

IOWA STATE UNIVERSITY

College of Engineering

# Welding Polymer Film for Packaging Applications with Ultrasonics

Jessica Riedl

*MS Degree Candidate in Agricultural Engineering*

*Advised by Dr. David Grewell*

# Overview

- Objectives
- Background
- Equipment and Material
- Sample Creation Methods
- Performance Analysis
  - Visual Inspection
  - Ultimate Strength
  - Tearing Force
- Conclusions
- Future Research



# Objectives

- Characterize the weldability of 6 coextruded polymer laminate films
  - Benchtop
  - Vertical Form Fill Seal at state of industry speed
- Determine optimal parameters for welding those materials
  - Energy
  - Amplitude
  - Weld Force

# Background

- Applications include:
  - Food & Beverage
  - Cosmetic & Pharmaceutical
  - Chemical
- Advantages
  - Use energy only when needed ~.5sec/weld
  - No glue or consumables
  - High repeatability
  - Ability to seal through contaminants



# Equipment

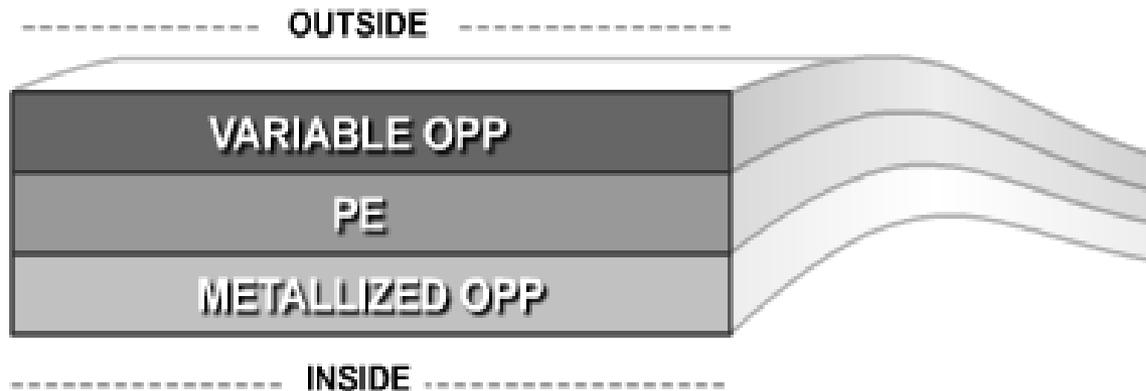
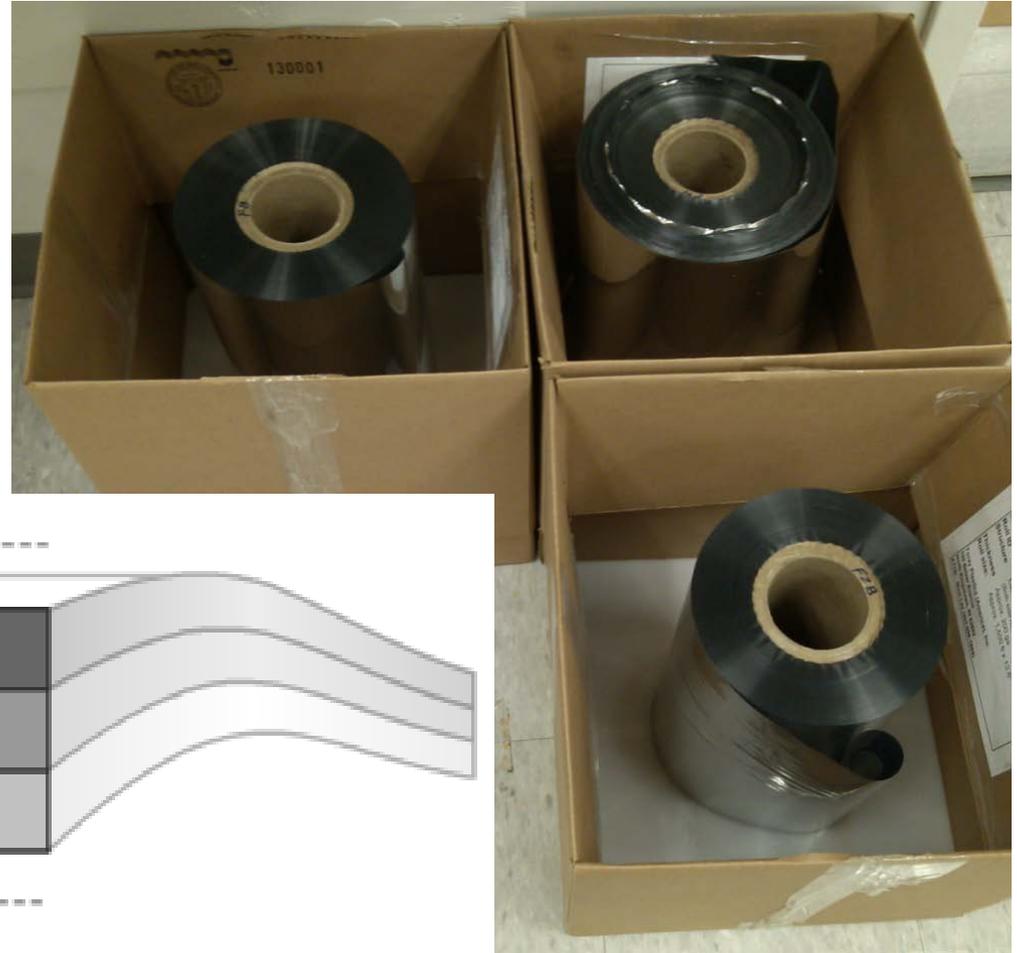
- Branson 2000 X single converter/booster
- 30kHz
- 6" long riser back rectangular slotted horn
- Horn gain = 3
- Booster gain = 1.5
- Amplitude approx 0.0032"



# Machine Factors

Energy (J)	Amplitude (%)	Weld Force (psi) / Trigger Force (lb)
400	100	70 / 125
300		
250	90	60 / 100
200		
100	80	50 / 75

# Material

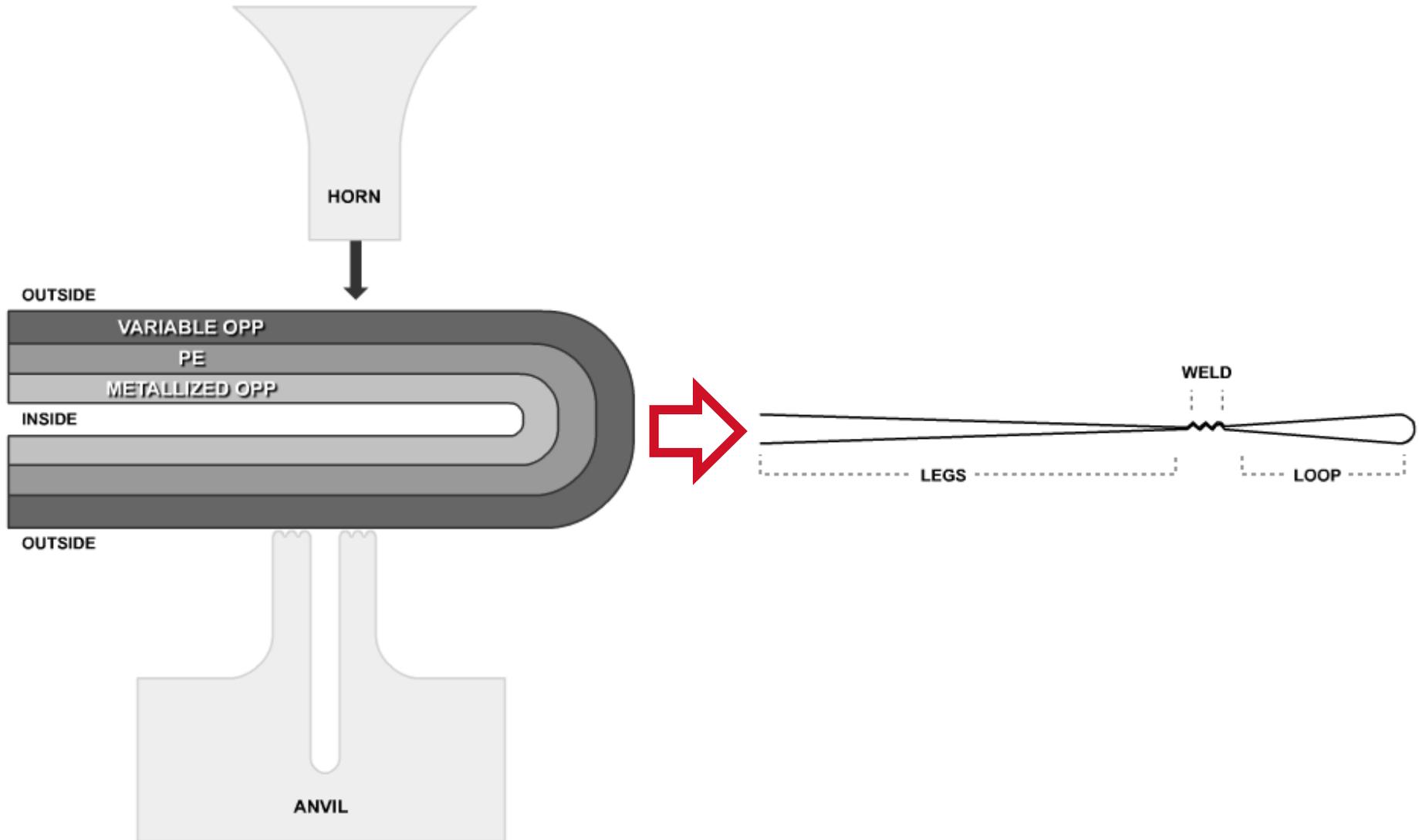


# Coextruded polymer laminate

- Thickness: 200g = 2mil = 0.002” = 50 microns
- Metallized biaxially oriented polypropylene (OPP)
- Polyethylene
- Variable layer:

ID	Variable Layer Description	Weight (g)
A	Printable OPP, lower friction	70
B	Printable OPP, lower friction	90
C	Thicker OPP, lower friction	90
D	High barrier OPP	80
E	OPP, both sides metallized	70
F	Metallizable base OPP	70

# Cross Section View of Welded Sample

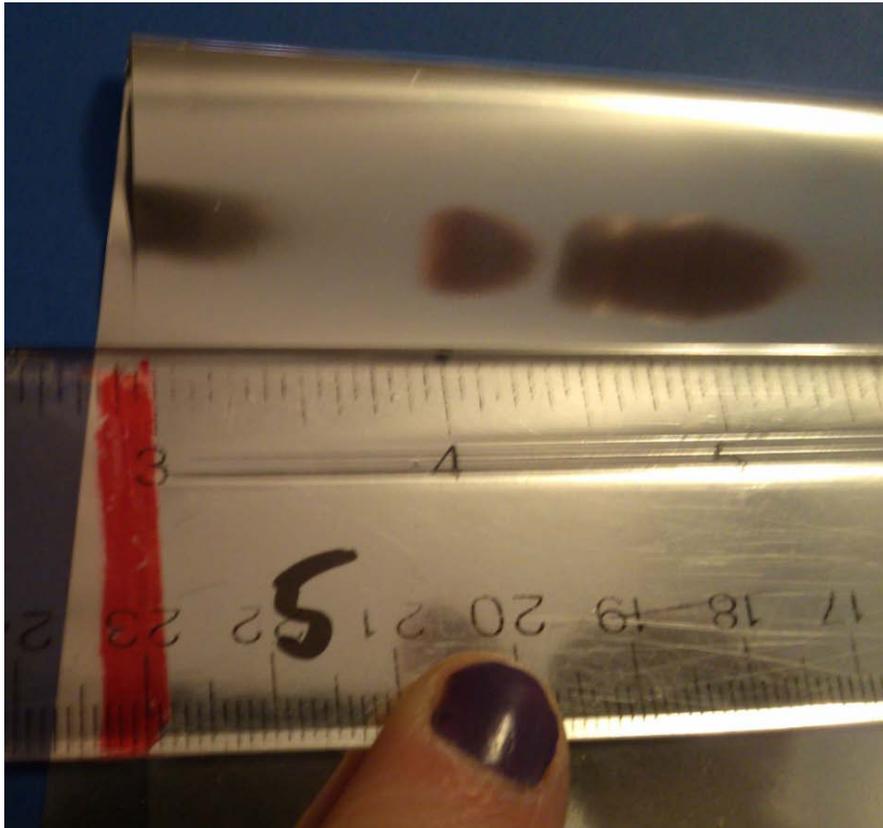




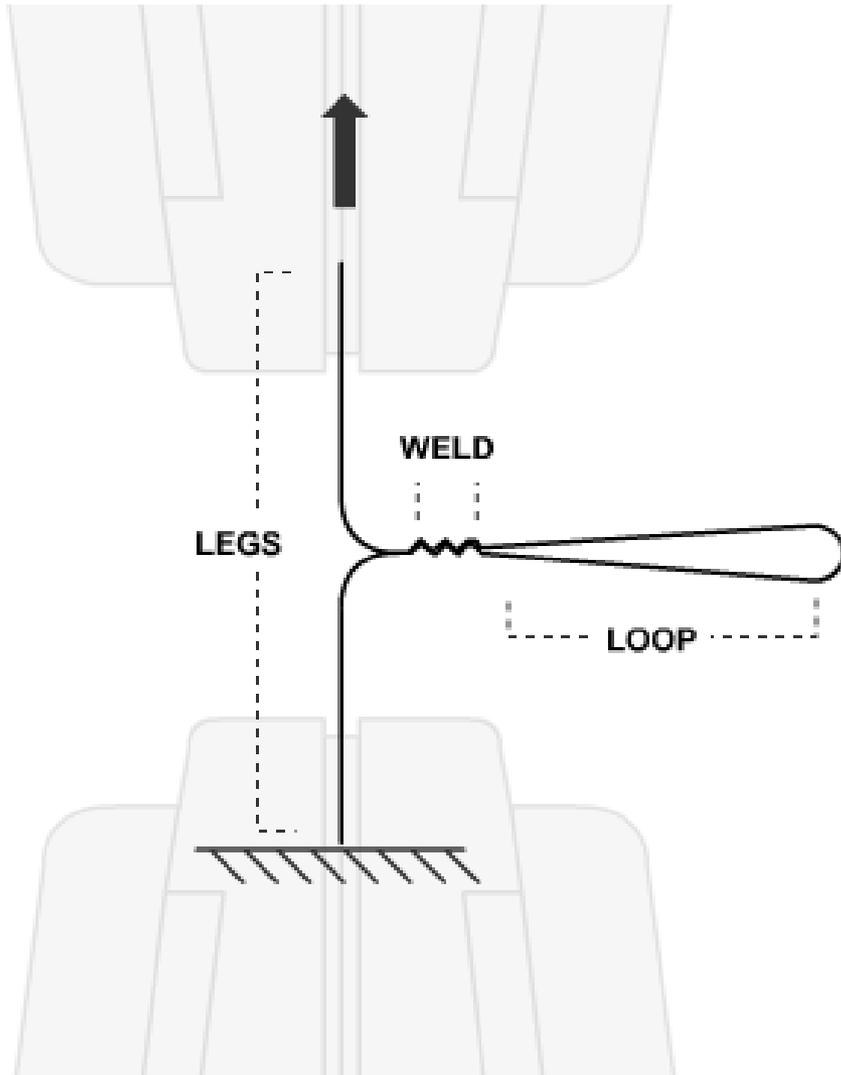
# Visual Inspection

Checking for:

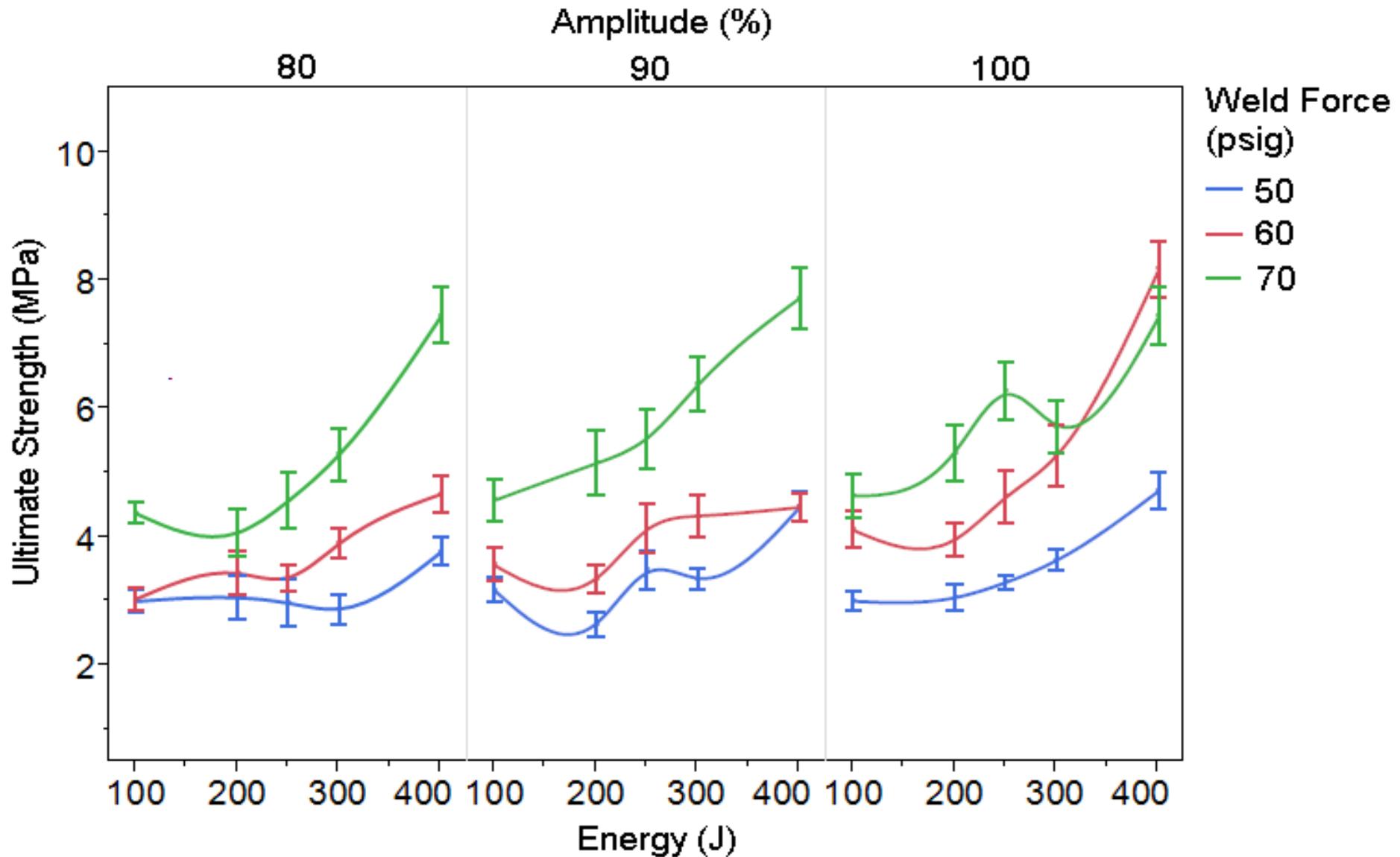
- Completeness (6" weld)
- Burn-through of metallized layer



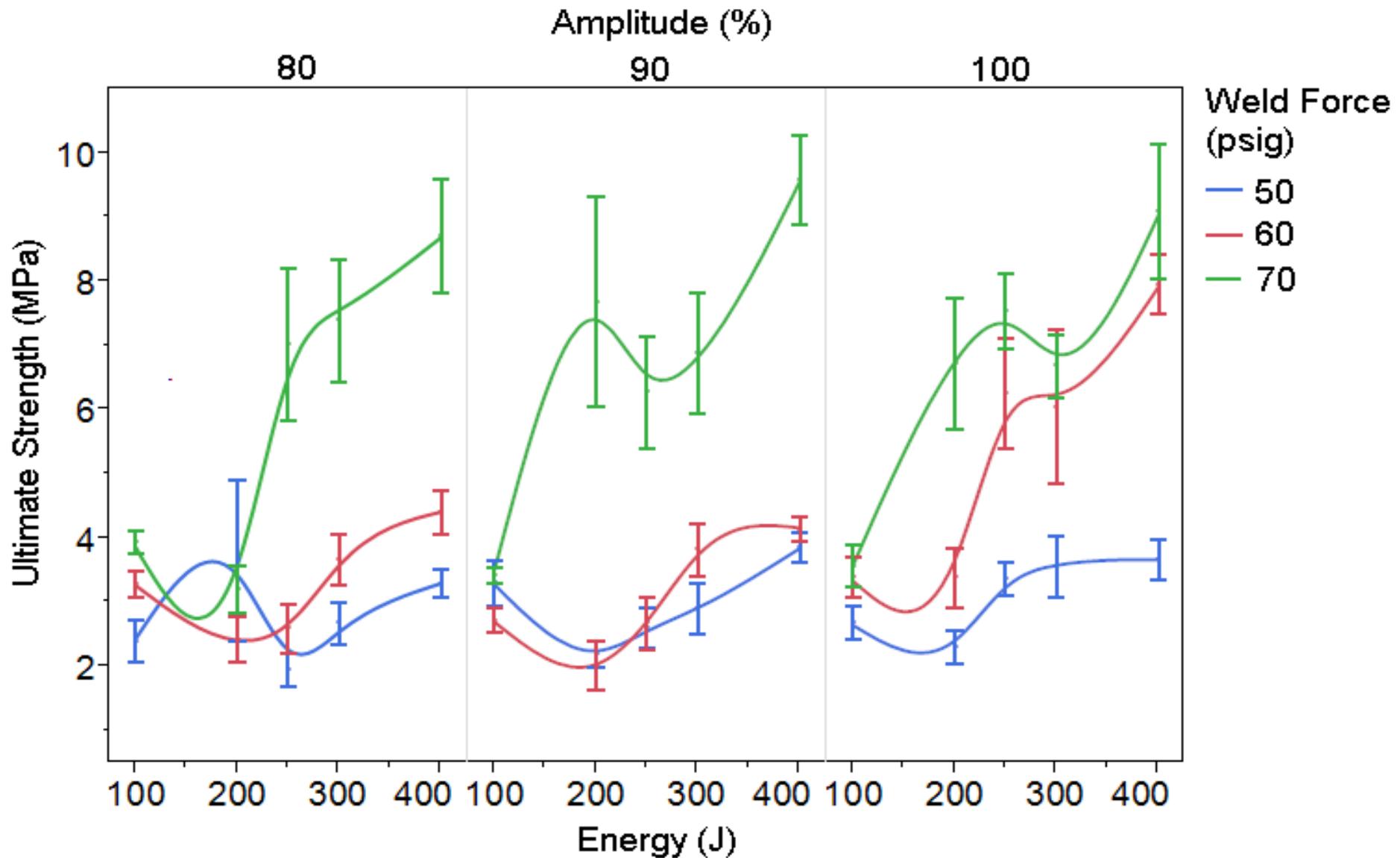
# Modified ASTM D882 Peel Strength



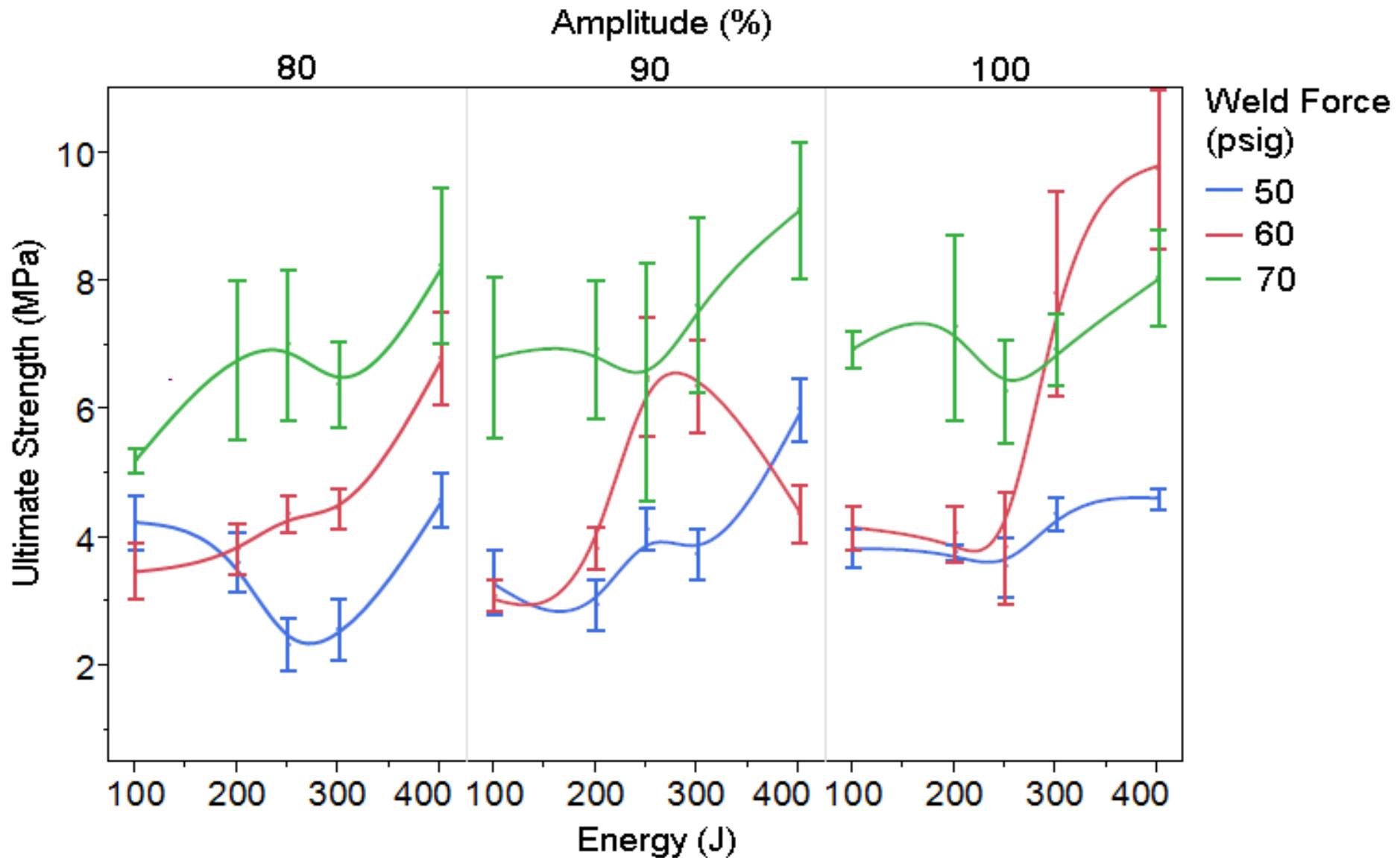
# Mean Ultimate Strength – All Materials



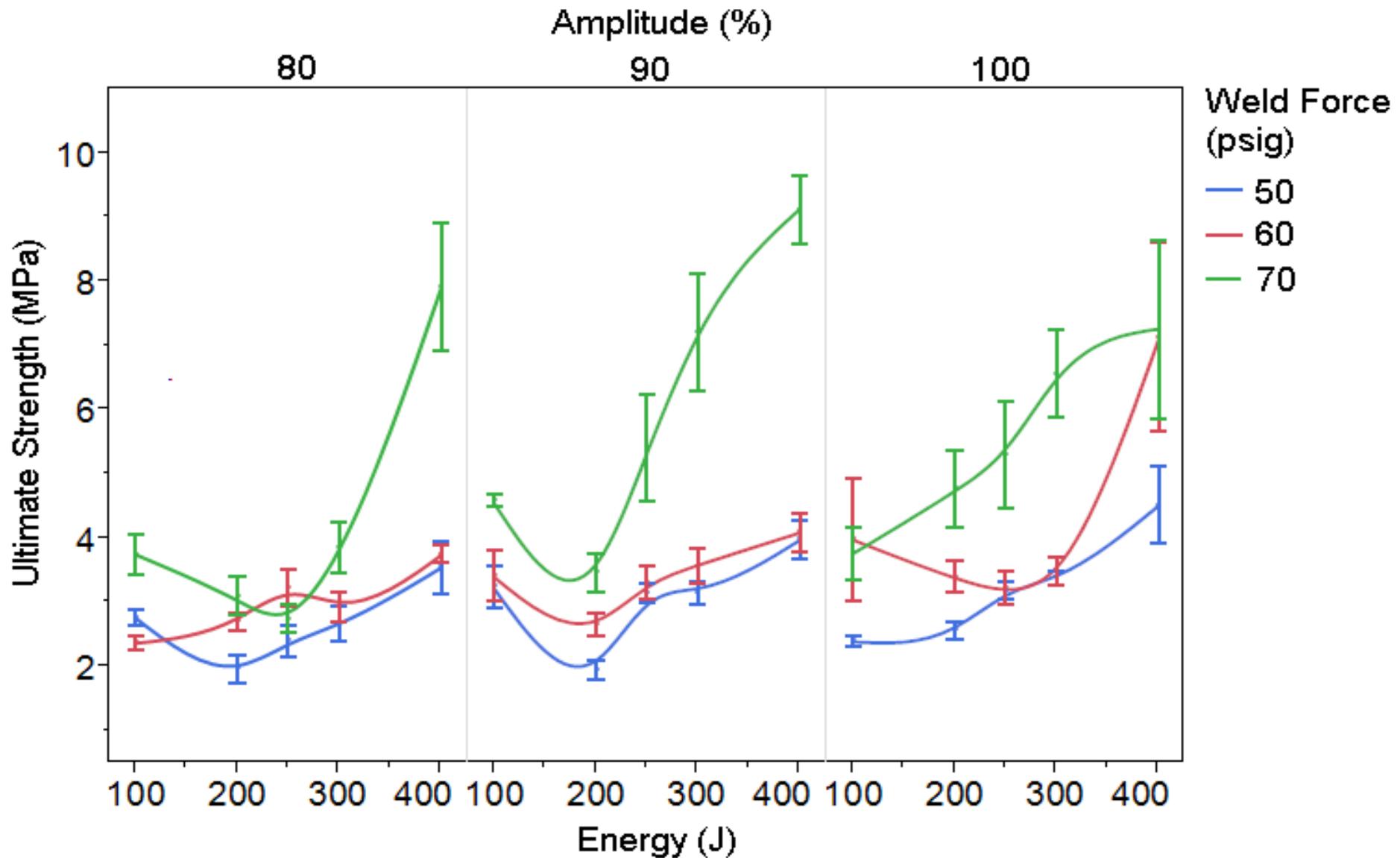
# Mean Ultimate Strength – A



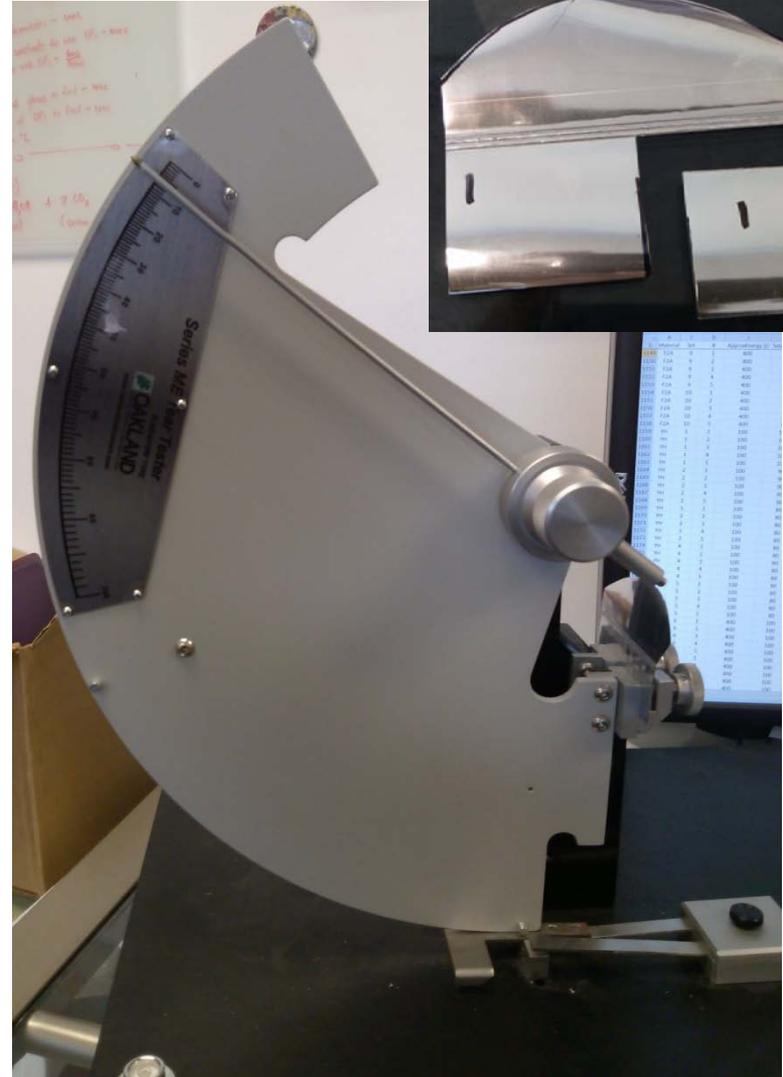
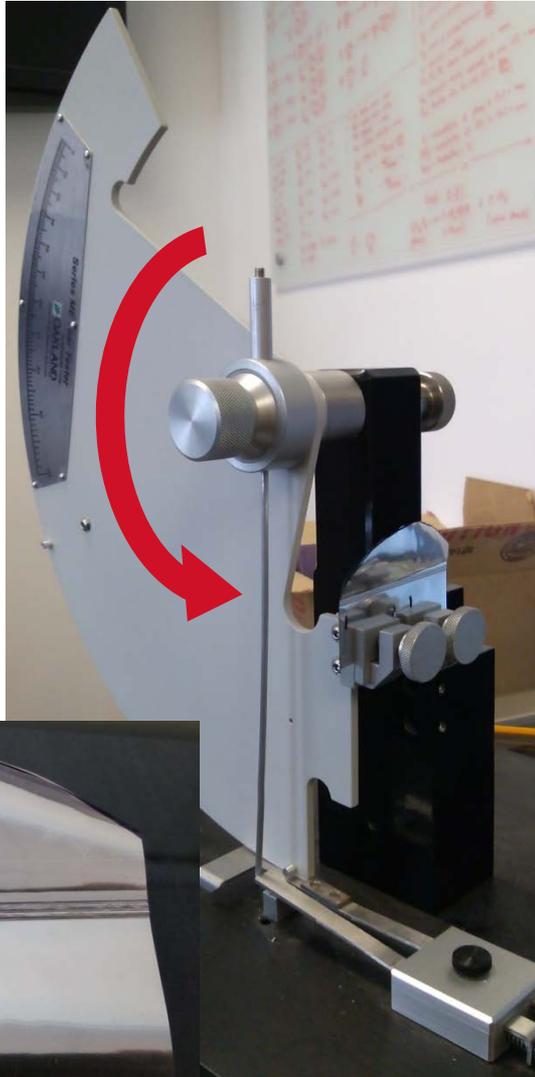
# Mean Ultimate Strength – C



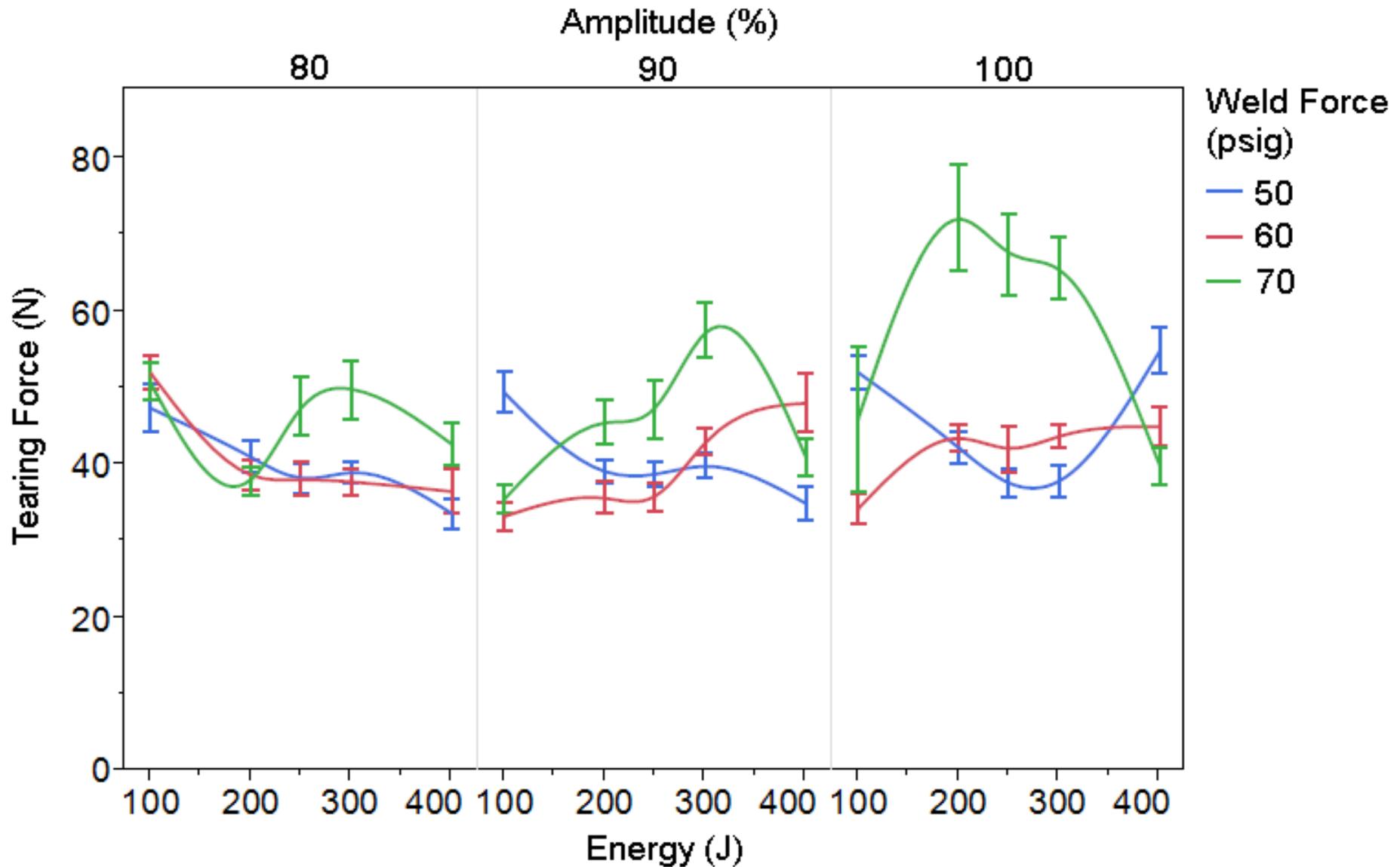
# Mean Ultimate Strength – F



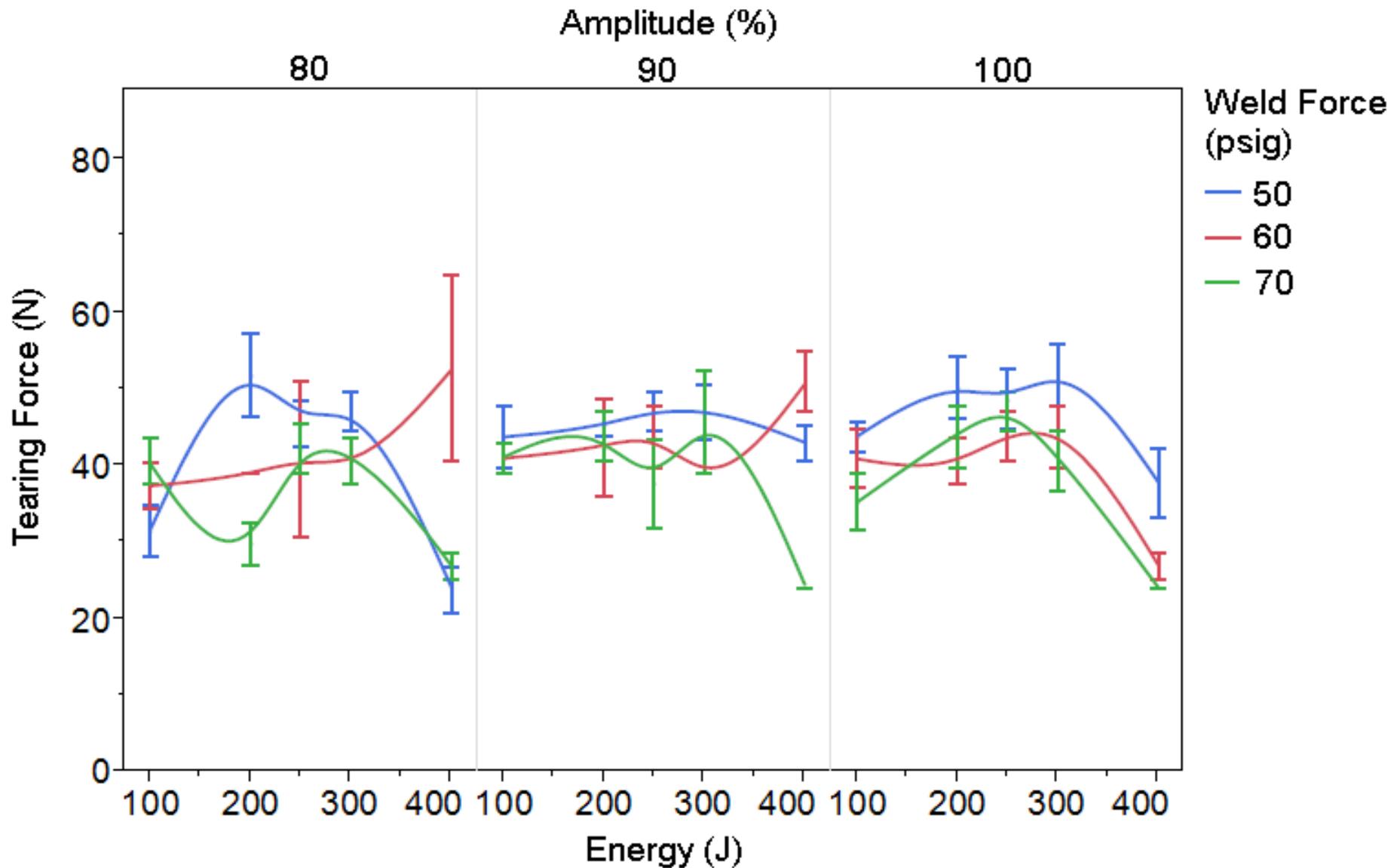
# ASTM D1922 Tear Resistance



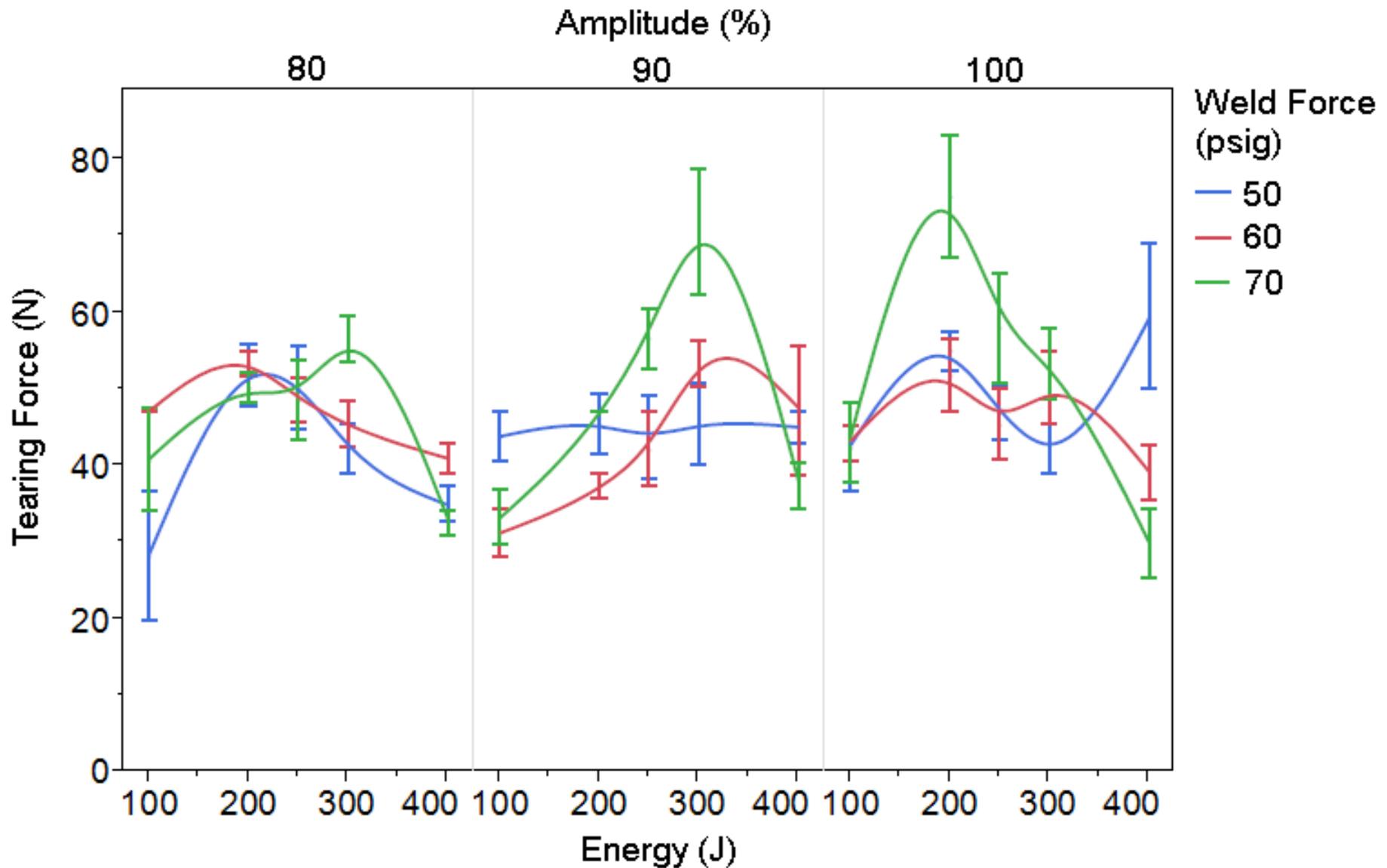
# Mean Tearing Force – All Materials



# Mean Tearing Force – E



# Mean Tearing Force – C



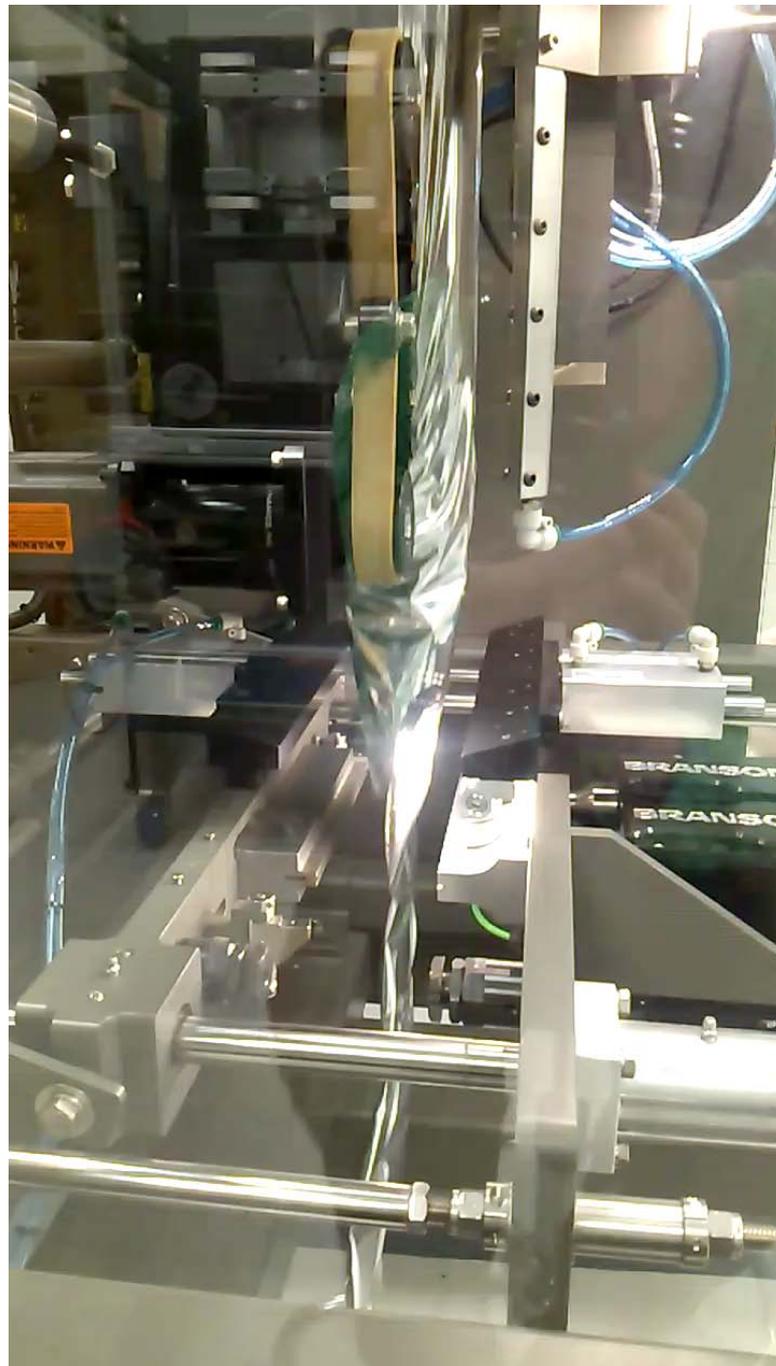
# Conclusions

- Ultimate Strength: Increased pressure, amplitude, and energy generally correlates with increased strength
- Tearing Force: No strong correlation, high energy results in breaks along weld due to micro holes
- Customer may have visual or barrier requirements that will reduce weld strength
- Trade-offs will be required to satisfy all requirements

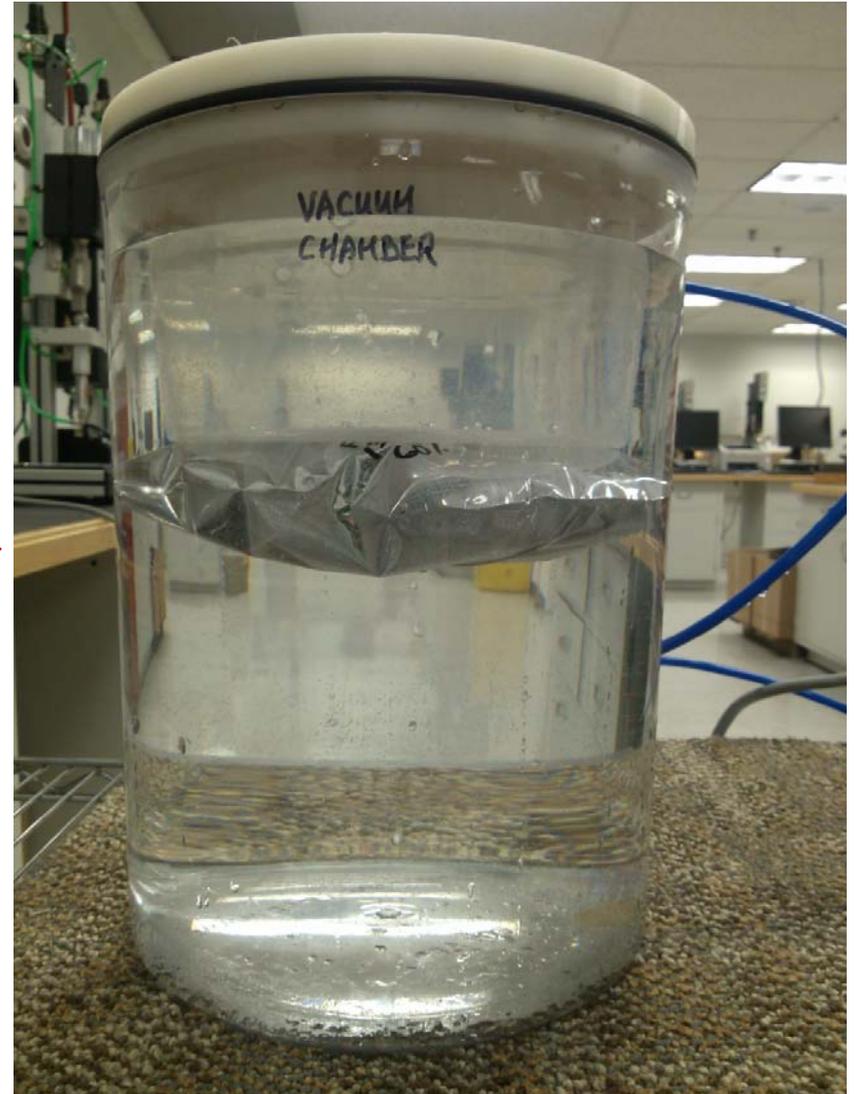
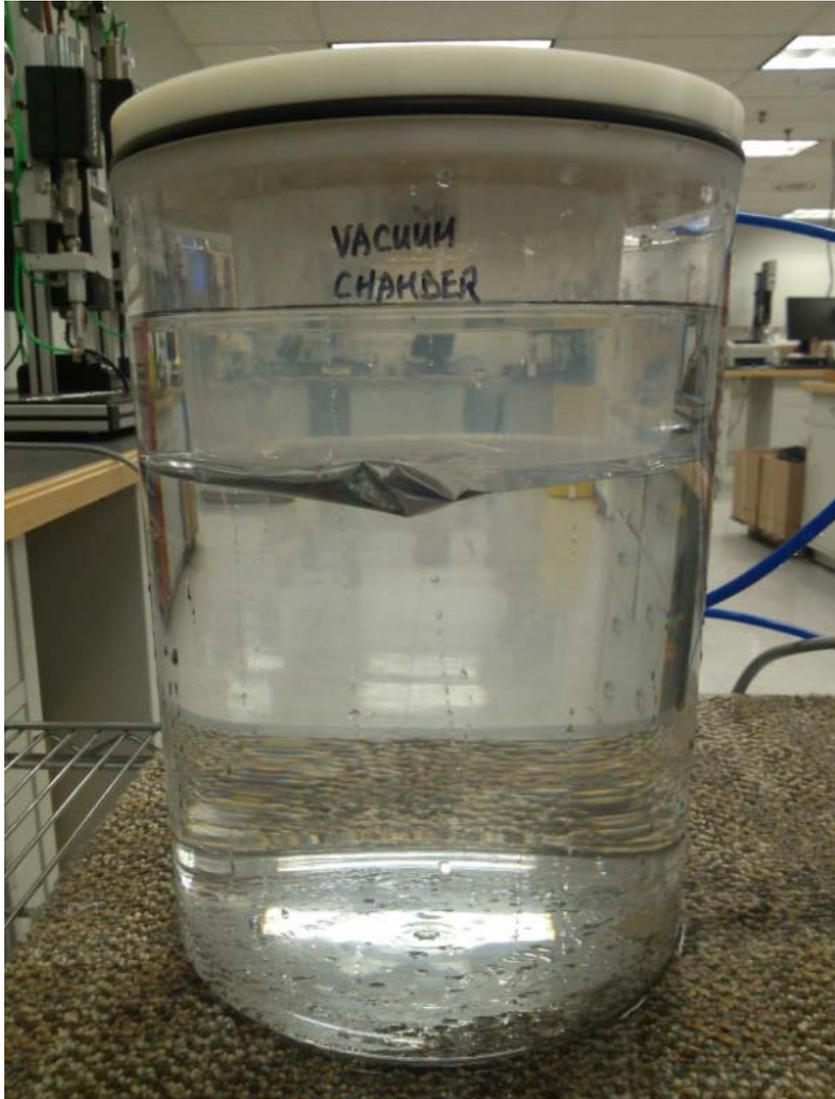
# Future Research: Vertical Form Fill Seal



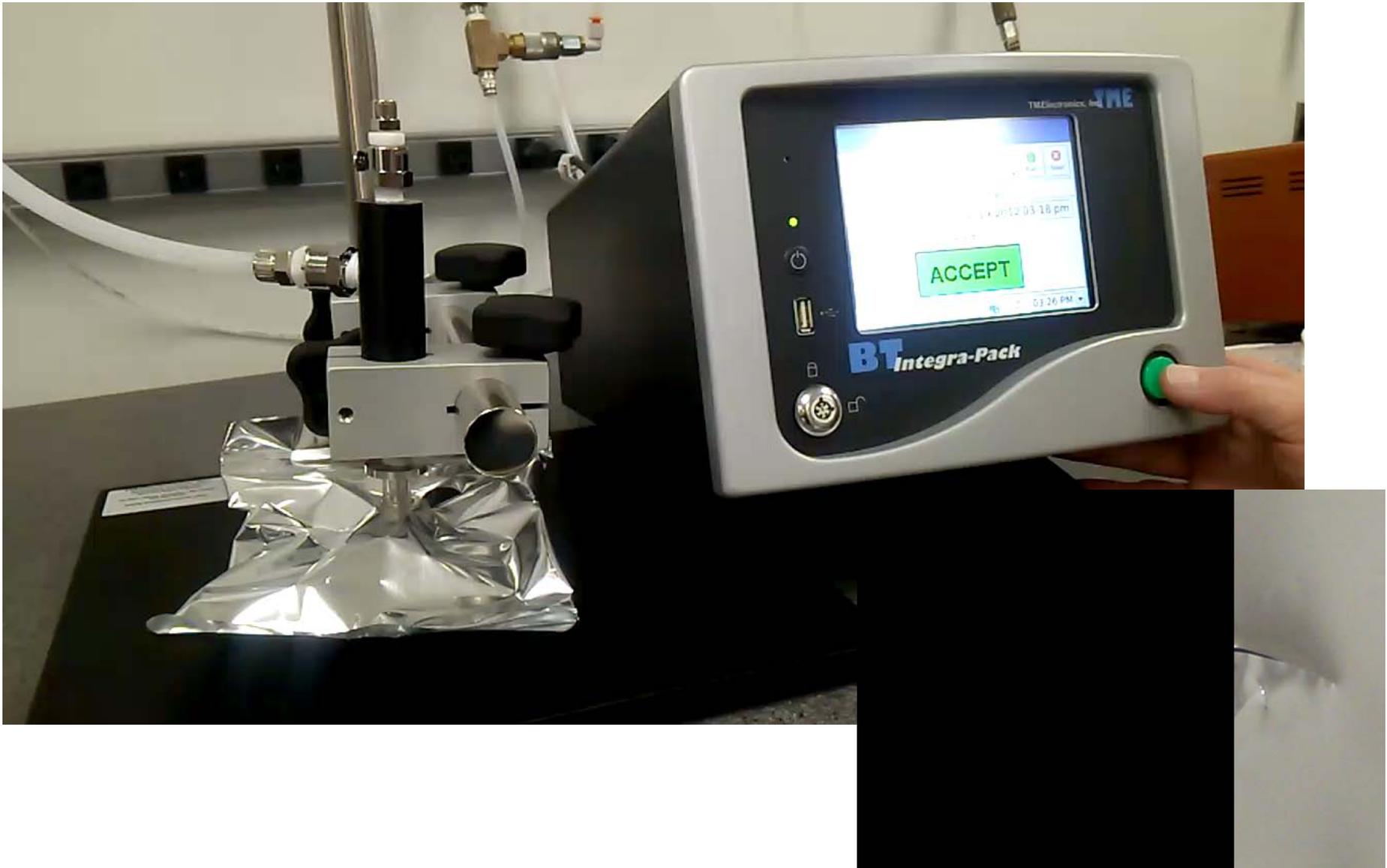
VFFS



# Vacuum Testing



# Burst Testing



# Acknowledgements

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Jessica Riedl  
jesriedl@iastate.edu

