

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, California 95819-4612



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

A. SCOPE

The procedure used for evaluating epoxy resin systems on the basis of flexibility and creep of 1 in. × 1 in. × 11¼ in. beam-type specimens under a mid-span loading, at low temperatures, is described in this test method.

B. REFERENCES

ASTM C 151/C 151M - Autoclave Expansion of Hydraulic Cement

C. 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 10 in. (See Figures 1 and 2). The radius of the upper portion of the fixed support and the radius of the roller shall be ¼ in. 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 ⅜ in.
3. **Loading Mass:** A total weight of 6.67 lb (including the weight of the hook assembly) shall be used to apply the load to the specimen. (The weight creates a flexural stress of approximately 100 psi in the outer-most fiber of a specimen having a cross-sectional area of 1 in².)
4. **Dial Indicator:** A dial indicator with 0.0001 in. or smaller units and a 0.20 in. 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 C 151/C 151M for fabricating 1 in. × 1 in. × 11¼ in. 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 -2 to -6°F.

D. 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 1 in. × 1 in. × 11¼ in. bars from each epoxy resin mix being tested.
2. Curing:

Cure all specimens at 75°F ± 5°F for at least 7 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.

E. TEST PROCEDURE

1. At least 24 hr before starting the test, place each deflection apparatus in the freezer having a controlled temperature range of -2 to -6°F.
2. Also place the cured test bars in the freezer at least 24 hr 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 weight 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 hr for 7 d. (Weekend readings may be omitted provided at least 24 hr and 48 hr readings have been made.)

F. CALCULATIONS

Calculate the creep at each time interval:

$$C_i = \delta_i - \delta_o$$

Where:

δ_0 = initial deflection

δ_i = deflection at time i

i = time interval under consideration

G. REPORTING OF RESULTS

Report initial deflection and creep of the test specimens to the nearest 0.0001 in., as an average of the total movement, of the two test bars at the following time intervals after the 6.67 lb weight is applied at the mid-span:

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

H. PRECAUTIONS

Perform this test in a cold room or freezer at -2 to -6°F 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.

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.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

End of Text
(California Test 419 contains 4 Pages)

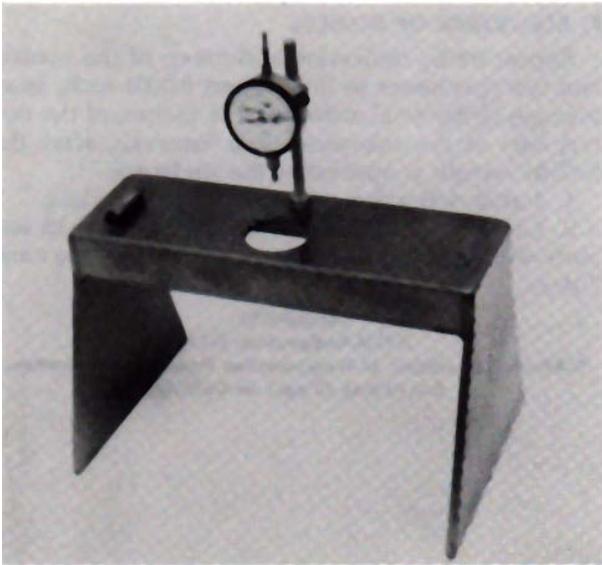


FIGURE 1. Deflection Apparatus

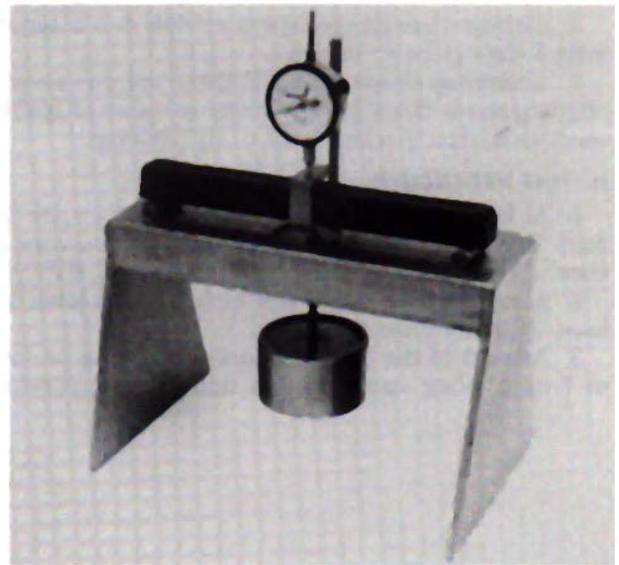


FIGURE 2.