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# Shear Assisted Processing and Extrusion of Magnesium Alloy Machining Chips

September 2025

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Prepared for  
the U.S. Department of Energy  
under Contract DE-AC05-76RL01830

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## Abstract

The Pacific Northwest National Laboratory (PNNL) utilized Shear Assisted Processing and Extrusion (ShAPE) to convert magnesium alloy machining chips directly into wrought material. PNNL fabricated 0.25" and 0.50" round rod from cold compacted briquettes pressed from dry-machined chips by Loukus Technologies. The alloy composition is proprietary and protected by a Materials Transfer Agreement (MTA) between PNNL and Loukus. Extrusions were fabricated using the ShAPE 2.0 machine, tooling, and process. PNNL is evaluating tensile properties per ASTM E8 and microstructure for grain size, texture, and porosity using Scanning Electron Microscopy (SEM) and Electron Backscatter Diffraction (EBSD). Tensile properties and microstructure results were not available at the time of writing this document. Extruded rods have also been sent to Loukus for evaluation.

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## Acronyms and Abbreviations

ASTM	American Society of Testing and Materials
EBSD	Electron Backscatter Diffraction
ER	Extrusion Ratio
MTA	Material Transfer Agreement
SEM	Scanning Electron Microscopy
ShAPE	Shear Assisted Processing and Extrusion

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## 1.0 Summary

Briquettes had a diameter of 2.44" and length ranging from 2.5" to 3.0" as shown in Figure 1. Archimedes measurements revealed the billet had a density >90% of bulk density. For extrusion diameters of 0.25" and 0.50", the extrusion ratios (ER) were 95 and 24 respectively. Briquettes were stacked to 4-5" total height and processed by ShAPE over a range of temperatures (450-550°C) and ram speeds (10-40 mm/min). The length of 0.25" diameter rods was nominally 30 feet while the length of 0.50" diameter rods was nominally 8 feet.



Figure 1. Briquettes cold compacted from dry-machined magnesium alloy chips.

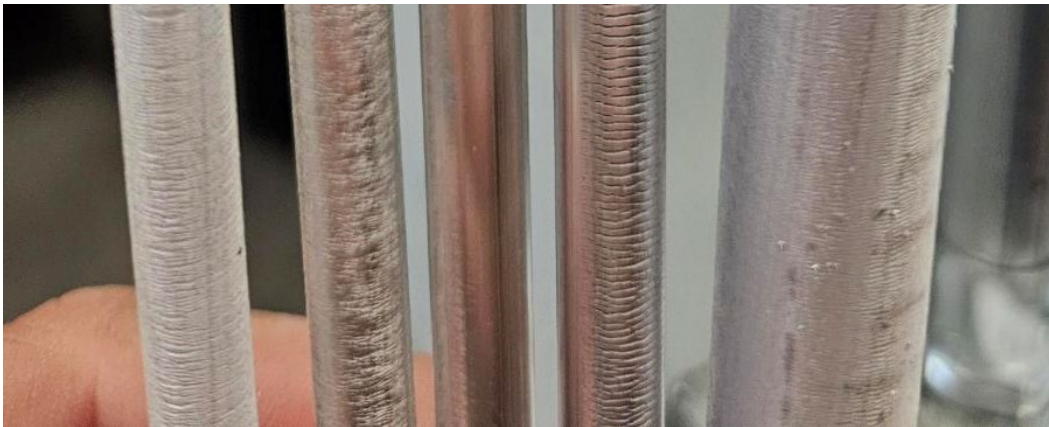


Figure 2. Examples of 0.25" diameter and 0.50" diameter rods.

Figure 2 shows typical sections of the various rods exhibiting smooth and cracked surfaces which depended on the process parameters. The four rods on the left are 0.25" diameter while the rod on the right is 0.50" diameter.

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