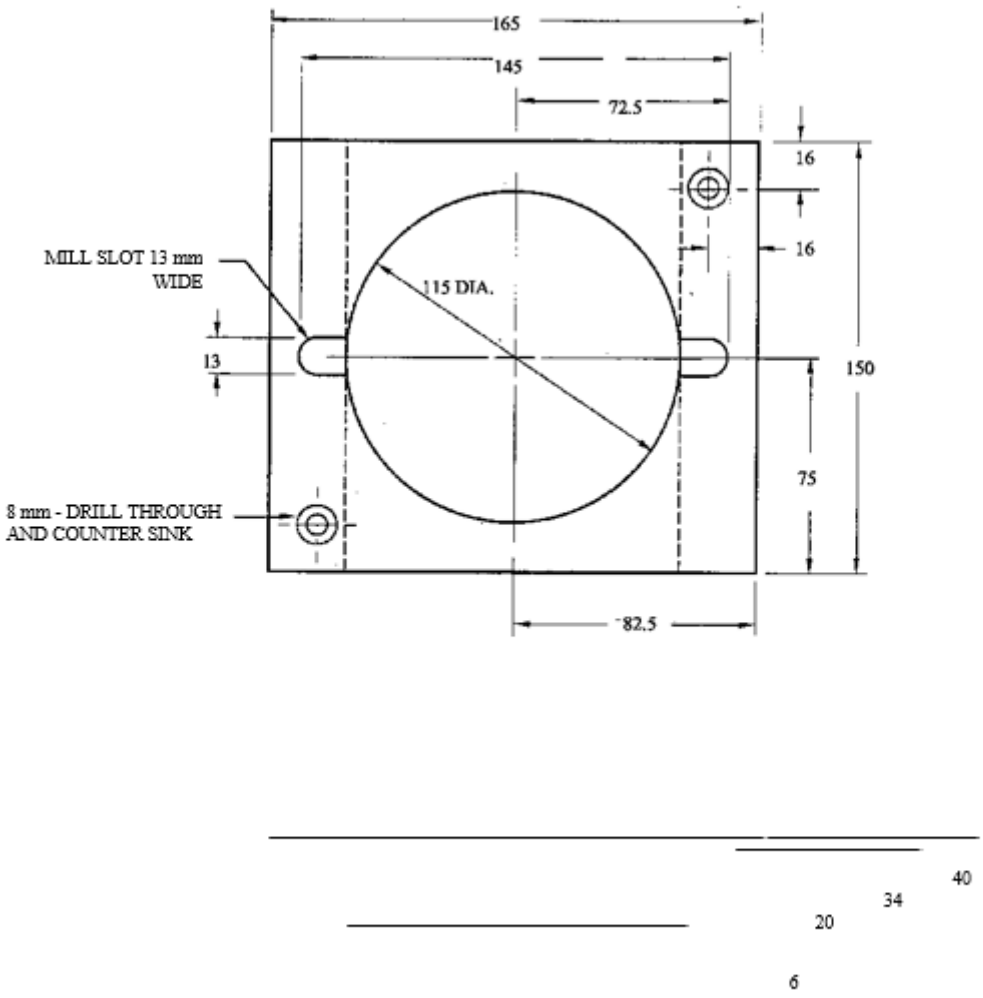


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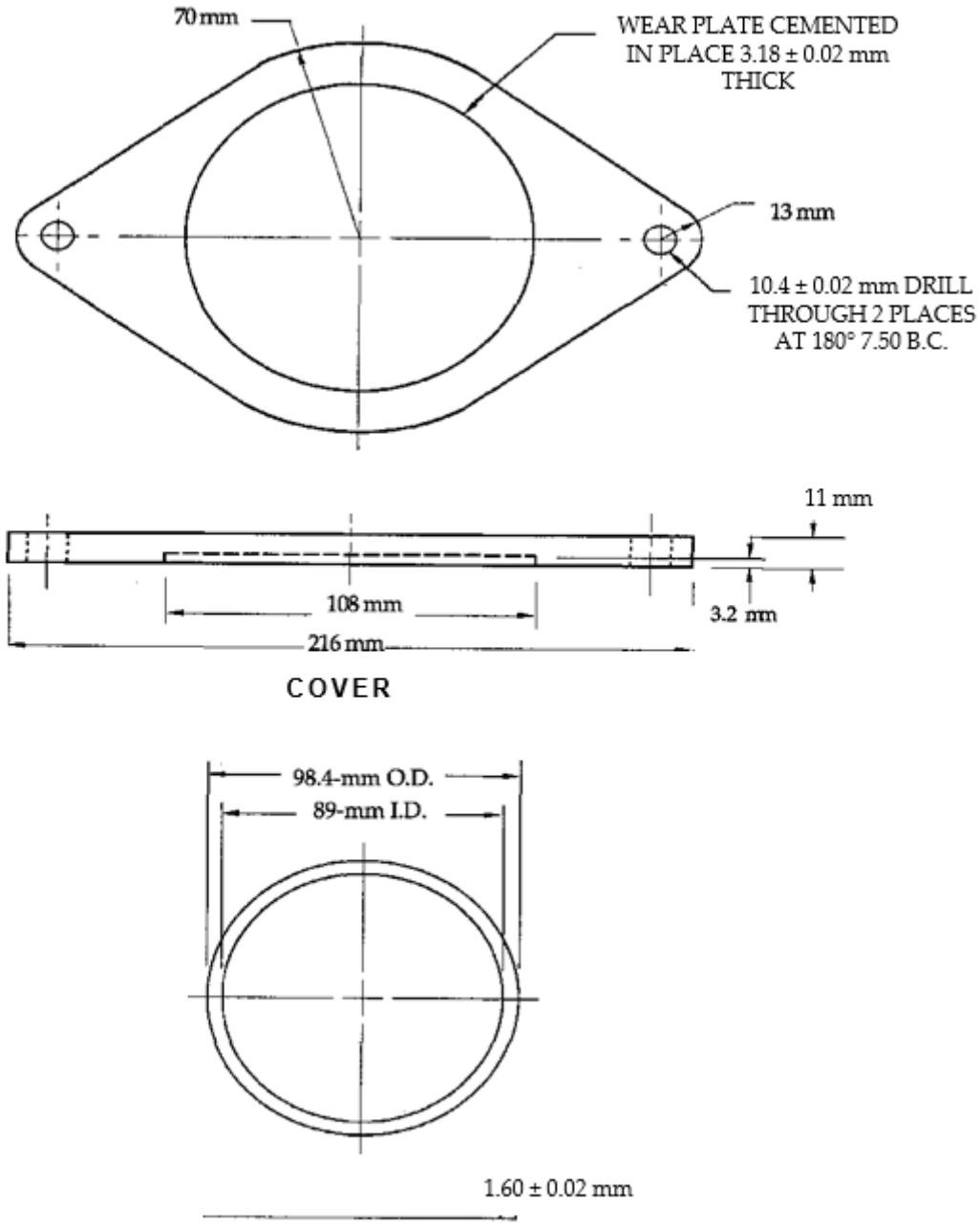
FIGURE 5. BASE ASSEMPLY FIXTURE



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± 2 mm, unless otherwise stated.

FIGURE 6. GASKET