

Submitted for recognition as an American National Standard

FATIGUE TESTING PROCEDURE FOR SUSPENSION-LEAF SPRINGS

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. **Scope**

1.1 Test Material—Only fully processed new springs which are representative of springs intended for the vehicle shall be used for the tests. No complete spring or separate leaf shall be used for more than one test.

2. References—There are no referenced publications specified herein.

3. Report Content—To obtain uniform documentation, every report shall include detailed information on the following points, when applicable:

3.1 Geometry—Overall dimensions, location and dimensions of fracture sections including the location of the fracture initiation point shall be described in writing or by photographs.

3.2 Material and Manufacturing Process—The type of material, as well as essential steps in the manufacturing which may affect the test results, shall be specified. As examples, type of hardening, shot-peening under stress at given level, etc., can be mentioned.

The hardness shall be checked on critical surfaces, and the hardness distribution through the section shall be measured. Shot peen coverage and the microstructure shall be evaluated.

3.3 Fractography—Fracture surfaces shall be shown on photographs and the type of fracture discussed. The extension of fatigue fracture shall be measured and the crack starting points shall be examined.

3.4 Test Result Presentation—The individual test results may be clearly stated. Even noncritical events like cracks in secondary leaves must be recorded.

The results of the fatigue testing of a group of springs should be subjected to statistical analysis. The Weibull distribution is recommended. Also, it is recommended that minimum fatigue performance requirements be specified in terms of B10 life and population slope.

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4. Vertical Loading Methods

4.1 General Directions

4.1.1 EQUIPMENT—The test machine shall be able to maintain the maximum and minimum specified force within $\pm 2\%$. This can be accomplished by force control or control of deflection calibrated against a static force. In the latter case, dynamic and static spring rates must be considered.

4.1.2 CLAMPING—The spring shall be clamped at the center to simulate its installation in the vehicle. The clamping parts and assembly requirements must be specified by the vehicle manufacturer.

The clamping hardware shall be tightened to the torque values specified and verified throughout the test. The bolt torque should be measured and brought up to specification more frequently at the beginning of the test. Measurements are to be taken at 2000, 5000, and 10 000 cycles; then at 10 000 cycle intervals up to 50 000 cycles and every 50 000 cycles until completion of the tests are recommended.

4.1.3 TEST MOUNTINGS—Unless otherwise specified, springs with eyes shall be free to move in the direction of the datum line; springs with slipper ends shall be tested on fixed mountings. The vehicle manufacturer shall specify the mountings on springs with other end configurations.

4.1.4 RATE OF TESTING—Springs shall be cycled at a rate of between 0.5 and 2 Hz. The cyclic rate shall be chosen so that surface temperature on the spring does not exceed 90 °C. Fans may be used to provide cooling air.

4.2 Test Procedure

4.2.1 STATIC LOAD TEST—The spring shall be loaded from zero up to the prescribed maximum deflection and back to zero. It is acceptable to apply the load in steps.

The force shall be measured at the center clamp. The vertical deflection of the spring center shall also be measured. The relation between the force and the deflection during a full cycle may be plotted in a diagram.

4.2.2 FATIGUE TEST—The spring shall be loaded from 1/2 g (g = design load) to maximum load experienced under actual vehicle conditions, typically 2 g.

For validation, six springs for each design, shall be tested to failure or to the number of cycles specified.

Position limit switches shall be placed so that the test is terminated when the spring deflection has increased a prescribed distance (see 5.1).

In the case of a deflection controlled test, the spring rates shall be measured at uniform intervals during the test on at least one specimen in a test batch.

If the spring rate increased more than 5% during the test, the deflection should be corrected to keep the test peak forces constant. Regarding a corresponding decrease, see 5.1. If it is necessary to correct the deflection during the test as shown by the measurement of the spring rate, this shall be recorded and done in the same way, including the number of cycles, for all springs in the batch.

Measure the load at rated load position at 50 000 cycle intervals to determine load loss due to permanent set.

5. Fatigue Failure Criteria

- 5.1 Inability of Spring to Sustain Load**—Normally, this is said to happen when deflection has increased 5 to 10% above the maximum total deflection at the test start or load loss at 50 000 cycles exceeds 5% of the load at test start.
- 5.2 Visible Crack in #1 Leaf or Visible Cracks in More Than Two Supporting Leaves.**

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