Designation: C 394 – 00

Standard Test Method for Shear Fatigue of Sandwich Core Materials[1]

This standard is issued under the fixed designation C 394; 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 This test method covers determination of the effect of repeated shear loads on sandwich core materials.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given may be approximate.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 273 Test Method for Shear Properties of Sandwich Core Materials[2]

E 4 Practices for Force Verification of Testing Machines[3]

3. Significance and Use

3.1 Usually the most critical stress to which a sandwich panel core is subjected is shear. The effect of repeated shear stresses on the core material can be very important.

3.2 These test methods provide a standard method of obtaining the sandwich core shear fatigue properties.

4. Apparatus

4.1 *Fatigue Testing Machine*, any standard constant load fatigue testing machine capable of applying a direct stress to the specimen and equipped with a counter. The load measuring system used shall have an accuracy of ±1 % of the indicated value. The accuracy of the test machine shall be verified in accordance with Practices E 4.

4.2 *Testing Machine*, any standard universal testing machine capable of operation at a constant rate of motion of the cross-head. The load measuring system used shall have an accuracy of ±1 % of the indicated value. The accuracy of the test machine shall be verified in accordance with Practices E 4.

4.3 *Test Fixtures*, test fixtures similar to those described in Test Method C 273.

4.4 *Micrometer, Gage, or Caliper*, capable of measuring accurately to 0.025 mm (0.001 in.).

5. Test Specimens

5.1 The test specimens shall be similar to those described in Test Method C 273, except that the core material shall be bonded directly to the fixture plates. The dimensions of the specimen shall be such that the line of load action passes through the diagonally opposite corners of the core material.

5.2 The number of test specimens and the method of their selection depend on the purpose of the particular test under consideration. It is recommended that at least five specimens are used for static control tests, and three specimens for each stress level to be tested. For establishment of an S-N curve of stress versus number of cycles to failure, test at least three stress levels.

6. Conditioning

6.1 When the physical properties of the component materials are affected by moisture, bring the test specimens to constant weight (±1 %) before testing, preferably in a conditioning room having temperature and humidity control. Conduct the tests under the same temperature and humidity conditions. A temperature of 23 ± 3°C (73 ± 5°F) and a relative humidity of 50 ± 5 % are recommended as standard conditions.

7. Procedure

7.1 The length and width dimensions of the specimen shall be measured to the nearest 0.25 mm (0.01 in.) and the thickness dimension to the nearest 0.025 mm (0.001 in.). Weight the specimen to the nearest 0.1 g and calculate the specimen density.

7.2 Before the fatigue tests, test a minimum of five control specimens statically in a standard test machine in accordance with Test Method C 273. Use the average of the five specimens as the 100 % level for the fatigue tests.

7.3 The stress levels to be tested shall be agreed upon by the purchaser and the seller, or other parties involved. The stress level is defined as the maximum repeated stress to which the specimen is subjected.

7.4 For standard tests, use a stress ratio of minimum to maximum load of 0.10, unless agreed upon previously by the parties involved. Apply the mean load (50 % of difference between maximum and minimum) through the preloading

[1] This specification is under the jurisdiction of ASTM Committee D-30 on Composite Materials and is the direct responsibility of Subcommittee D30.09 on Sandwich Construction.

Current edition approved Jan. 10, 2000. Published April 2000. Originally published as C 394 – 57 T. Last previous edition C 394 – 94 .

[2] *Annual Book of ASTM Standards*, Vol 15.03.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

mechanism and the dynamic load (the remaining 50 %) through the dynamic loading mechanism.

7.5 After testing has begun, check the loading frequently unless the test machine is equipped with automatic load maintainers. Also check the specimen's temperature to be sure that the loading rate is not heating the specimen more than 3°C (5°F).

7.6 Record the maximum load and number of cycles to failure.

7.7 Specimens that have core-to-plate adhesive adhesion bond failures or adhesive cohesive failures are not valid and shall be retested.

8. Calculation

8.1 Calculate the core shear stress in accordance with Test Method C 273.

$$\tau = \frac{P}{Pb} \quad (1)$$

where:

τ = core shear stress, MPa (psi);
P = load on specimen, N (lb);
L = length of specimen, mm (in.); and
b = width of specimen, mm (in.).

9. Report

9.1 The report shall include the following:

9.1.1 Description of test specimens; core material, adhesive,

9.1.2 Dimensions and densities of the test specimens, core orientation,

9.1.3 Method of bonding specimens to plates; cure cycle and pressure,

9.1.4 Description of test machines, including loading rate on static control specimen and testing speed (number of cycles per second) on fatigue test specimens and mode of testing (tensile or compressive).

9.1.5 Testing conditions, including temperature and relative humidity.

9.1.6 Maximum load and maximum stress obtained on static control test, and a description of the type of failure.

9.1.7 Stress levels and stress ratio used in fatigue tests.

9.1.8 Number of cycles to failure. If test is stopped at a specified number of cycles without failure occurring, it shall be so noted.

9.1.9 A curve of maximum stress versus number of cycles to failure (S-N curve) shall be plotted.

10. Precision and Bias

10.1 *Precision*—The precision of the procedure in Test Method C 394 for measuring sandwich core material shear fatigue is not available.

10.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in this test method, bias has not been determined.

11. Keywords

11.1 fatigue; sandwich core; shear strength; shear stress