THE EXTRACTORS

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PROJECT BACKGROUND:

- During the manufacturing process of heat exchangers, tubes are expanded using high water pressure
- Occasionally tubes are ruptured during this process
- Our task is to safely extract these ruptured tubes
- Tool needs to be safe, durable, and efficient

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DESIGN SPECS

- Tubes are 1”, 7/8”, and 5/8” in diameter
- Aluminum tubes
- Up to 320” long
- Minimal damage to surrounding fins when extraction is performed
- Tools designed for winch pulling

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TESTED CUTTING TOOLS

- Carbide Lathe Tooth Insert
- High Speed Tool Cutter
- Hacksaw Blade
- Reverse Drilling

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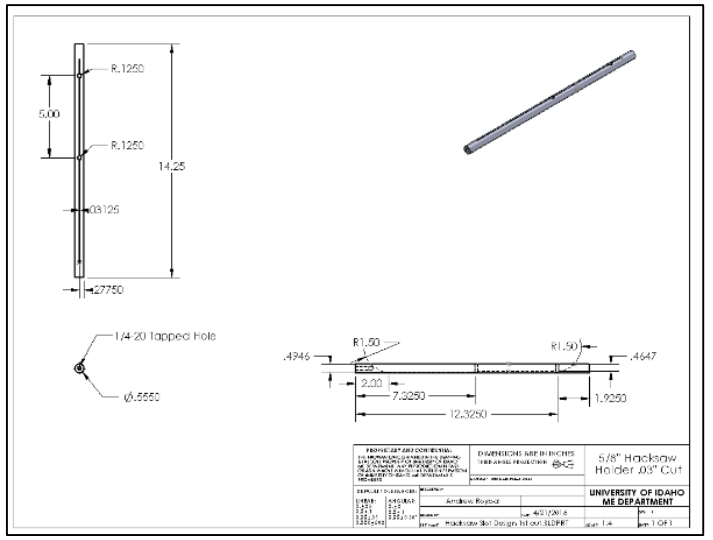
FINAL CHOICE OF DESIGN

Modified Hacksaw Holder

- Rationale
  - Removal Process Requires Straight Cuts
  - Most Consistent Cutting Tool
  - Scales to 5/8” 7/8” 1” without significant modification
- Manufacturing Process – Easy
  - Requires Manual Lathe and CNC Mill



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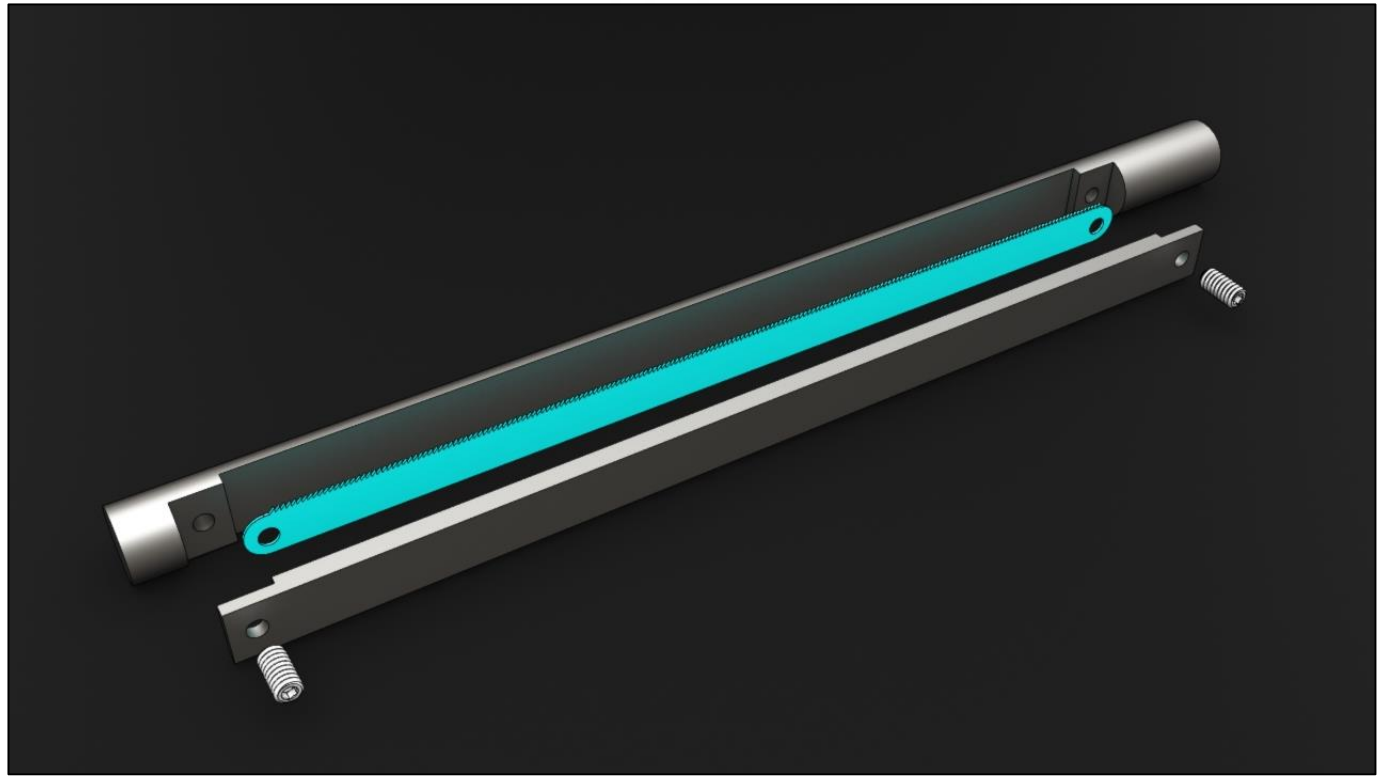
AS BUILT – SHIM DESIGN

Design Concept:

- 1 set of removable pieces
  - Adapts to all 3 sizes
- Easy removal of saw blade
- Adjustable cut depth
  - Three steps



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AS BUILT – SHIM DESIGN

Components:

- Base
- Shim
- Screws

Design Failures:

- Cold Rolled Steel
  - Warps when material is removed
- Uneven pressure caused tool to spin
  - Inconsistent
- Additional removal time
  - To attach/detach shims

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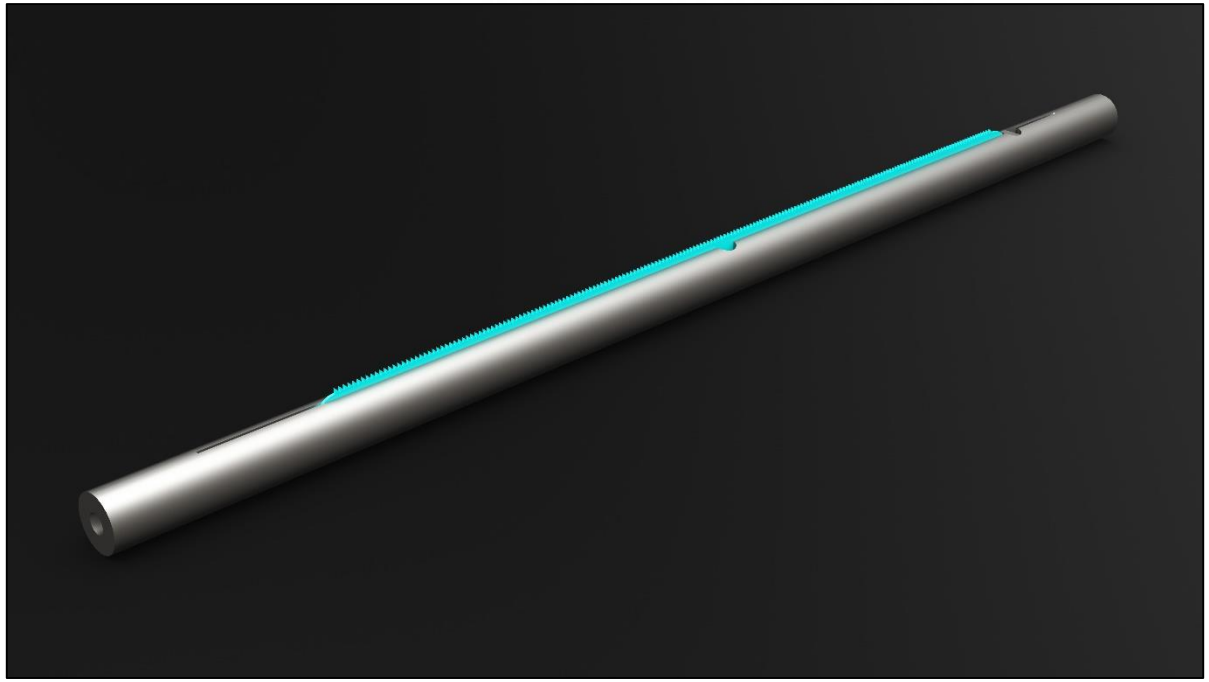
AS DESIGNED

Rational for redesign:

- Less manufacturing time
- No significant material removed
  - No warping
- No shim substitution
  - Reduces removal time
- Product does not spin in tube
  - Tested in 12’ coil with trimmed blades



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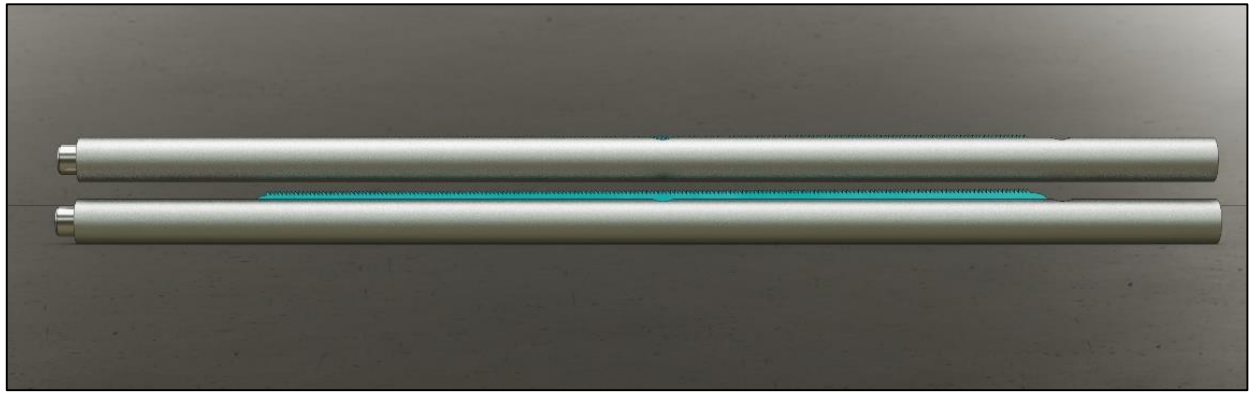
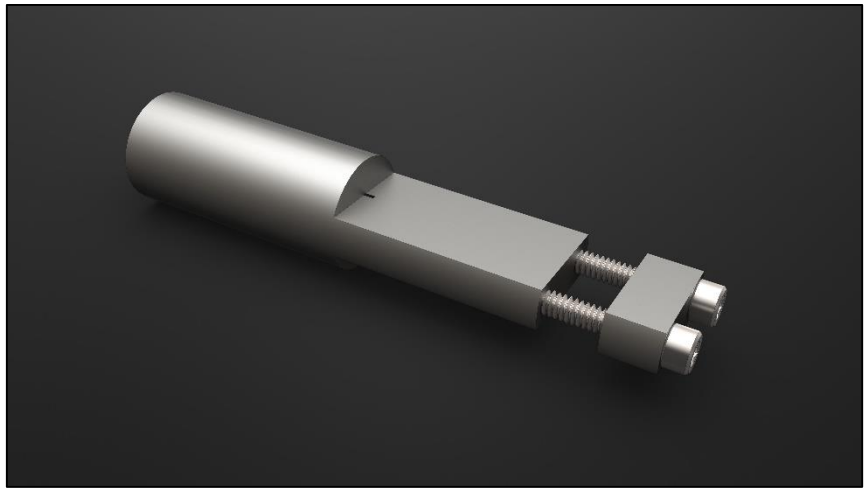
AS DESIGNED – DESIGN CONCEPT

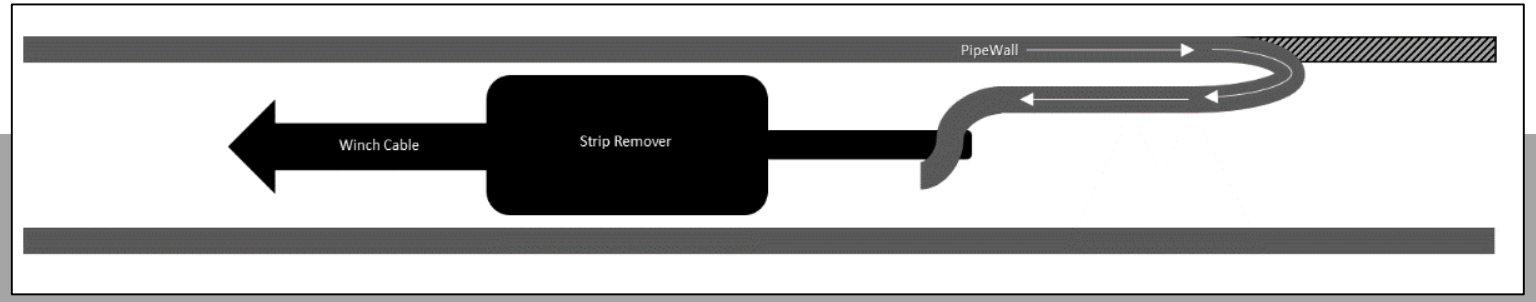
- Full contact with inside of pipe
- Three tools per pipe size
  - 3 Steps: .03” .06” .09”
    - Similar to shim design
- Angle of attack reduced by 400%
  - From original hacksaw design
- Full length of blade will be engaged



STRIP REMOVAL TOOL

- Objective – Utilizes aluminum's malleable properties to remove a small strip of pipe.
  - Requires two straight cuts (from hacksaw design) about 3/8" apart.
  - The strip is clamped between the two plates of the tool
    - The end of the strip is bent though the hole.
    - When the winch engages, the tool bends the aluminum in a way that as the winch pulls, the strip is peeled away from the pipe.





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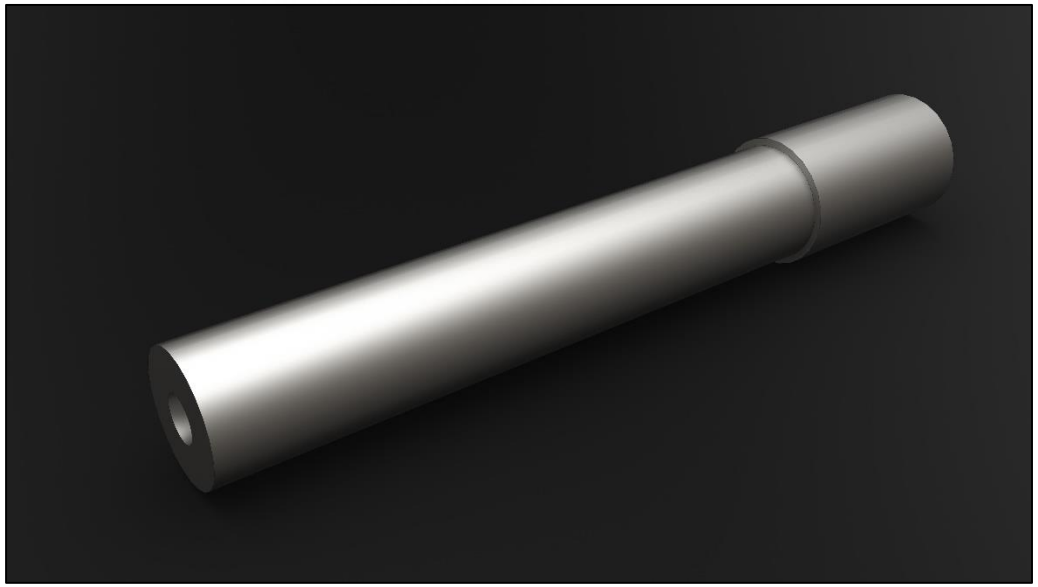
STRIP PEELER VIDEO EXPLANATION

THE PLUG

- Objective – Use Winch and plug to pull the pipe out.
  - Requirements
    - Removed strip
- How it works
  - Small diameter is marginally smaller than the ID
    - Fits inside the pipe.
  - Large diameter is the same as the OD
    - Winch pulls entire pipe when large diameter come in contact with the pipe



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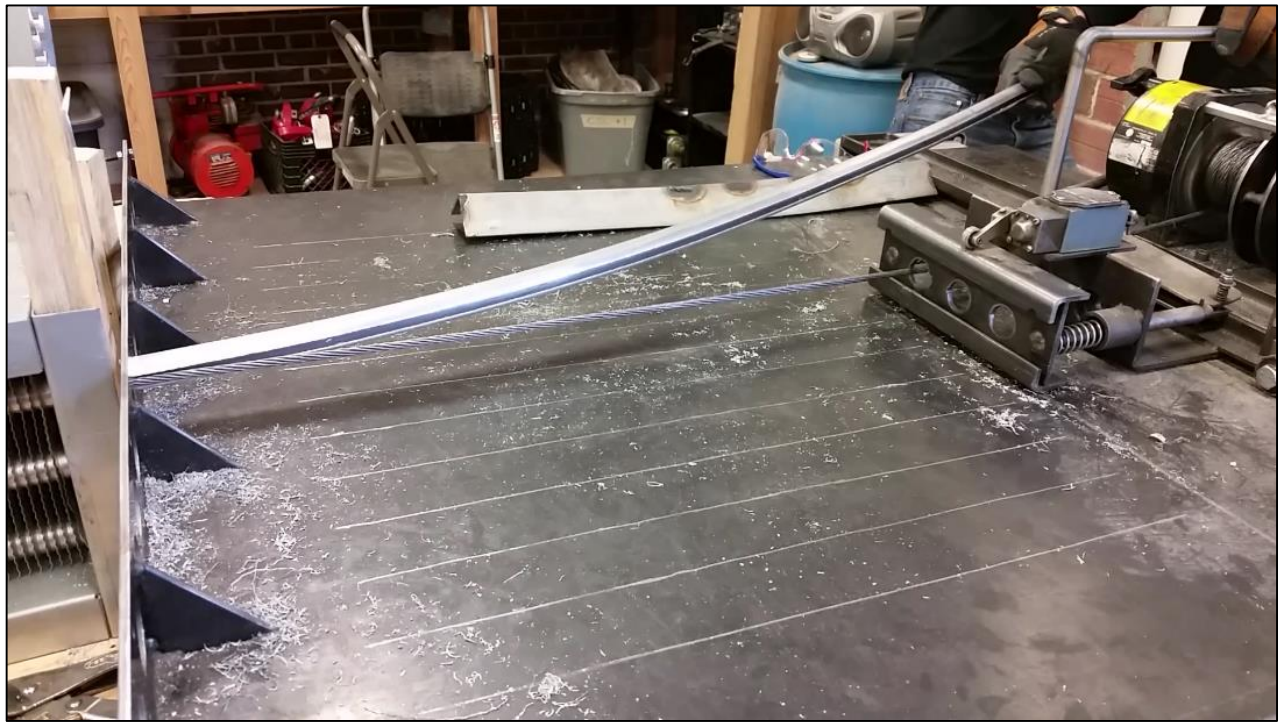
PLUG VIDEO EXPLANATION



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QUESTIONS?