Cryogenic Thermomechanical Noise

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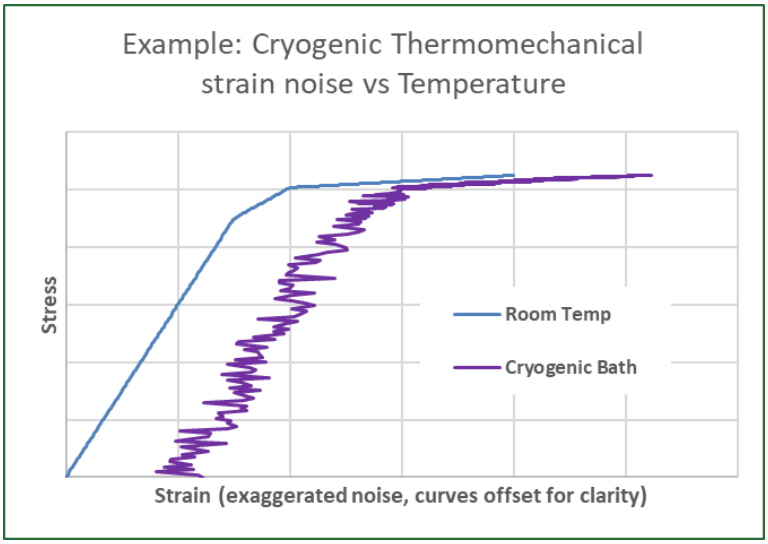
Overview and Root Cause

Thermomechanical noise is a common problem in cryogenic testing applications, when testing with mechanical extensometers submerged in a cryogenic bath; it is typically significant only at the lowest temperatures, *i.e.* in liquid helium. Heat from the strain-gaged extensometer causes mixing turbulence in the bath, adding noise to the strain measurement. In more severe cases, bubbles can form in the cryogen.

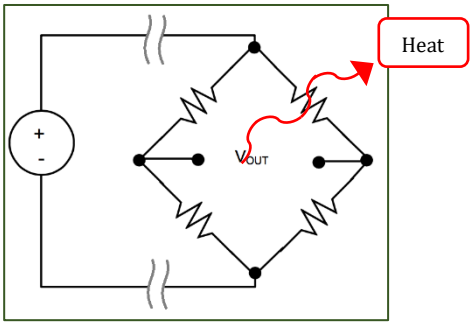
Initial Cooldown

If a liquid cryogen bath is used (rather than an environmental chamber), it will take some time for the system to equilibrate when the cryogen is first introduced to the test area. The extensometer signal may be noisy for a minute or two while it cools off. It is advisable to wait for the system to equilibrate before beginning a test.



Extensometer Self-Heating

If the extensometer signal remains very noisy after thermal equilibrium has been reached, extensometer self-heating may be the root cause. This issue is typically significant only at the lowest temperatures, *i.e.* in liquid helium. The strain gages of the extensometer act as tiny heaters due to the electrical current supplied.



<u>*Resolution: reduce the excitation/supply voltage.*</u> 5-10V excitation is typical for ambient testing. 1-2V excitation might be used for testing in liquid Helium.

The magnitude of thermomechanical noise, in strain units, also generally correlates with the gauge length of the extensometer. *It can be beneficial to select a longer gauge length.*

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