NASA TECH BRIEF

NASA Pasadena Office

High-Temperature Gas/Liquid Stress Relaxometers

The problem:

Stress decay of an elastomer is determined by placing a sample into a temperature-controlled oven and subjecting the specimen to a constant strain. After a certain time span, the specimen stretches, or relaxes, under elevated temperatures, and any changes in the applied force are recorded. Unfortunately, the specimen cannot be immersed in various fluids during such tests, because commercial ovens are not designed to be gastight or liquidtight.

The solution:

Two stress relaxometers were developed which allow testing of elastomers in various fluids. The two units differ primarily in the method of application of the strain to the specimen.

How it's done:

One relaxometer, shown in Figure 1, uses a fork-like loading spacer interposed between the loading lever and the support ring, so that the sample is stretched a predetermined amount. An O-ring at the top of the test chamber allows the load-cell rod to move freely yet provides a gastight seal. The rod has a glass-filled Micarta tube at its upper end to minimize the transfer of heat from the oven to the load cell. The test fluid enters and exits through the two ports shown. Alternately, the chamber can be sealed to maintain the test fluid under pressure. Ambient air cools the load cell. The temperatures in the chamber and the oven are

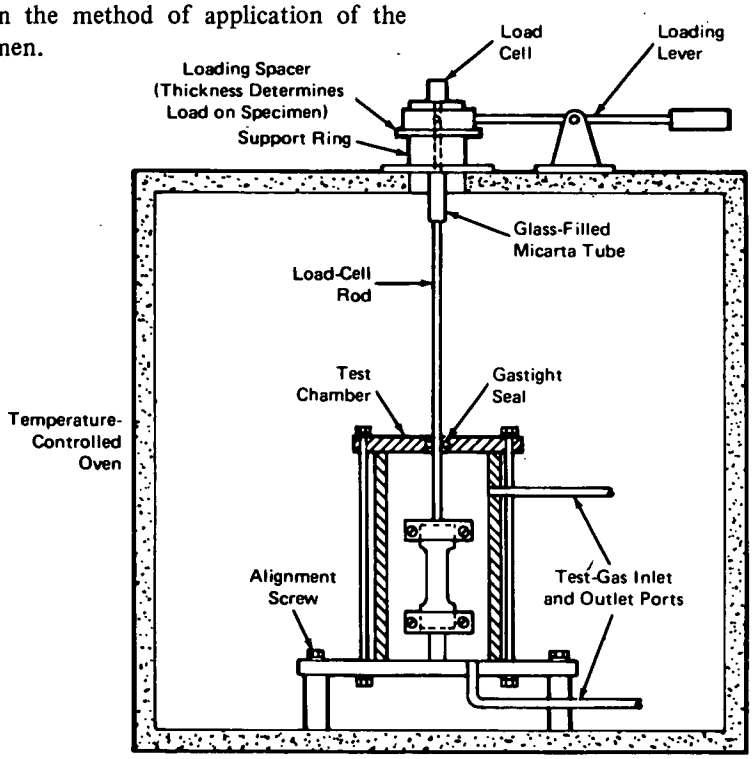

Figure 1. Relaxometer Using The Loading Lever

(continued overleaf)

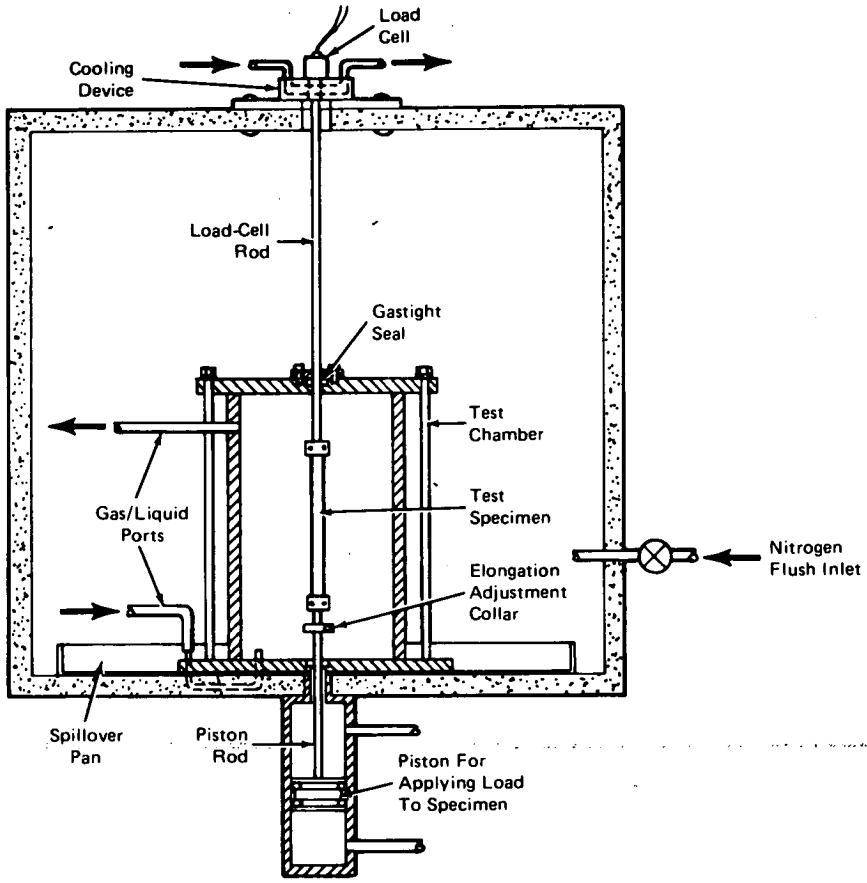

Figure 2. Relaxometer Using a Piston for Applying Load to a Specimen

recorded by the use of thermocouples and strip-chart recorders. The load on the sample is recorded on a separate instrument.

In the other relaxometer, shown in Figure 2, the degree of initial elongation is set by means of an adjustment collar, which, when locked in place on a piston rod, enables the sample to be stretched a predetermined length. At both the top and the bottom of the test chamber, there are O-rings which allow the piston and load-cell rods to move while preserving a gastight seal. The test fluid is introduced through one port and is exhausted through the other. The load cell is maintained at near-ambient temperature by the continuous circulation of water in a cooling device.

In a typical test, (see Figure 2) a tensile specimen is clamped to the upper and lower grips, while the operating cylinder is in the up position. The extension collar then is adjusted for the required elongation. Gas or liquid, as the case may be, is introduced into the chamber. The oven is heated to the required test temperature; during the heatup, the pressure in the test chamber is monitored.

To initiate the relaxation test, the upper volume of the operating cylinder is pressurized, forcing the piston downward and elongating the test specimen to an extension determined previously, by the position of the adjustment collar. The load on the test sample is recorded continuously.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
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Reference: TSP73-10457

Patent status:

NASA has decided not to apply for a patent.

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