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ENGINEERING SERVICE CENTER
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METHOD OF TEST FOR EVALUATING EPOXY RESIN SYSTEMS AT LOW TEMPERATURES BY FLEXURAL-CREEP MEASUREMENTS

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 procedure used for evaluating epoxy resin systems on the basis of flexibility and creep of 25 by 25 by 285 mm beam-type specimens under a mid-span loading, at low temperatures, is described in this test method.

B. APPARATUS (See Figures 1 and 2)

1. Test Stand: The test stand shall provide two supports for the test specimen. One of the supports shall be fixed and the other shall be a roller. The clear span between supports shall be 254 mm (see Figures 1 and 2). The radius of the upper portion of the fixed support and the radius of the roller shall be 8 mm. A dial indicator shall be firmly mounted so that the stem of the dial indicator is midway between the specimen supports, and at the center of the test specimen in a transverse direction. A hole shall be provided through the base at mid-span to accommodate the hook assembly.
2. Hook Assembly: A hook assembly for applying the load at the midpoint of the specimen shall have a smooth upper bearing surface to accept the spindle of the dial indicator, and a hole in the lower end for attaching the loading mass. The rounded surface in contact with the specimen shall have a radius of 10 mm.
3. Loading Mass: A total mass of 3.00 kg (including the mass of the hook assembly) shall be used to

apply the load to the specimen. (The mass creates a flexural stress of approximately 0.71 MPa in the outer-most fiber of a specimen having a cross-sectional area of 625 mm².)

4. Dial Indicator: A dial indicator with 0.0025 mm or smaller units and a 5 mm range, shall be used to measure deflections at mid-span of the specimen. (An alternate digital or electronic indicator of the same precision is acceptable.)
5. Molds for Fabricating Test Specimens: Use steel molds similar to those used in ASTM Designation: C 151, "Autoclave Expansion of Portland Cement," for fabricating 25 by 25 by 285 mm test specimens. If gauge pins are not used, cover or plug the holes in the steel end plates.
6. Freezer: The freezer shall have a refrigeration system capable of maintaining a controlled temperature range of -19°C to -21°C.

C. PREPARATION OF SPECIMENS

1. Test Mix:
 - a. Use epoxy resin materials being investigated.
 - b. Mix epoxy resin binder components according to instructions.
 - c. Fabricate two 25 by 25 by 285 mm bars from each epoxy resin mix being tested.

2. Curing:

Cure all specimens at $24 \pm 3^\circ\text{C}$ for at least seven days prior to beginning the test procedure.
3. Trimming of Specimen:

If there are any rough edges remove them from bearing surfaces of specimen by means of a fine rasp or by sanding.

D. TEST PROCEDURE

1. At least 24 h before starting the test, place each deflection apparatus in the freezer having a controlled temperature range of -19°C to -21°C .
2. Also place the cured test bars in the freezer at least 24 h prior to testing.
3. To start the cold temperature testing, place each bar in a deflection apparatus while cold and still in the freezer, being careful not to handle the specimens any more than necessary. Specimens shall be so oriented that the upper surface as cast, is vertical during the test. Center each test specimen over the supports and under the spindle of the dial indicator.
4. Position the hook assembly to bear on the bar at the mid-span and center the spindle of the dial indicator to bear on its top surface.
5. Record the reading on the dial indicator.
6. Place the hook end of the loading mass through the hole in the hook assembly. Allow the mass to hang freely. Wait 10 s, then record the dial reading. The difference in readings is recorded as "initial deflection." (See Figure 2 showing weight in place.)
7. Record dial readings every 24 h for 7 days. (Weekend readings may be omitted provided at least 24- and 48-h readings have been made.)

E. CALCULATIONS

Calculate the creep at each time interval.

$$C_i = \delta_i - \delta_0$$

Where:

δ_0 = initial deflection

δ_i = deflection at time i

i = time interval under consideration

F. REPORTING OF RESULTS

Report initial deflection and creep of the test specimens to the nearest 0.0025 mm, as an average of the total movement, of the two test bars at the following time intervals after the 3.00 kg mass is applied at the mid-span:

1. Initial deflection, 10 s after loading.
2. Creep at 1, 2, 4 and 7 days.

G. PRECAUTIONS

Perform this test in a cold room or freezer at -19°C to -21°C and in a location that is free from vibration and sheltered from warm air currents. Vibrations (and warm currents) tend to increase deflections and give erroneous measurements. Prolonged handling of the test specimens when placing them in the test stand tends to raise their temperature and should be avoided.

H. 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.

REFERENCES:

ASTM Designation: C 151

California Department of Transportation Standard Specifications

End of Text (California Test 419 contains 3 Pages)

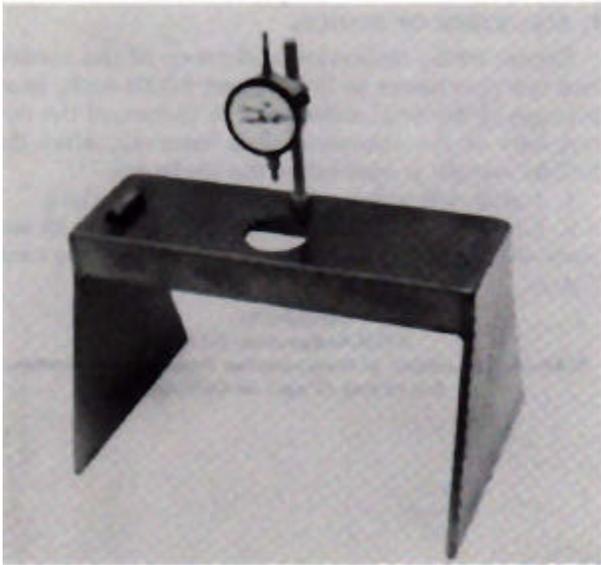


FIGURE 1

DEFLECTION APPARATUS

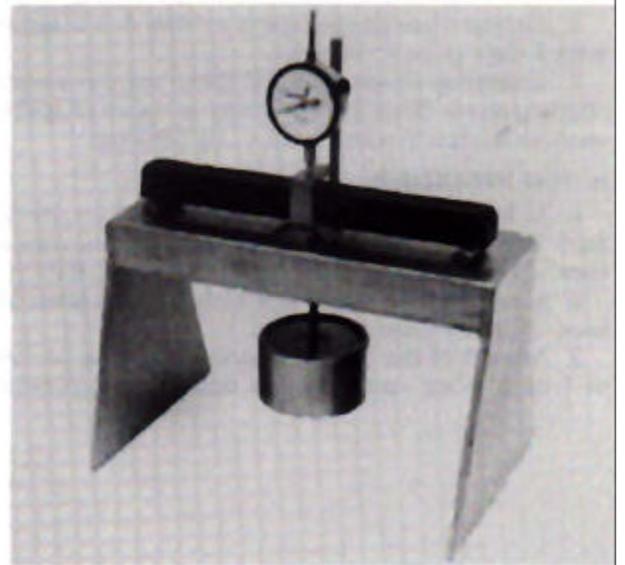


FIGURE 2