LIGO Coil Spring on Fluorel Seats - Comparison of Baked and Nonbaked Seats

HYTEC, Inc.
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Abstract

This document compares test results for dynamic shear stiffness and damping of LIGO coil springs on two different viscoelastic seats made from the same Fluorel formulation but one set of seats was vacuum baked while the other remained unbaked. Differences in measured properties are insignificant.

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1. Summary

The purpose of this work is to compare vacuum baked and non vacuum baked Fluorel seats in terms of mechanical stiffness and loss factor. A damped coil (DC06) was placed between the respective seats to measure free vibration decay responses in the shear direction (shear direction was selected because it is more affected by seat properties than the axial direction). Loss factor results are nearly identical while the vacuum baked seats show a slight decrease in shear stiffness over the nonbaked seats. Note that a decrease in stiffness from a vacuum baking goes against expectations; for that reason the difference is thought likely due to other experimental factors.

2. Seat Description and Test Procedure

Both sets of viscoelastic seats were fabricated by Molding Solutions using Fluorel formulation 2180 per Hytec Inc. specification[1]. Note that all seats are subject to a post-cure air bake at the manufacturer. The terminology “baked” and “nonbaked” only applies to a subsequent vacuum bake intended to remove the last traces of outgassing materials. The 2180 formulation was recommended by chemists at Dyneon for UHV applications.

A damped coil (DC06) was placed between the respective seats in the pendulum test apparatus[2]. Tests were conducted in the shear direction in a range of frequencies from approximately 0.5 Hz to 1.7 Hz. Each set of seats was tested twice; beginning with the baked seats followed by the nonbaked, then baked, and nonbaked seats. Ambient temperatures during these tests ranged from approximately 20.0 ^{0}C (68.0 ^{0}F) to 20.2 ^{0}C (68.4 ^{0}F).

3. Test Results and Discussion

Figures 1 and 2 present the test results in the form of frequency dependent parameters distinguished by symbols for the baked and nonbaked configurations as delineated by the figure legend. Inspection of curves in Figure 1 reveals very small differences in loss factor measured data comparing the two seat configurations (the ordinate scale is changed from the left plot to the plot on the right to show more resolution).

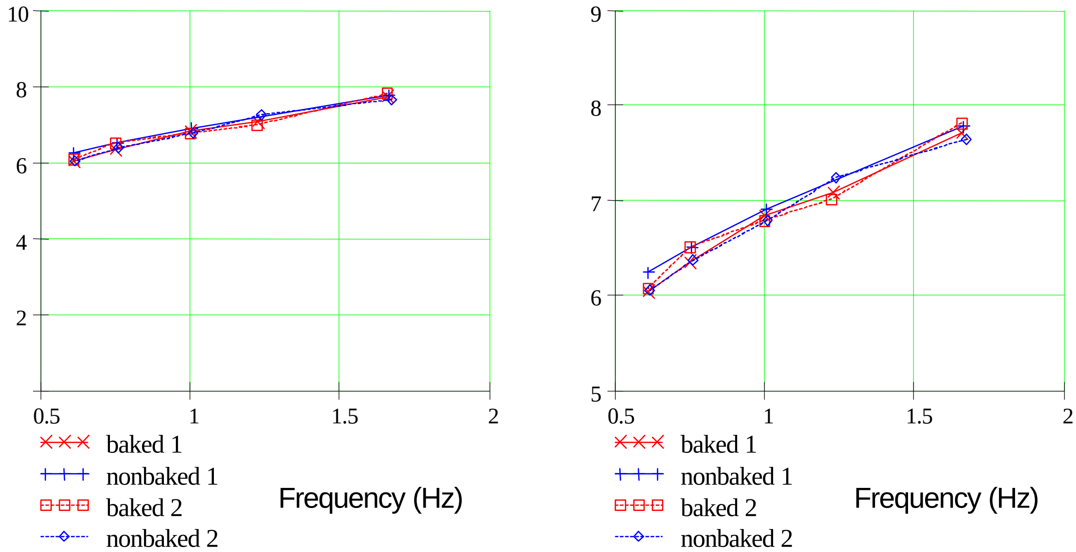

Figure 1: Comparison plot of shear loss factor (%) for the baked and unbaked seats as a function of frequency.

Figure 2 below shows that the shear stiffness for the unbaked assembly is approximately 3-3% greater than for the baked case. However that small difference could be due to other factors (such as seat-to-seat variability, measurement scales) and is considered insignificant.

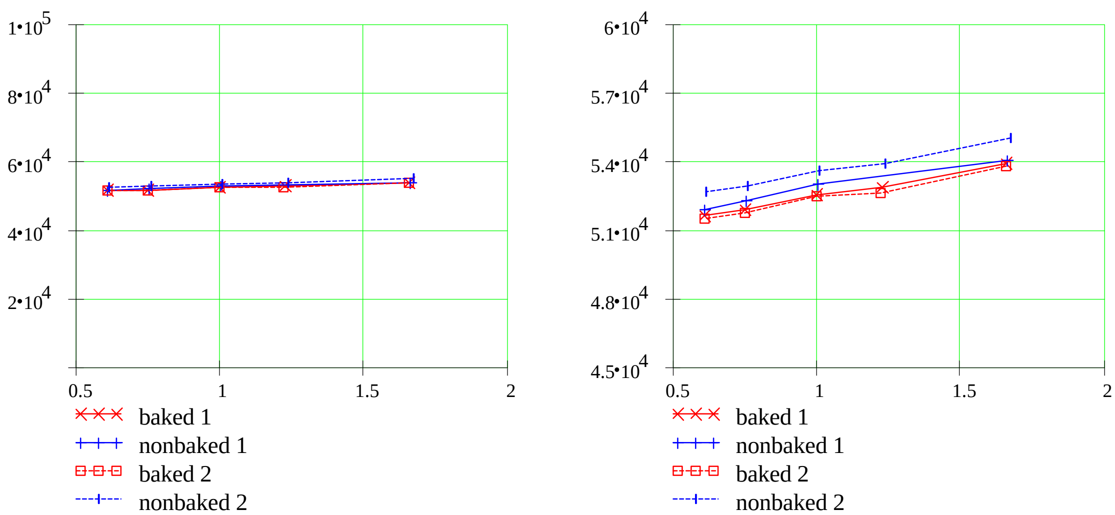

Figure 2: Comparison plot of shear stiffness (N/m) for the baked and unbaked seats as a function of frequency.

4. Conclusions

Test results presented in this report indicate that the mechanical shear properties (damping and stiffness) are essentially identical for the baked and nonbaked Fluorel seats.

5. References

1. E. Ponslet, *Material, Process, Handling, and Shipping Specification for Flourel Parts,*, HYTEC Inc., Los Alamos, NM, document HYTEC-TN-LIGO-05b, June 1997.
2. E. Ponslet, *Low Frequency Damping Measurement Setup and First Results,* HYTEC Inc., Los Alamos, NM, document HYTEC-TN-LIGO-17, June 1997.

Note 1, Linda Turner, 09/03/99 02:26:52 PM
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