Boil-off of a cryogenic fluid which is caused by thermal variations between the fluid and its environment is a phenomenon that has long been studied and understood. However, vibrational excitation of a cryogenic storage tank and the fluid inside it also play a role in the loss of cryogens. Mechanical energy applied to the system in the form of vibrational input is converted into thermal energy via viscous damping of the fluid. When a storage tank full of cryogenic fluids is vibrated, it boils off at an increased rate.

A series of experiments were performed in which a cryogenic storage dewar filled with liquid nitrogen was subjected to vibrational input while the rate of boil-off was measured. The tests were performed on a vibration table which simulated vibration levels comparable to those which occur at a space vehicle launch pad. Based on the results of the testing, it has been determined that the rate of boil-off of a cryogenic fluid could increase by a factor of approximately three during the application of vibrational energy. The development of cryogenic storage systems capable of reducing vibrational loading of the fluid could significantly decrease the loss of cryogens during procedures such as transporting and storing the fluid or launching a space vehicle.

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Approved for distribution by Louis Chow, Committee Chair, on June 20, 2016.

The public is welcome to attend.