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Qualification of movement leading to quench in Nb₃Sn coils by means of induced voltage, quench antenna and vibration measurements.

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A general understanding of training quenches in Nb₃Sn superconducting coils is that they are predominantly caused by settling of the coil while increasing the force in the magnet during current ramp up. In most cases, voltage measurements show precursors that can indicate the magnitude of movement. Three types of movement detection methods were combined in recent tests of Nb₃Sn model magnets: direct voltage measurements, quench antenna and accelerometers. The accelerometer measurements can exclude the electrical origin of the precursors in voltage and quench antenna data, and allow to further investigate the frequency and amplitude spectrum of the vibrations. In this paper we describe the test results of the three movement detection methods on state of the art Nb₃Sn model magnets and compare the results with each other and with existing and new theory. A proposal is made for clear classification of vibrations leading to quenches in the Nb₃Sn model magnets, which can be applied even when only the voltage measurement method is used.

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