THE sMDT PROJECT FOR THE ATLAS MUON SPECTROMETER UPGRADE

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on behalf of the ATLAS Collaboration

Introduction

In the ATLAS Muon Spectrometer(MS), MDT chambers do the primary precision tracker. To prepare for the challenge of a much higher interaction rate of the High-Luminosity LHC (HL-LHC), the central (barrel) region inner station of the Monitored Drift Tube (MDT) chambers will be replaced by new chambers using small-diameter MDT (sMDT) tubes of 15 mm diameter(Fig 1), half that of the previous MDT. It will have the advantage of reducing drift time (from 750 ns down to 180 ns), lower tube occupancy and leaving space for additional RPC chambers.

Figure 1: **MDT (left) and a sMDT (right)** [1]

Tube Construction and Quality Control

A total of 26000 tubes have been made in Michigan to make new sMDT chambers. MSU is responsible for tube assembly and initial Quality Assurance (QA) tests in the clean room(Fig 2). Then tubes are shipped to the University of Michigan to do the QA tests again and used in chamber production.

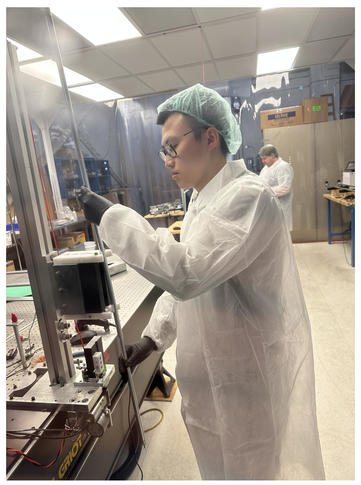

Figure 2: **Cleanroom**

In the swage station (Fig 3 left), to assemble the tube, the wire is first air-driven by a vacuum with a shuttle for wire stringing, then wire ends are threaded through endplugs at each end of the tube and then the endplugs (Fig 3 right) are inserted into the tube ends until seated. The next step is to tension the wire in a fully-automated tension station (Fig 4). The frequency of the wire oscillation is measured to get the tension. Then it will go back to the swage station for final swagging. The quality control of the tube consists of tension, leak tightness, and dark current. Figure 5 and figure 6 show the leak and dark current station.

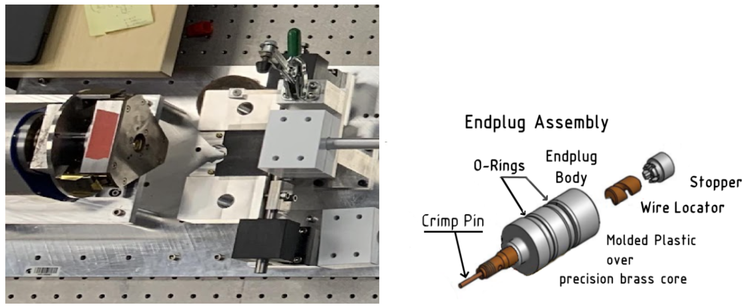

Figure 3: **(Left)Swage station. (Right)The components and assembly of an endplug.[2] .**

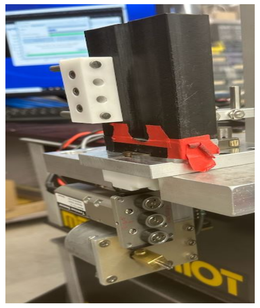

Figure 4: **Tension station**

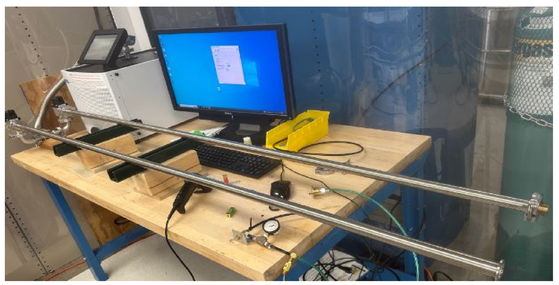

Figure 5: **Leak station**

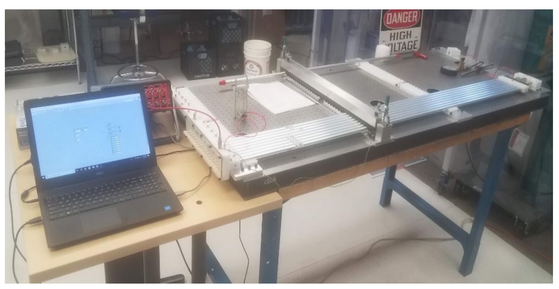

Figure 6: **Dark current station**

The recorded data of each quality control test is stored in the database. Figure 7 shows the distribution of tension measurement.

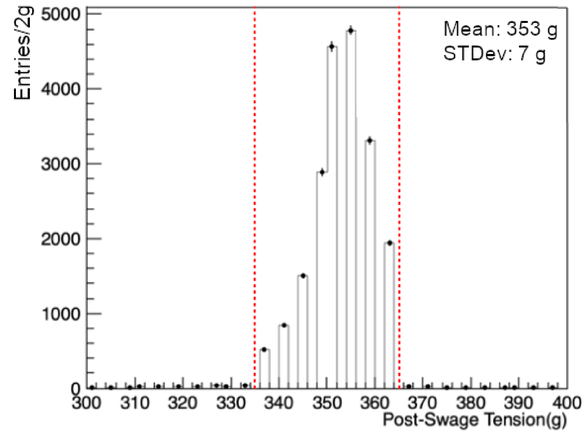

Figure 7: **The histogram shows the post swage tension.**

Mini chamber

The next step is to build an electronics testing station, to help test the full chambers after the final electronics are installed. To help set the electronics up at MSU, a mini-chamber is being built with shorter and fewer tubes. The testing station will include gas control, a chamber cart, power supplies, and a cosmic ray test including scintillator trigger system and DAQ system.

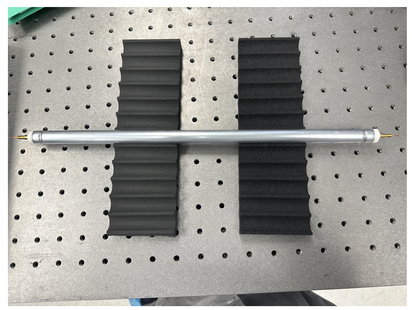

Figure 8: **The short tubes used in mini chamber**

References

[1] Emma Ward Katarina Anthony. https://atlas.cern/updates/news/atlas-starting-line.

[2] C. Wei et al. “Construction and testing of sMDT tubes at the University of Michigan for the ATLAS Muon Spectrometer upgrade”. In: *JINST* 17.10 (2022), P10010. DOI: 10.1088/1748-0221/17/10/P10010. arXiv: 2209.03864 [physics.ins-det].