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Superconducting coil stress specifications for the series production of the Nb3Sn MQXFA quadrupole magnets for the HL-LHC

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The High Luminosity LHC (HL-LHC) Project is planning to install 16 cold-masses, made with the Nb3Sn quarupole magnets, in the LHC Interaction Regions to significantly increase its luminosity. Half of these cold masses are fabricated at BNL, FNAL, and LBNL under the US Accelerator Research Program (AUP). Each cold mass includes two identical Nb3Sn quadrupole magnets, called MQXFA, each with a magnetic length of 4.2 m. Currently, the AUP project has completed the fabrication of the first 4 pre-series magnet, and is working on the following 12 magnets for the series production. The brittleness and strain sensitivity of the Nb3Sn superconducting material require a careful definition of the allowable maximum stress in the windings during magnet assembly and pre-load, and a tight control of their variation within the whole coil length. Therefore, a series of stress specifications have been defined with the goals of minimizing the risk of conductor degradation and providing the mechanical support required to reach the nominal current during powering. In this paper we present the pre-load specifications set for MQXFA magnets, and we provide an overview of the previous experiences, coming from R&D magnets developed by the LHC Accelerator Research Program (LARP) and the MQXF short model program, which contributed to the definition of coil stress limits.

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