



# Tensile Tester for In-Sito Scanning Electron Microscopy

By Team G7 Designs



Department of Mechanical Engineering  
 Dr. Scott Shaffar: Senior Design Professor  
 Dr. Wenwu Xu: Project Sponsor

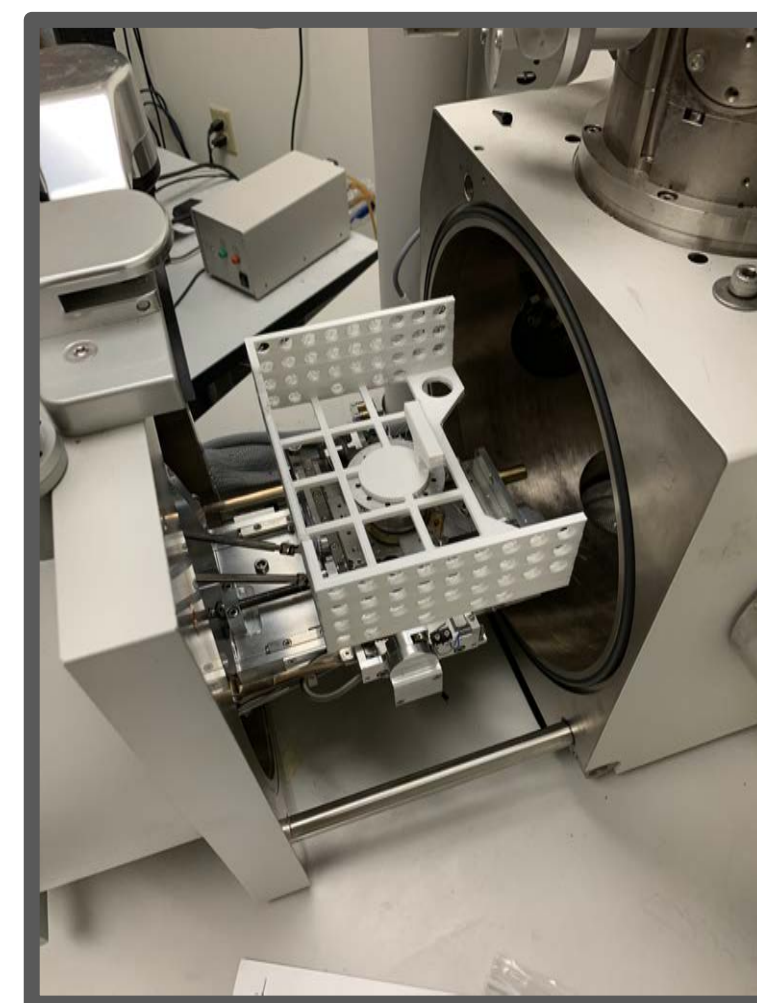
## Team Members



Left to Right

Christopher Guzman: Team Lead and Analysis  
 Peterson Frith: SEM specialist and Testing  
 Osvaldo Chavarin: Electrical and Testing  
 Christian Hernandez: Manufacturing and Design  
 Deven Harrington: Procurement and Quality Assurance

## Prototyping

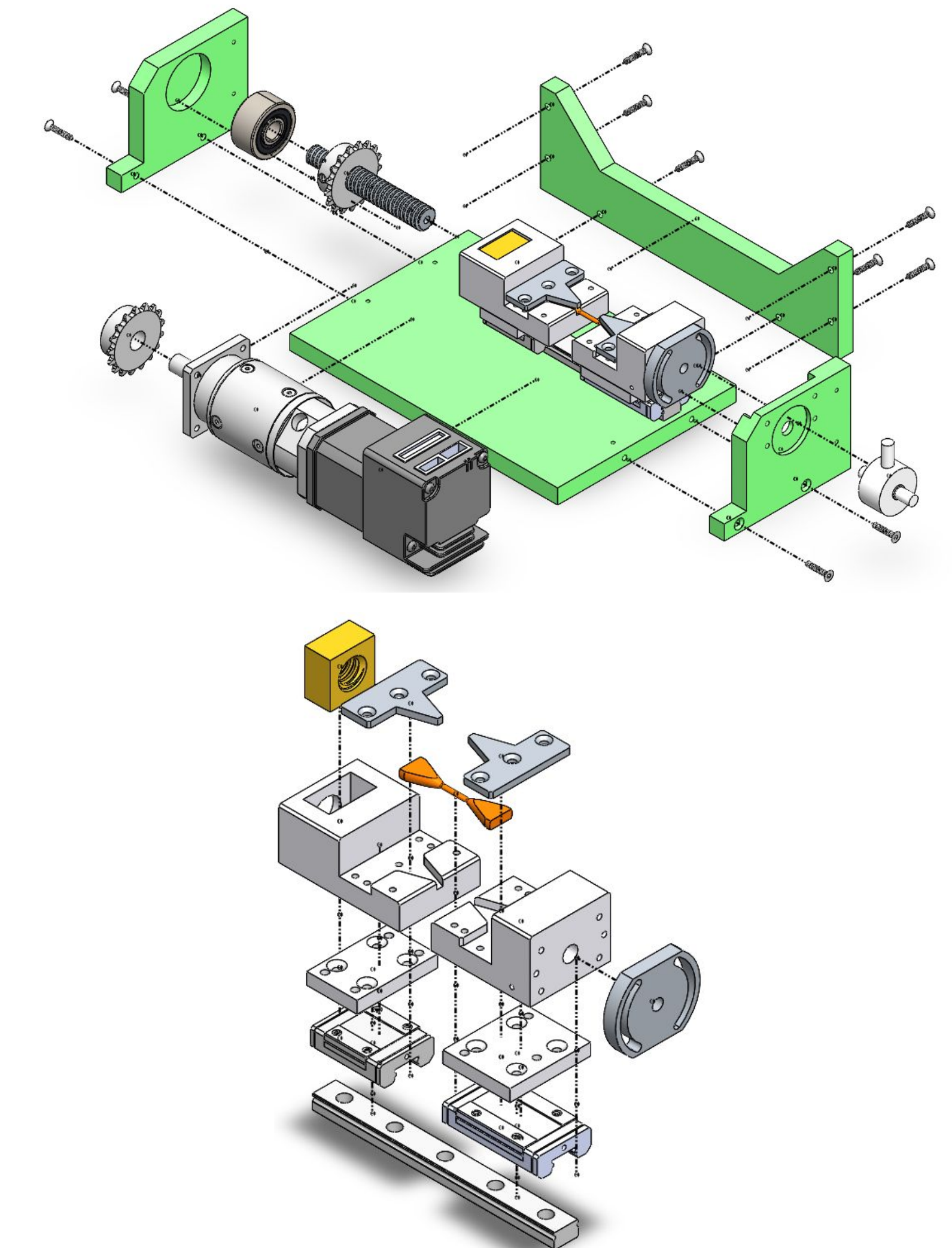


Prototype I



Prototype II

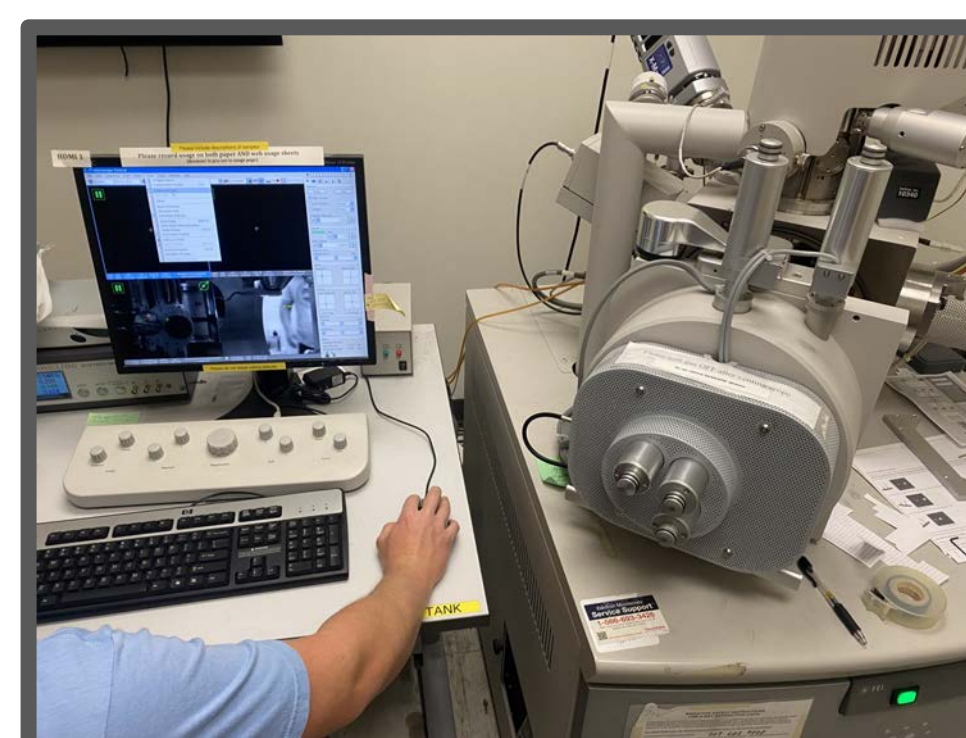
## CAD Model



## Project Description

Creation of Tensile Tester for applications within materials research. Tensile Tester is to be placed within scanning electron microscopy (SEM) to observe fracture and deformation of aluminum and magnesium specimens. To be used for SDSU research by Dr. Wenwu Xu and graduate students.

## The SEM



Our Tensile Tester must fit within the testing chamber of the SEM in order to view the specimens as they are being fractured. Due to the weight of the components of the Tensile Tester, the Tester will not be able to be moved around on the stage once inside the chamber. Therefore, specimen placement on the Tester itself is critical. While most samples being viewed in the SEM can be adjusted for view under the electron beam, our sample must be perfectly placed so that the electron beam is directly on top of the specimen. The cooling arm on the right of the SEM must also be removed and replaced with a pass through in order to provide power to the motor and load cell.

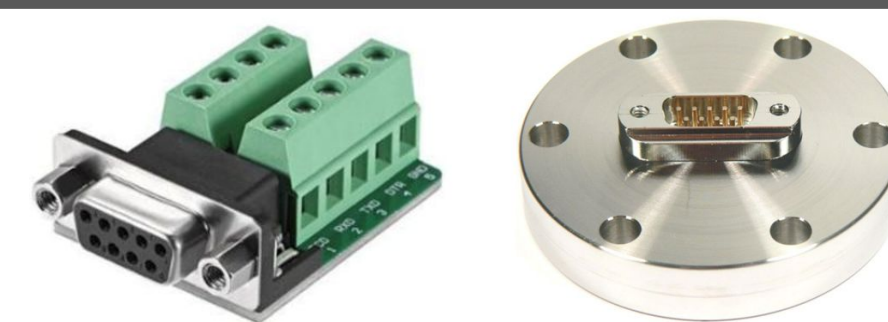
## Testing



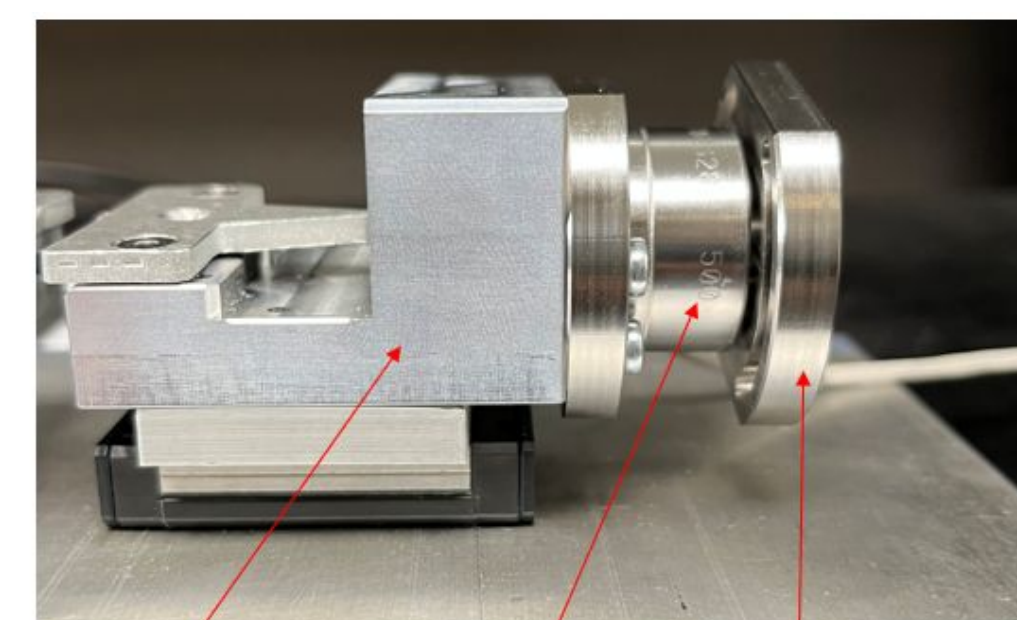
3D Printed and Aluminum Test Samples

- Phase 1**
  - Test all Electronics individually to ensure all code works as expected.
  - Calibrate and test Load Cell.
  - Calculate stepper motor rotational to linear conversion.
- Phase 2**
  - Assemble tensile tester and integrate all electronics.
  - Begin testing using 3D printed samples and "Thin" aluminum samples.
  - Ensure all components align and sample breaks as intended.
  - Test with at least one "Regular" aluminum sample.
  - Evaluate if any adjustments need to be made to design/parts need to be re manufactured.
- Phase 3**
  - Make any adjustments to parts/design if needed.
  - Test inside SEM.

## Electrical Components



9 Pin Female D-sub Port Adapter & SEM Passthrough



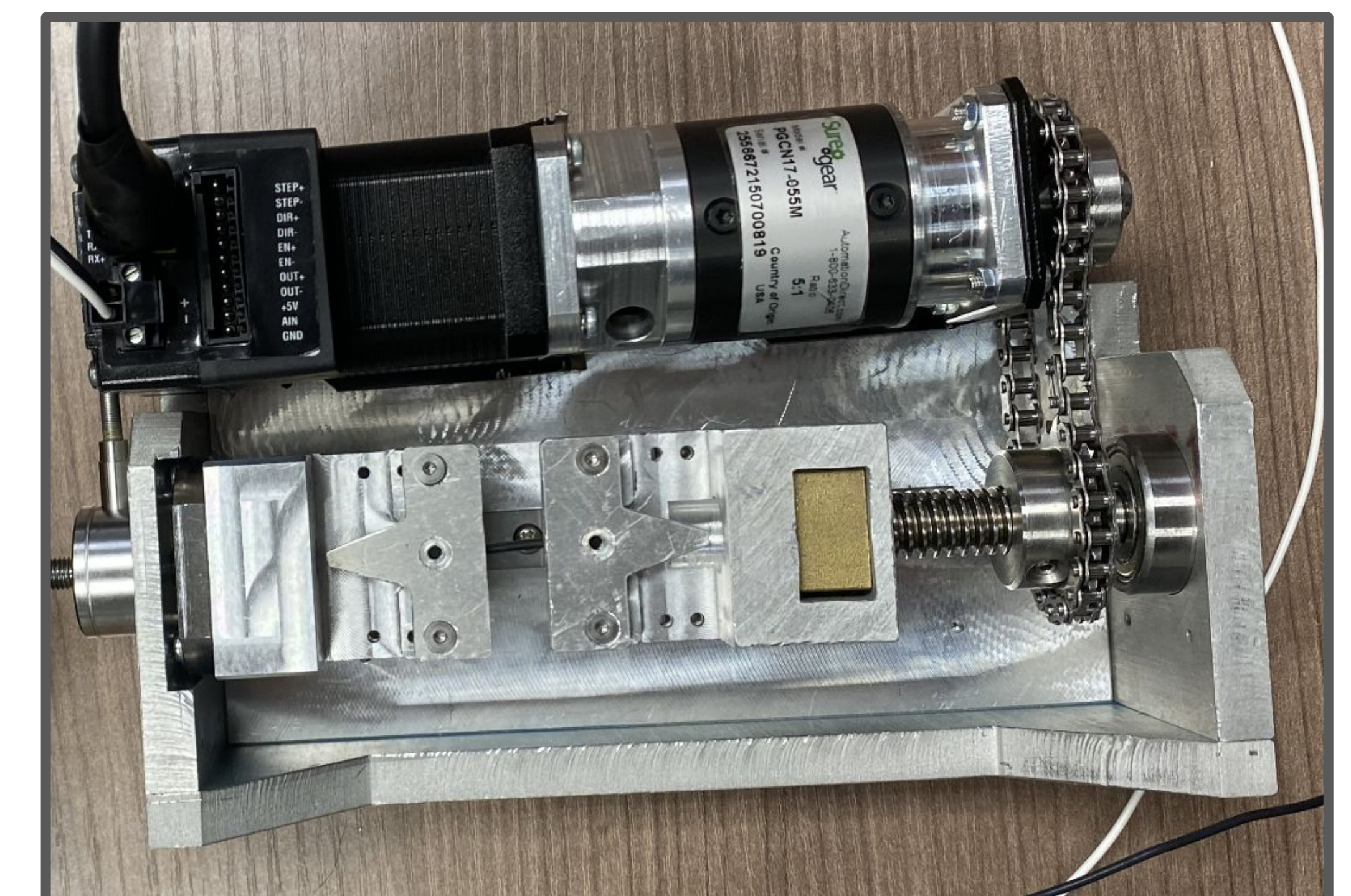
Right Carrier Load Cell Pulling grip



Integrated Stepper Motor

There are three main electrical components for this tensile tester as shown in the pictures. In order to connect the hardware inside the vacuum chamber to the outside of the SEM, an SEM passthrough with two 9 pin male D-sub connectors was designed. A female D-sub adapter was used to connect the necessary pins from the load cell, the motor power connector and the motor communication cable.

## Final Design



In the image above the final assembled model can be seen. There is a communication cable and power source connected to the motor, with a load cell at the end of the carriage to measure tension force.

By using the SureMotion Pro software, we are able to feed commands to the motor to generate a linear carriage motion. The speed and linear distance can be calculated and changed accordingly depending on the research application.