

Test Results of TQS03: a LARP Shell-based Nb₃Sn Quadrupole Using 108/127 Conductor

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Abstract - Future insertion quadrupoles with large apertures and high gradients will be required for the Phase II luminosity upgrade ($10^{35} \text{ cm}^{-2}\text{s}^{-1}$) of the Large Hadron Collider (LHC). Although improved designs, based on NbTi, are being considered as an intermediate step for the Phase I upgrade, the Nb₃Sn conductor is presently the best option that meets the ultimate performance goals for both operating field and temperature margin. As part of the development of Nb₃Sn magnet technology, the LHC Accelerator Research Program (LARP) developed and tested several 1-meter long, 90-mm aperture Nb₃Sn quadrupoles. The first two series of magnet used OST MJR 54/61 (TQ01 series) and OST RRP 54/61 (TQ02 series) strands. The third series (TQ03) used OST RRP 108/127 conductor. The larger number of sub-elements and the consequent reduction of the effective filament size, together with an increased fraction of copper and a lower J_c were expected to improve the conductor stability. The new coils were tested in the TQS03 series using a shell structure assembled with keys and bladders. The objective of the first test (TQS03a) was to evaluate the performances of the 108/127 conductor and, in particular, its behaviour at 1.9 K, while the second test (TQS03b) investigated the impact on high azimuthal pre-stress on the magnet performance. This paper reports on TQS03 fabrication, the strain gauge measurements performed during assembly, cool-down, excitation and the quench behaviour of the two magnets.

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