

LEAN PROCESS FLOW SHELLCASE ANNEAL

Team: Case X Case



Project Objective

To create a proof of concept signal piece flow annealing system using induction technology and lean manufacturing principles.

Background

- Annealing softens the metal by removing work induced stresses from creating the shell.
- If not properly annealed, the shell will split when the bullet is fired, causing damage to the firearm or harming the operator.
- In the current batch process one bad shell causes the entire batch to be thrown out.
- Single piece flow changes these large batches to batches of one.

Key Requirements

- Utilizes induction to anneal shell cases.
- Process flow rate of 1 shell per second.
- A near zero defect rate.
- Applicable to 9mm, .40, and .45.
- Does not pose a hazard to employees.

Governing Equations

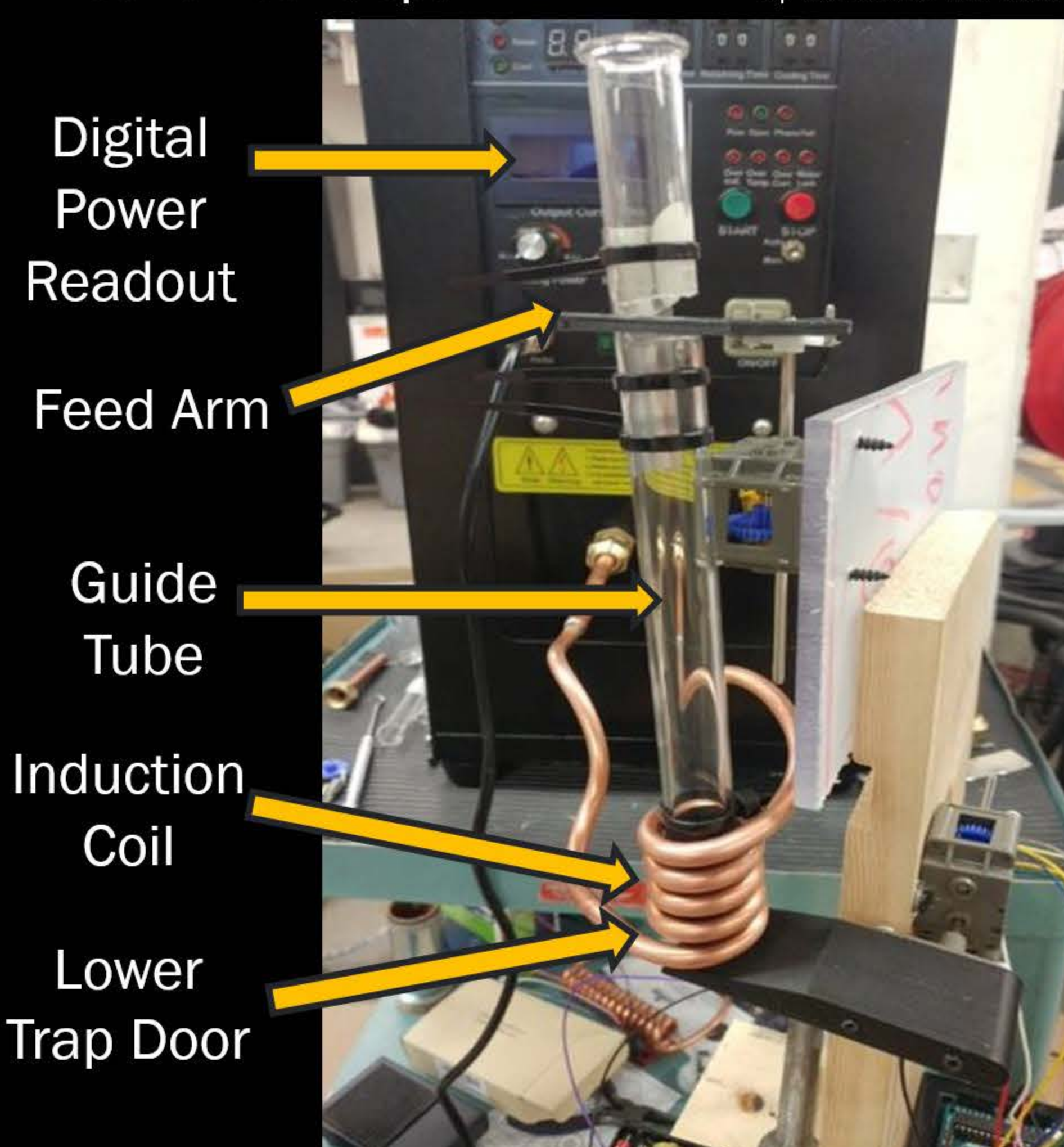
$$P = m * c * \frac{\Delta T}{\Delta t}$$

$$\delta = \frac{1}{\sqrt{\pi f \mu \sigma}}$$

Skin Effect (Depth penetration)

Top view of Shell case showcasing depth direction

Proof of Concept



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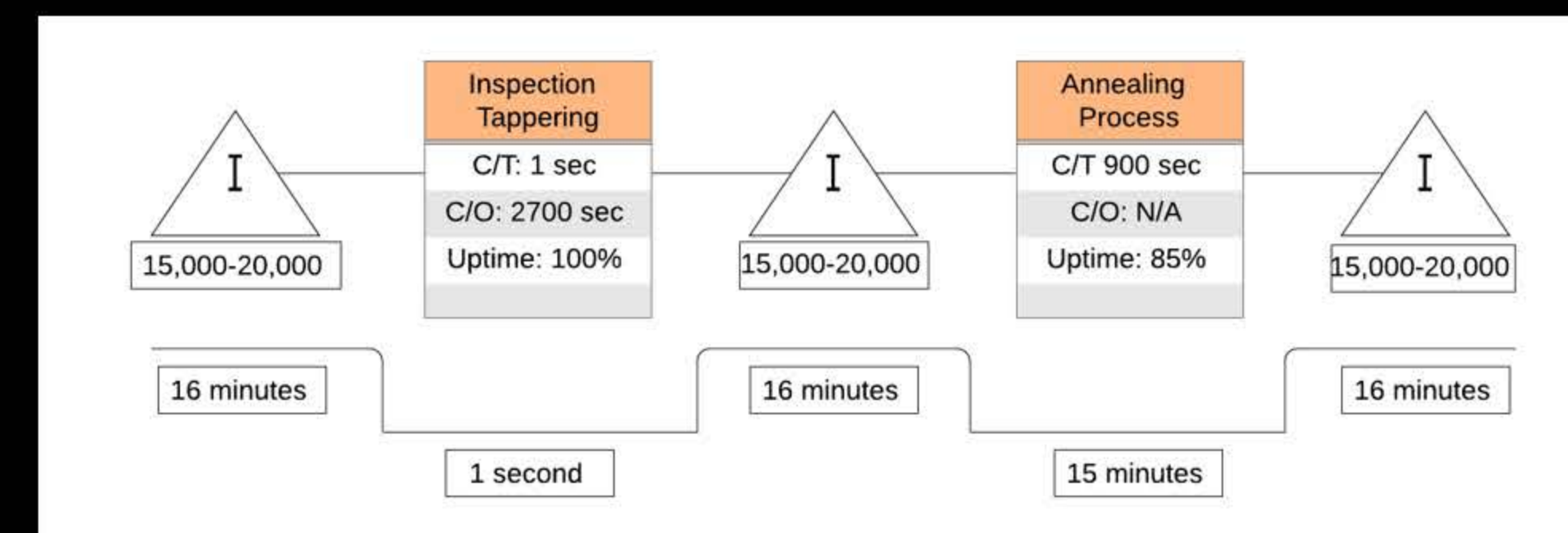
Dwain Stucker

Value Proposition

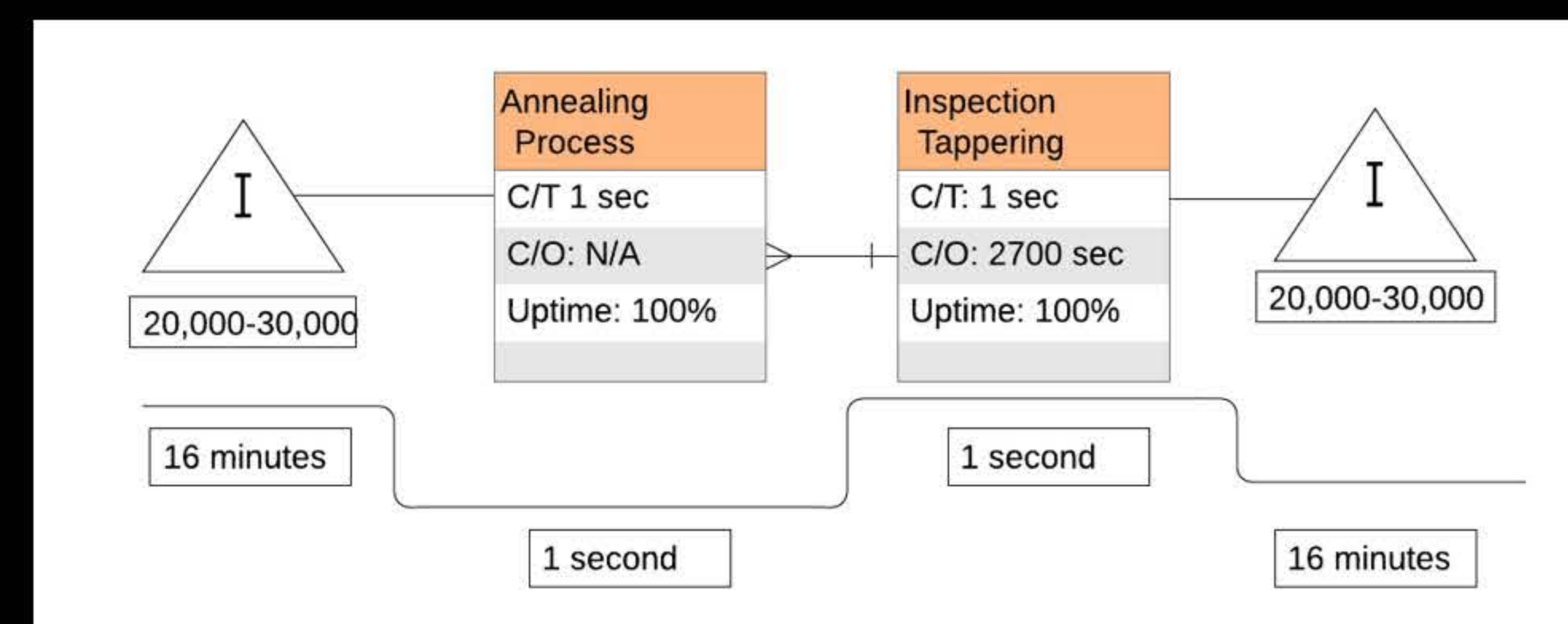
Vista Outdoor ammunition is supplied to law enforcement, who face life and death situations. A defective shell can make the difference between life and death; therefore, a properly heat-treated shell is crucial. Instead of using a batch oven process, we are designing a product that uses induction technology to anneal shells faster and more efficiently.

Lean Manufacturing

Current State



Future State



Inventory Saved (\$/day)	
9mm	100,000.00
.40	14,285.70
.45	571.43

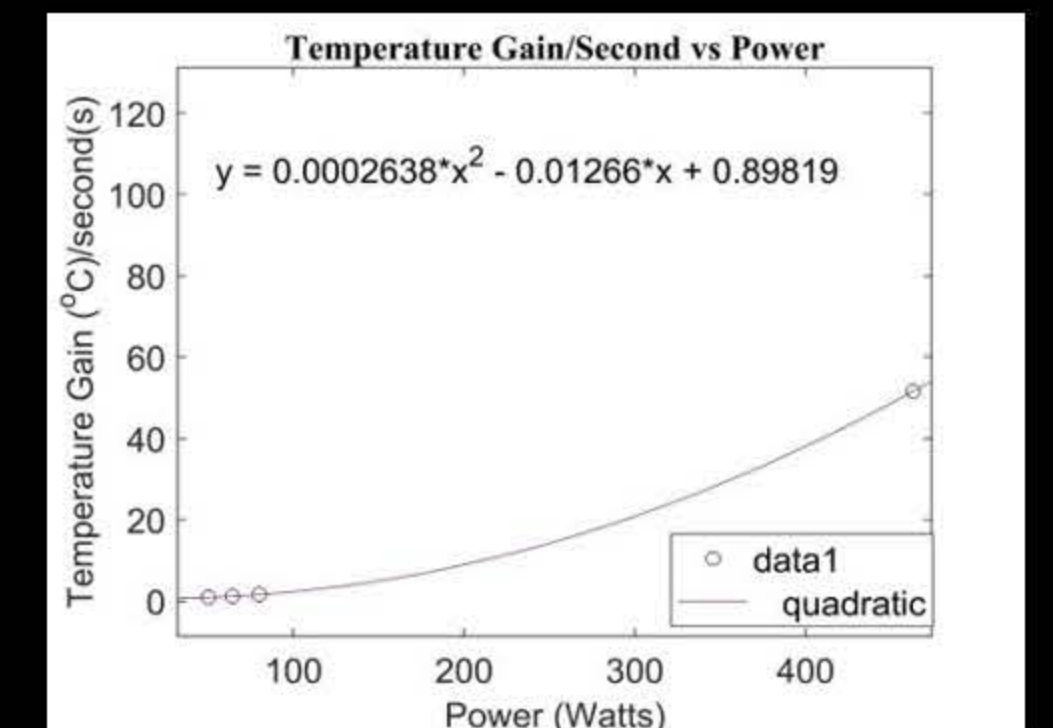
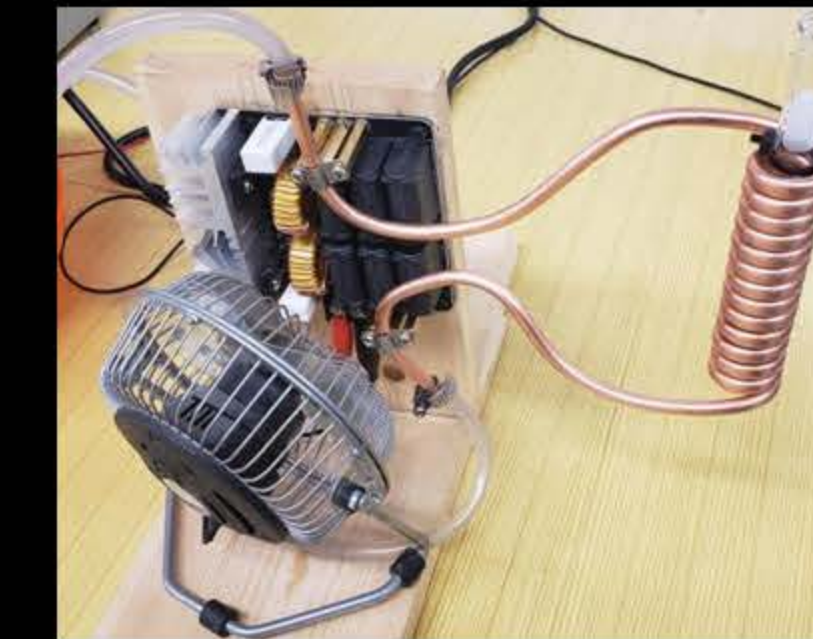
This table shows the cost savings in the inventory between the inspection/tapering step and the annealing step in the "current state" chart causes.

Cost Percent Reduction	
From Natural Gas	93%
From Electrical Oven	87%

This table shows the percent reduction in cost for moving from a natural gas oven or an electrical oven to the team's induction heater.

Project Learning

Math Model Test Design



Used to establish power necessary to achieve annealing temperatures.

Shell Testing

Annealed shells were pressed till failure to establish when annealing occurred. Annealed shells tend to buckle while hardened shells split.

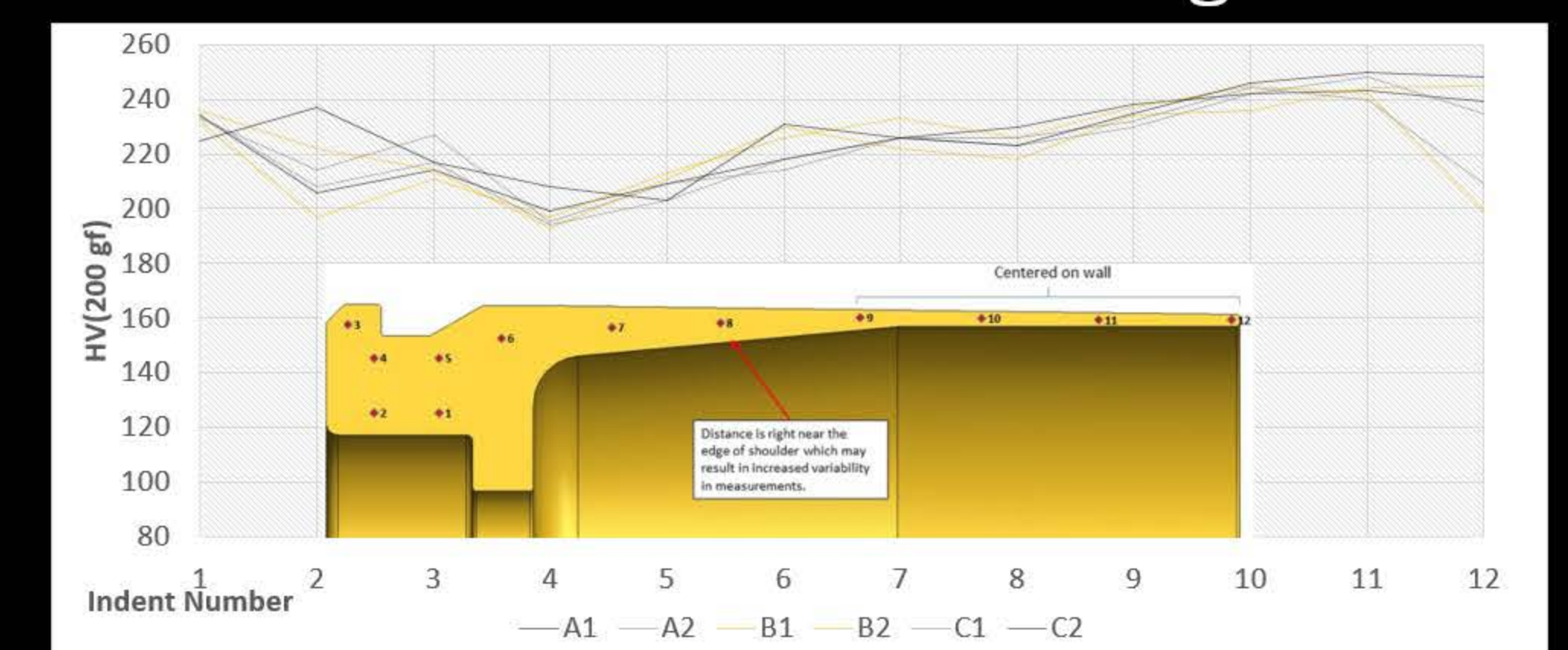
Press Tool



Shell Failure Modes



9mm 30A Hardness Testing:



9mm 38A Hardness Testing:

