

## Mechanical Performance of the LARP Nb<sub>3</sub>Sn Quadrupole Magnet LQS01

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**Abstract** - As part of the effort towards the development of Nb<sub>3</sub>Sn magnets for future LHC luminosity upgrades, the LHC Accelerator Research Program (LARP) has fabricated and tested the quadrupole magnet LQS01. The magnet implements 3.4 m long Nb<sub>3</sub>Sn coils contained in a support structure characterized by an external aluminum shell segmented in four sections. The room temperature pre-load of the structure is obtained by shimming load keys through bladders, pressurized during the loading operations and removed before cool-down. Temperature compensated strain gauges, mounted on structure components and coil poles, monitor the magnet's mechanical behavior during assembly, cool-down and, excitation. During the first test, LQS01 reached the target gradient of 200 T/m; the gauge data indicated that the aluminum shell was pre-tensioned to the target value estimated by numerical models, but a lack of pre-load was measured in the coil inner layer during ramping. As a result, the test was interrupted and the magnet disassembled, and inspected. A second test (LQS01b) was then carried out following a re-loading of the magnet. The paper reports on the strain gauge results of the first test and the analysis performed to identify corrective actions to improve the coil pre-stress distribution. The mechanical performance of the magnet during the second cool-down and test is then presented and discussed.

**Index Terms** - LARP, Nb<sub>3</sub>Sn, Quadrupole magnet.

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