Gap Pad® Materials

Application Note #116

Compressive Modulus of Elasticity for Gap Pad Materials

Introduction

The key to determining the suitability of a material to a given application is its response to applied stress. In typical applications, screws and clips induce stress on Gap Pad materials. The moment of assembly is the point at which the material will experience the highest levels of physical stress. An important characteristic of any Gap Pad material is its long-term ability to deflect this stress at low pressures.

The Gap Pad material's ability to deflect stress over time is reflected in the compressive modulus (Young's Modulus) and compression/deflection data. Modulus is a measure of the hardness or softness of a material and is equal to stress divided by strain. Stress is equal to pressure. Strain or deflection is equal to the ratio of the change in thickness to the original thickness of the material. The lower the modulus the softer the material. In most cases, soft gap filling material is desired to minimize pressure exerted on printed circuit boards, component leads and solder joints while the material is being deflected during the assembly process.

Variability in Compressive Modulus Values

Compressive modulus can be measured in various ways yielding different values for the same material, depending on the test method and parameters specified. Compressive modulus can be measured by dynamic and non-dynamic methods. Dynamic or periodic methods measure the complex modulus, which is made up of the storage modulus and the loss modulus. Non-dynamic or transient methods measure the relaxation modulus. Among the transient methods is the constant rate of strain method.

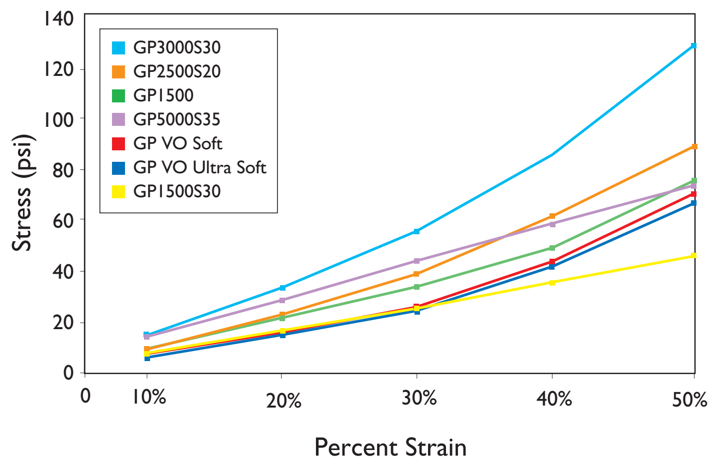
Since Gap Pad is viscoelastic, its modulus is time dependent. This means that the complex modulus varies with the frequency of strain and the relaxation modulus varies with the rate of strain. At high frequencies and rates of strain, the complex modulus and relaxation modulus of Gap Pad will be higher and it will appear harder. At lower frequencies and rates of strain the complex modulus and relaxation modulus of Gap Pad will be lower and it will appear softer. Viscoelastic materials will stress relieve themselves over time, so increasing the measurement time interval in a step strain application test will decrease the modulus measured and the material will appear to be softer.

Constant Rate of Strain Relaxation Modulus

The Constant Rate of Strain Transient Test involves applying an increasing strain at a constant rate while measuring induced stress. This test simulates the deflection of a gap filling material during the course of an assembly process. A design engineer needs to know the constant rate of strain while the product is being assembled (Figure 1). During the Constant Rate of Strain Transient Test the measurement time interval is small and the amount of relaxation of the test material is low. Therefore, it will give the engineer an indication of the maximum stress that will be generated in the application. Here the design engineer needs to remember that by decreasing the rate at which the Gap Pad is deflected during the assembly process, the stress induced in the application can be decreased (Figure 2).

Figure 1: Compression vs. Deflection

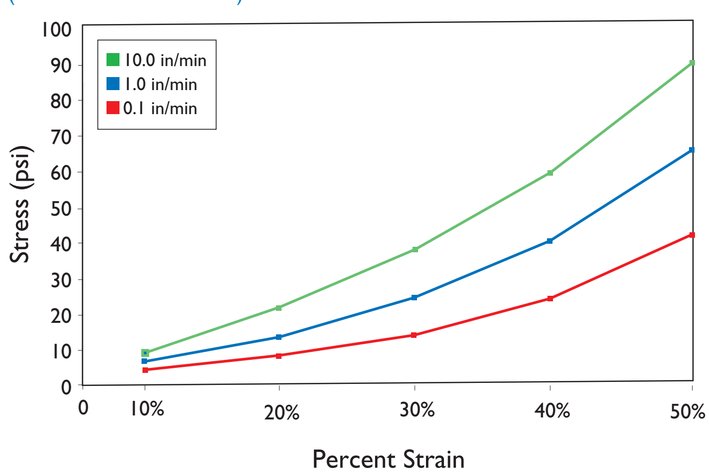
(Constant Rate of Strain 1.0 in/min)



0.5 in (12.7mm) Circular Test Sample.
All materials tested are 125 mil (0.125 in / 3.175mm) thick.

Figure 2: Gap Pad VO Compression vs. Deflection

(3 Constant Rates of Strain)



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