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## Dynamic Flex Fatigue Test for SLAB Polyurethane Foam

1. **Scope**—This SAE Recommended Practice describes a laboratory test procedure for evaluating the loss of thickness and the amount of structural breakdown of slab polyurethane foam seating materials. A test specimen is measured for thickness under a specified load and subsequently subjected simultaneously to compressive and shear deformation in a controlled atmosphere. This is accomplished by subjecting the foam to a rolling shearing action under a constant load for a specified number of cycles. Specimen thickness under a constant load is obtained after a 1 h recovery period following dynamic fatigue to determine loss in foam thickness.
2. **References**—There are no referenced publications specified herein.
3. **Items to be Measured**
  - 3.1 Total loss number or the sum of the 1 lb, 25 lb, and 50 lb percent loaded height losses.
  - 3.2 The absolute increase in percent deflection from the 1 lb original load and the 50 lb original and fatigued loads.
4. **Apparatus Required**
  - 4.1 **Constant Load Height Measuring Device**—An apparatus having a flat circular indenter foot, 50 in<sup>2</sup> in area, and a deadweight loaded through a swivel joint (capable of accommodating the angle of the sample) with loads of 1, 25, 50, and 75 lb, shall be mounted over a level horizontal 15 by 15 in platform with 0.25 in holes on 0.75 in center. The distance between the indenter foot and platform shall be variable to compress the sample under test at a speed of 2 in/min for thickness measurements of 8 in/min for preflex conditioning and shall be measured with a gage measuring device. The gage measuring device shall be capable of measuring and recording the loaded height of the test specimen to 0.001 in with a reasonable degree of precision.
  - 4.2 **Constant Load Dynamic Fatigue Apparatus**—Details of the equipment for dynamic fatigue are illustrated in Figure 1.

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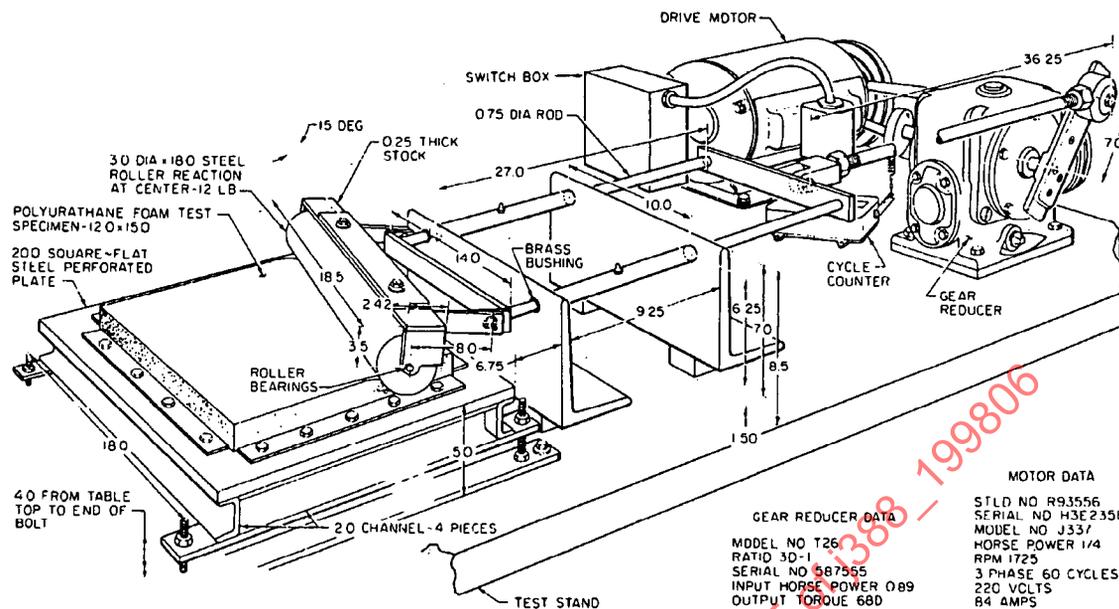


FIGURE 1—FIXTURE FOR POLYURETHANE FOAM FATIGUE TEST

5. **Test Specimens**—Foam samples shall be furnished in a thickness of 2 in ( $\pm 1/8$  in). A test specimen measuring 12 x 15 in ( $\pm 1/8$  in) shall be cut from representative 2 in stock. Length and width dimensions of the samples may be die-cut as long as no edge sticking persists over the time allowed for sample conditioning as outlined in 6.2.
6. **Procedure**
- 6.1 The test apparatus shall consist of the following parts:
- A perforated base platen with 0.25 in diameter holes on 0.75 in centers. Four metal retainer straps capable of holding the sample on the platen during the flex fatigue.
  - A roller 18 in long and 3 in in diameter mounted in an offset position (15 degrees) with suitable means for specified load on the test specimen. The test is conducted at the rate of 20 to 30 cycles/min. One complete cycle shall consist of a forward and a reverse motion of the roller over the test specimen.
  - Motor and gear box for actuating the roller.
  - Counter for recording test cycles.
  - Sturdy table for mounting and support of the entire apparatus.

The foam shall be retained on the base platen as follows: Four 3 in wide pieces of cotton sheeting shall be required—two 14 in long and two 17 in long. Bond the cotton sheeting strips along the edges of one surface of the test specimen with a solvent or water emulsion type of adhesive. Allow 2 in of each strip to extend beyond the edges of the test specimen so that the specimen can be securely clamped to the base platen through the use of suitable metal retainer straps.

- 6.2 Condition the test specimen, undeflected and undistorted at a temperature of  $72\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$  and in an atmosphere of  $50\% \pm 2\%$  relative humidity for at least 24 h prior to testing. All subsequent tests should also be conducted under these temperature and RH conditions. It is recommended that all tests shall be performed 96 h or more after the foam has been manufactured.

- 6.3 Place the test specimen on the supporting plate of the load deflection test apparatus (4.1). The indentations shall always be run in the very center of the test specimens.
- 6.4 Deflect the specimen ten times, using the 75 lb load at the 8 in/min speed. Mark the indentation area with a marking pencil so that subsequent indentations will be performed in exactly the same spot on the foam. Then let the specimen rest undeflected and undistorted for a period of 5 min.
- 6.5 Bring the indenter foot into contact with the test specimen, apply a preload of 1 lb at 2.0 in/min speed. Note the height or thickness of the test specimen. Without moving the sample and within 1 min after preloading, apply and maintain a constant 1, 25, and 50 lb load at the rate of 2.0 in/min in the area previously deflected. Read and record the specimen thickness exactly 1 min after each specific load of 1, 25, and 50 lb is reached.
- 6.6 Adjust the load on the flex fatigue roller to obtain a 30 lb load when the roller pivot arms are perfectly level. Then, mount and secure specimen on flex fatigue base by means of the cotton sheeting and metal retainer straps or other suitable method.

NOTE—See Figures 2 or 3 for proper method of weighing roller assembly.

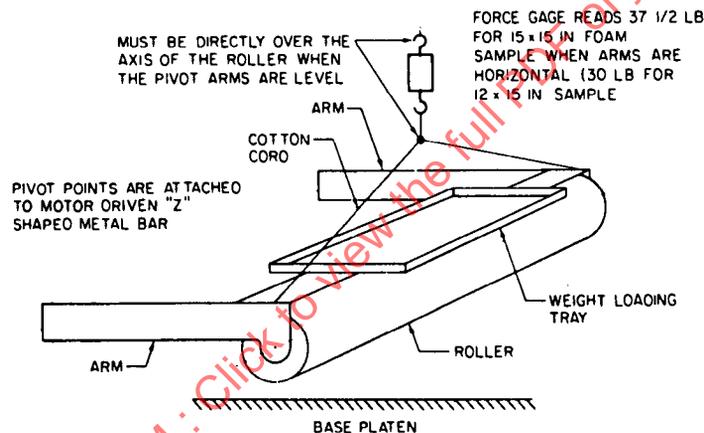


FIGURE 2—METHOD OF WEIGHING ROLLER FOR CONSTANT LOAD FATIGUE OF URETHANE FOAM

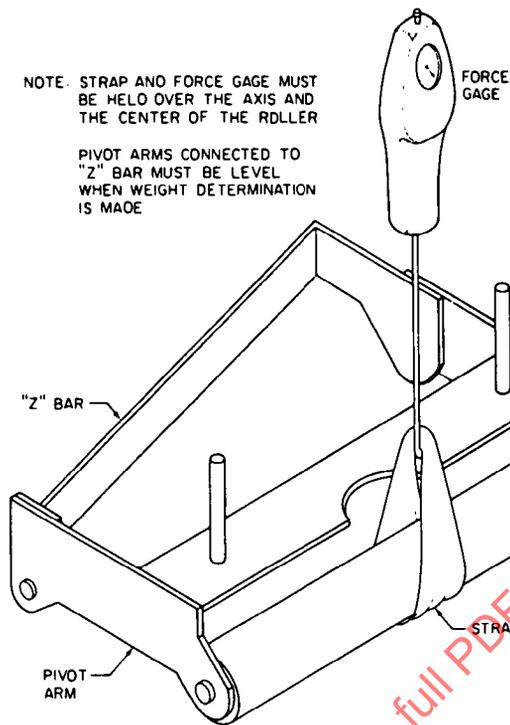


FIGURE 3—ALTERNATE METHOD OF OBTAINING PROPER ROLLER WEIGHT

- 6.7 To insure proper roller-specimen contact, operate machine so roller traverses foam two or three times. Stop machine, rotate drive pulley to position roller in the center of the specimen. Then adjust the height of the base platen (up or down depending on foam stiffness), so that the pivot arms holding the roller are horizontal (using a level positioned on both pivot arms) when the roller is resting on the foam.
- 6.8 Set the counter, start the machine, and flex the sample for the specified number of cycles. Usually 20 000 cycles (40 000 flexes).
- 6.9 After dynamic fatigue, condition the sample at 72 °F ± 5 °F and 50% ± 2% relative humidity for 1 h (+10/−0 min) in an undistorted and undeflected position.
- 6.10 Repeat steps 6.3 through 6.5 of this procedure.
- 6.11 Check the specimen for cellular breakdown visually and by comparison with unflexed samples.

## 7. Calculations

- 7.1 Calculate and report the percent loaded height loss under 1 lb lead as follows in Equation 1:

$$F_T = \frac{T_0 - T_F}{T_0} \times 100 \quad (\text{Eq. 1})$$

where: