How Hot is Too Hot for Your Seal?

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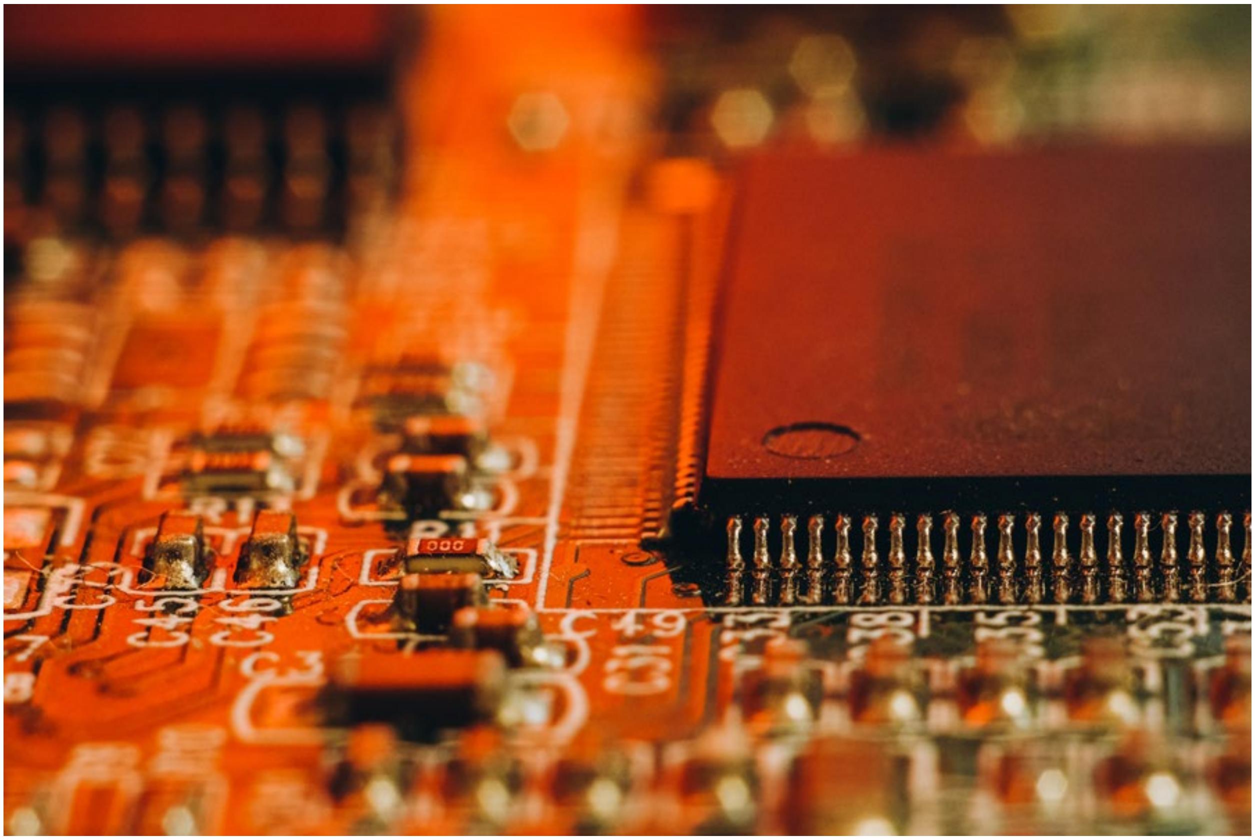
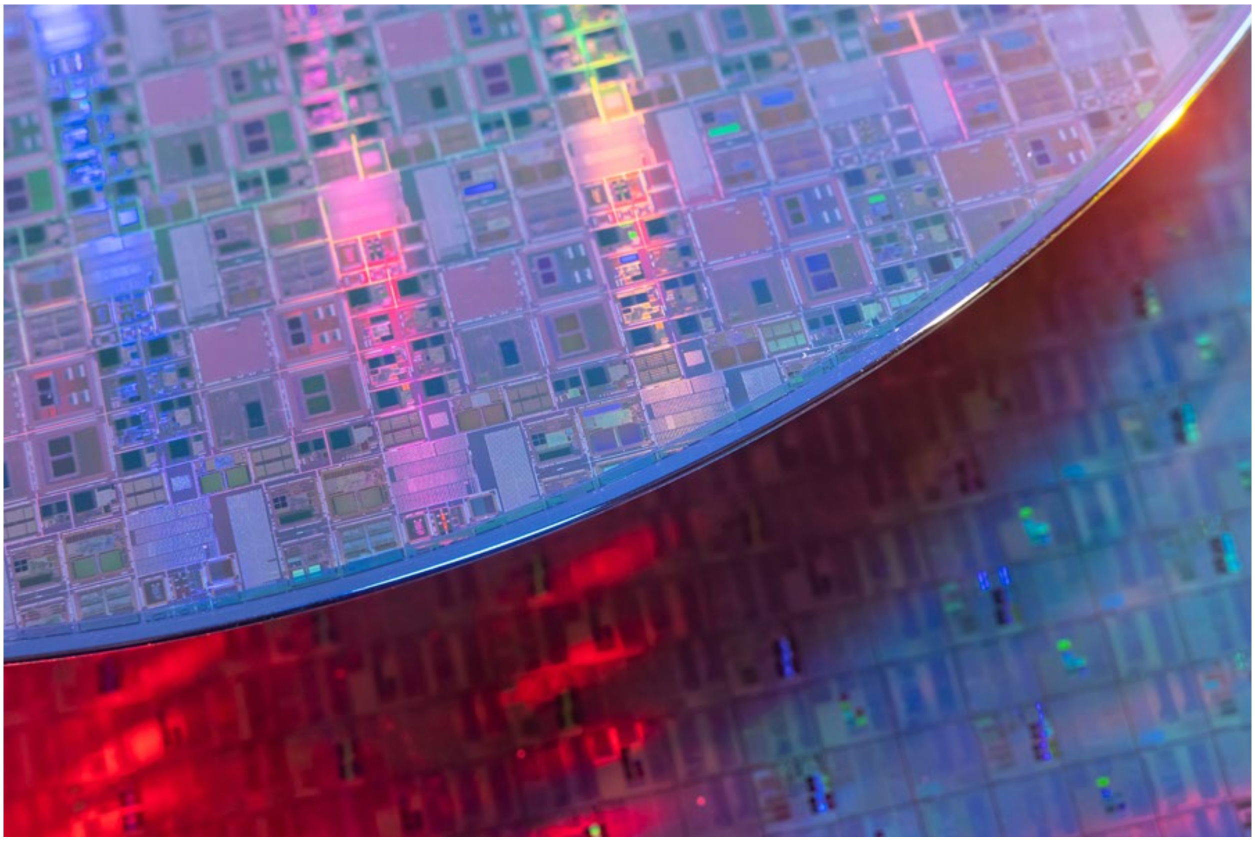
The heat is on! Many process industries, like semiconductor and Chemical processing industries deploy exotic chemistries at elevated temperatures to revolutionize the communications, computing, clean energy, and countless other applications. Indeed, many of the advanced chemistries are only reactive at high temperatures and this places new burdens on components like elastomeric seals to achieve their design intent in these more aggressive environments.



Elastomeric materials such as FKM and FFKM are commonly used in many applications in industries such as semiconductor, oil & gas, and aerospace, with trends pointing toward even higher temperatures in some evolving applications. This raises the question of how to best evaluate an elastomeric material and assess its ability to perform for an adequate lifetime under challenging conditions. The first point to understand is that thermal stability is a combination of time and temperature, which can also be influenced by other factors such as exposure to chemicals or plasma.

One of the most fundamental tests for measuring thermal stability of an elastomeric material is thermogravimetric analysis (TGA), but this method may not provide an adequate representation of seal performance. TGA essentially measures weight change of a material as it is exposed to a temperature ramp or is held at a set temperature for a period of time. When combined with a mass spectrometer, the thermal degradation products can often be identified. While this method is useful for understanding the full thermal degradation process, relating it to longevity of a seal in an application can be challenging.

Compression set is a measure of an elastomer's ability to return to its original thickness after being compressed to a set deflection and held at an elevated temperature for a period of time. High compression set is often associated with poor thermal stability of elastomeric seals considering that the consequence is an associated reduction in sealing force. A common practice for estimating the upper use temperature of a seal material is by conducting long term compression set measurements to 1000 hours or more. Datasets at various temperatures are then used to determine the temperature at which the material will reach an 80 percent compression set at 1000 hours. Other combinations of time and compression set can be chosen based on the specific application.



Compressive stress relaxation (CSR) is a measure of the elastic force provided by the elastomer under a constant deflection over time at a given temperature. This elastic or sealing force can be collected continuously or as the material is aged at given time intervals. If the minimum sealing force to maintain seal integrity for a given application is well understood, an upper use temperature or longevity at a given temperature can be estimated from the CSR measurements. While CSR may be the test most representative of seals in application, there is not as much historical data on elastomers for comparison when compared to compression sets.

It is obvious that understanding the thermal stability and upper use temperature of elastomeric seals is critical for choosing the right materials and predicting longevity.

Greene Tweed formulation scientists, applications engineers and marketing teams have developed and continue to develop Chemraz® and Fusion® elastomer seals to meet the evolving challenges of industry. By collaborating with our customers on their technical problems of today, and the anticipated challenges of tomorrow, we ensure a steady supply of solutions to enable our shared future. Please reach out to a Greene Tweed representative to learn more about how to test your seal's performance.