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Production of Aluminum Stabilized Superconducting Cable for the Mu2e Transport Solenoid

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The Fermilab Mu2e experiment seeks to measure the rare process of direct muon to electron conversion in the field of a nucleus. The experiment makes use of three large superconducting solenoids: the Production Solenoid (PS), the Transport Solenoid (TS), and the Detector Solenoid (DS). The TS is an “S-shaped” solenoid with a warm-bore aperture of half a meter and field between 2.5 and 2.0 T. The three solenoids feature four different Al stabilized NbTi superconducting cables. All the conductors are manufactured conforming a NbTi Rutherford cable into an aluminum matrix. Cables are subsequently cold-worked to meet the mechanical and electrical cable requirements in terms of yield strength and RRR of the Al stabilizer. This paper describes the various steps that led to the successful procurement of over 700 km of superconducting wire and 44 km of Al-stabilized cable needed to build all the 52 coils for the Mu2e Transport Solenoid (TS). The main cable properties and results of electrical and mechanical test campaigns are presented and discussed for each stage of the cable development process. Critical current measurements of the full stabilized cables are presented and compared to expected critical current values as measured on strands extracted from the final cables after etching of the Aluminum stabilizer. Effect of cable bending on the transport current are also investigated and presented.

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