



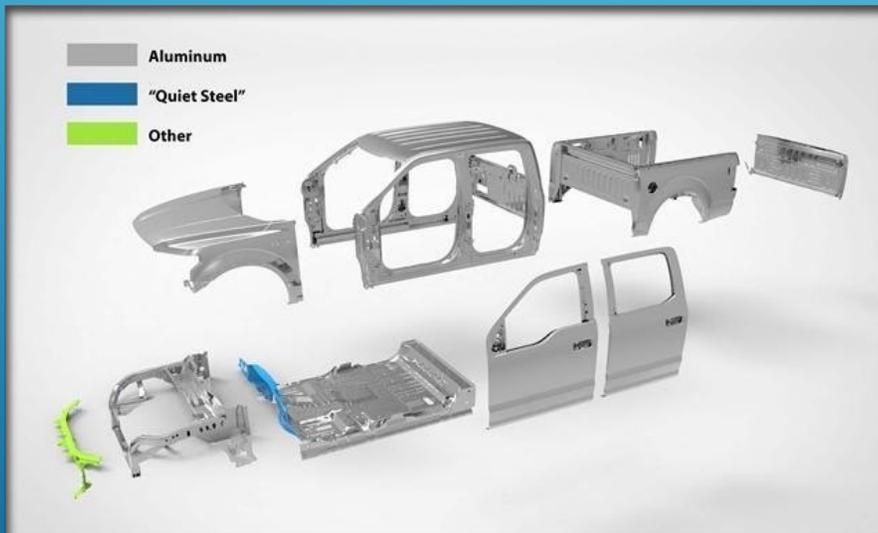
# TENSILE BAR MANUFACTURING AND PROCESSING FOR THE FURTHER DEVELOPMENT OF HIGH ENTROPY ALUMINUM ALLOYS

Davis Ladd  
Mechanical Engineering

Advisor:  
Yu Zhong



# INTRODUCTION TO THE PROBLEM

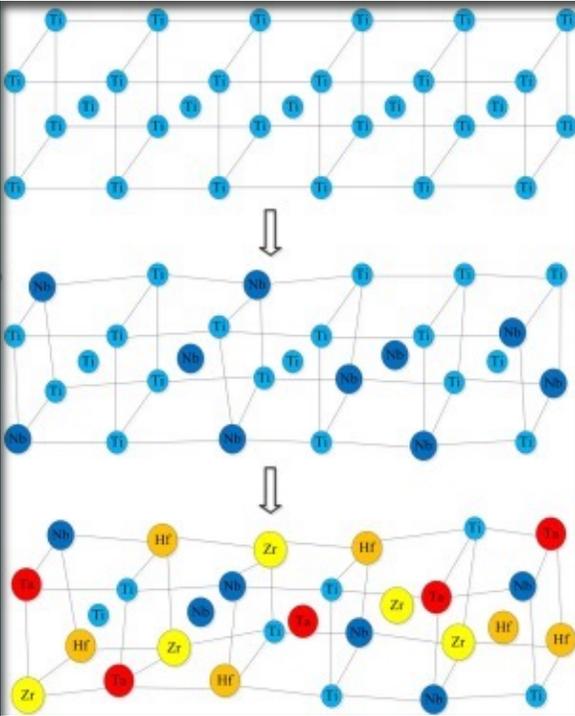


- Aluminum alloys are a rising industry due to their economic potential and mechanical properties.
- New Experimental platforms are needed for new alloys with low castability
- CNC Machining procedure may be viable for new tensile bar development



# HIGH ENTROPY ALUMINUM ALLOYS

- Alloys that contain 5 or more elements in their composition
- Core effects, including lattice distortion, is what makes high entropy alloys (HEAs) so strong
- The new samples developed must exhibit similar reactions to treatments in order to be considered acceptable



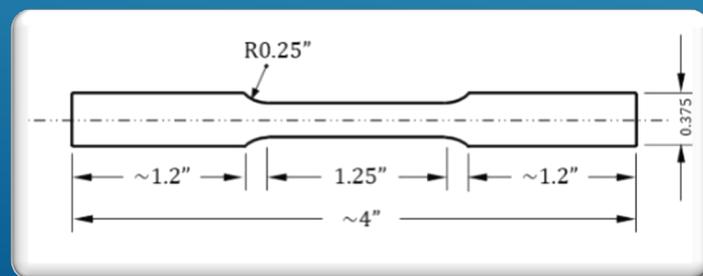
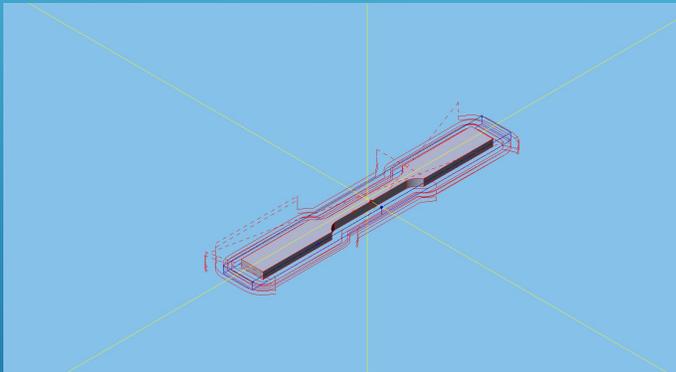
# CASTING PROCEDURES FOR TENSILE BAR MANUFACTURING



- Tensile bar tests are a method of measuring a variety of mechanical properties of an alloy
- The standard tensile bars are 8 inches and weigh  $\approx 120$  grams depending on the alloys composition
- Samples are cast in a permanent mold like the one shown in the bottom left



# TENSILE BAR REDESIGN CONSIDERATIONS

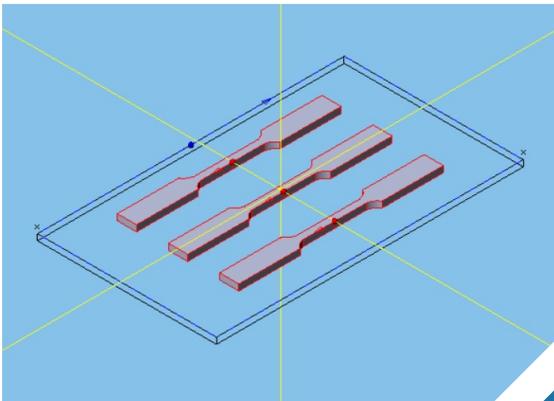
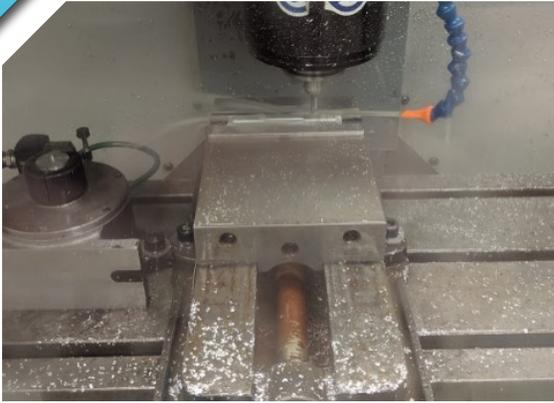


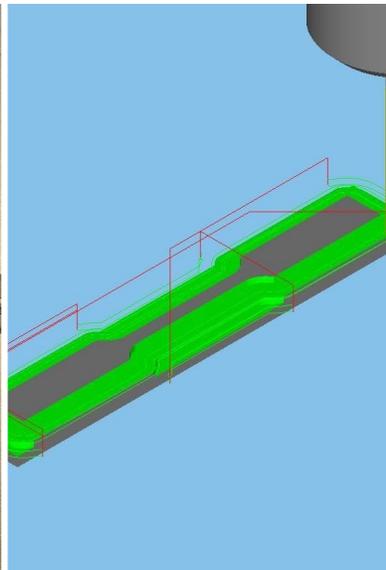
- Our chosen design coincided with current ASME standards
- The 4-inch size made them desirable because more samples could yield more tests.
- ESPRIT was used to design the machining paths
- Different fixture methods, tool paths and speeds were used



# ITERATIONS OF TENSILE BAR CREATION

- Iteration 1: Machining straight from the pour samples
- Iteration 2: Gluing the pour samples to a sacrificial block
- Iteration 3: Playing with tolerances and parallel supports
- Iteration 4: Using multiple machining tactics to ensure accuracy and minimal stress on the tensile bars





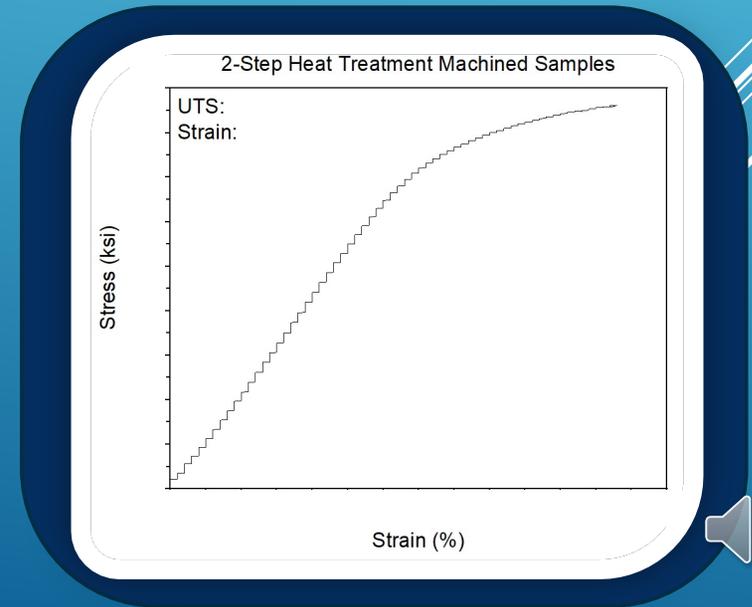
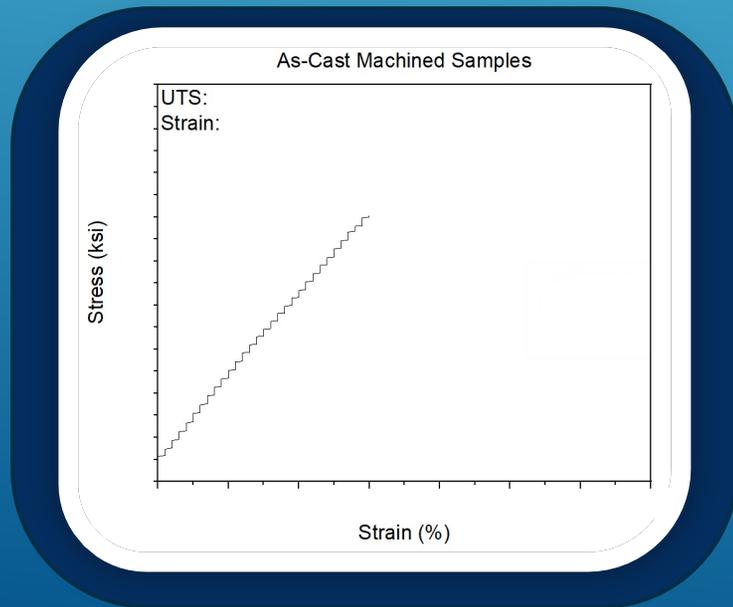
## RESULTS AND FINDINGS

- The new tensile bars weigh roughly 20 times lighter than the originals
- The machine time and processing is near equal for both
- The new bars have a higher percentage of premature fracture

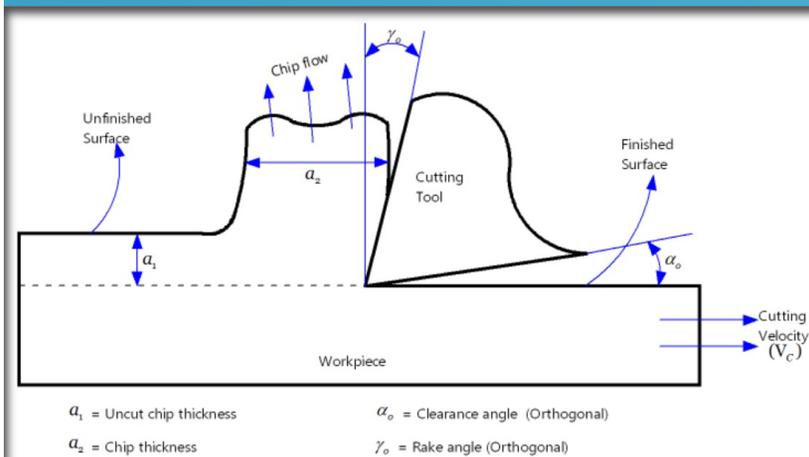


# RESULTS AND FINDINGS CONT.

- These results show similar reactions to the heat treatment
- The ultimate values are lower however the trend can be tracked
- The small bars are solutionizing from the heat treatments in the same way as the large bars



# FUTURE DEVELOPMENTS AND STUDIES



- Microcracks caused by machining the samples may be what causes the premature fracture
- Higher cooling rates result in a refined grain structure and should be experimented with
- The different processing systems leave a lot to study given the difference in results





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