THE EXTRACTORS

Lane Matteson, Andrew Roybal, Tony Keys, Alan Edwards

University of Idaho
College of Engineering

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

COLMAC COIL
Manufacturing Inc.

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

COLMAC COIL
Manufacturing Inc.

CURRENT DRILLING METHOD

- Involves pushing drill bit though the pipe.
- Concerns
  - Does not inherently self-center
  - Long process
  - No guaranteed success
  - Potential safety hazard

COLMAC COIL
Manufacturing Inc.

REVERSE DRILLING PROTOTYPE

Tool Design	Scale 1-4
Safety	3
Reliability	3
Durable	4
Quickly Operated	2
Easily Operated	4
Easy Production	3
Cost	3

Scale	1	2	3	4
Rating	Poor	Average	Good	Very Good

COLMAC COIL Manufacturing Inc.

FIRST TEST OF DRILLING TOOL

Tube results

- Pulling drill bit (not pushing)
- Self-centering (no wandering)
- Removes pipe to desired depth
- Currently a slow process
- Requires securing the frame

COLMAC COIL Manufacturing Inc.

ORIGINAL CARBIDE INSERT TOOL

- Soft aluminum adheres to carbide insert
- Tube wall bulges preventing effective cutting

COLMAC COIL
Manufacturing Inc.

REVISED CARBIDE INSERT TOOL

- 15 degree angle of attack, the chips produced with lubrication are a spiral in the relief area
- Tool draw backs: Tool does not cut straight
- Modifications needed to produce a straight cut and adjustable depth.
- Without lubrication the aluminum will adhere to the carbide and prevent cutting.

COLMAC COIL
Manufacturing Inc.

HACKSAW PROTOTYPE

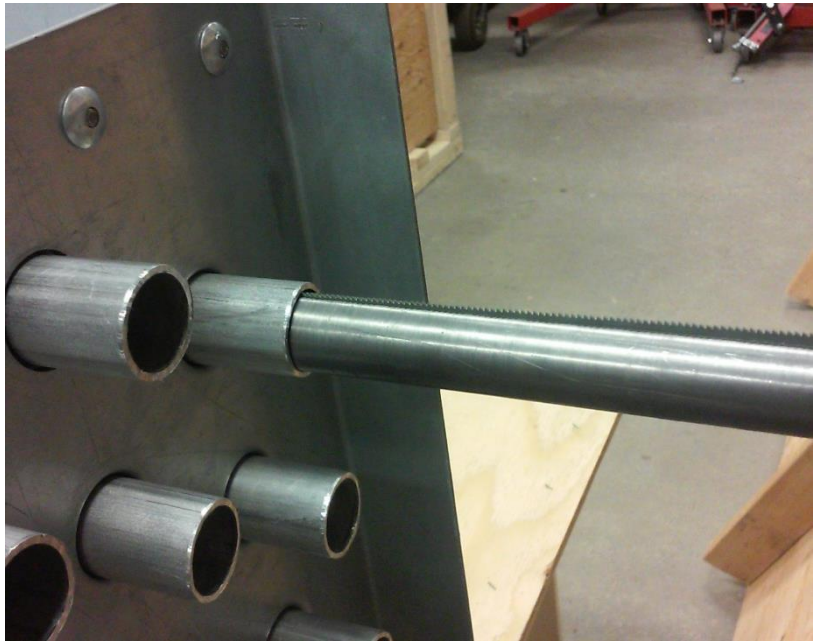
Tool Design	Scale 1-4
Safety	3
Reliability	2
Durable	2
Quickly Operated	3
Easily Operated	4
Easy Production	4
Cost	4

Scale	1	2	3	4
Rating	Poor	Average	Good	Very Good

COLMAC COIL Manufacturing Inc.

CURRENT HACKSAW CONCEPT

- 1/32” slot
- Hacksaw blade fits in slot
- Circular Pin at end of design keeps hacksaw from exiting the back of the tool
- Cutting depth – though tube, slightly into fins



COLMAC COIL
Manufacturing Inc.

CURRENT HACKSAW CONCEPT

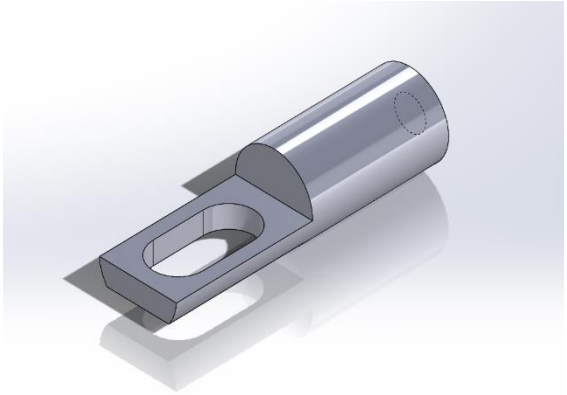
Problems with design

- Full Depth First Pass
  - Too aggressive – winch (and frame) stall and yield amount of force required to pull this blade though on first pass
  - Current Solution – Mill non-tooth end of hacksaw blade to certain depths (.08”, .05”, .025”)
    - This will not translate into a final design due to number of engaging teeth.
      - Without many teeth engaging, tool will spiral in pipe

COLMAC COIL Manufacturing Inc.

STRIP REMOVAL TOOL

- Objective – Utilizes aluminum's malleable properties to remove a small strip of pipe.
  - Requires two strait cuts (from hacksaw design) about 3/8" apart.
  - Works as a hook
  - The strip is located at the top of the tool
    - The end is bent though the hole.
    - When the winch engages, the hook bends the aluminum so as the winch pulls, the strip is peeled off of the pipe.



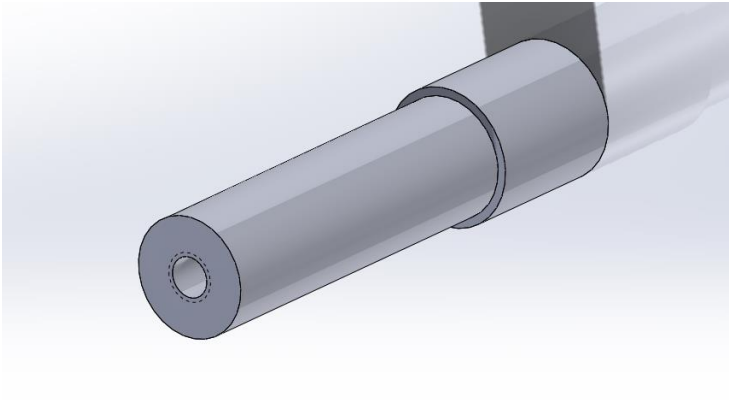
COLMAC COIL
Manufacturing Inc.

STRIP PEELER VIDEO EXPLANATION

COLMAC COIL
Manufacturing Inc.

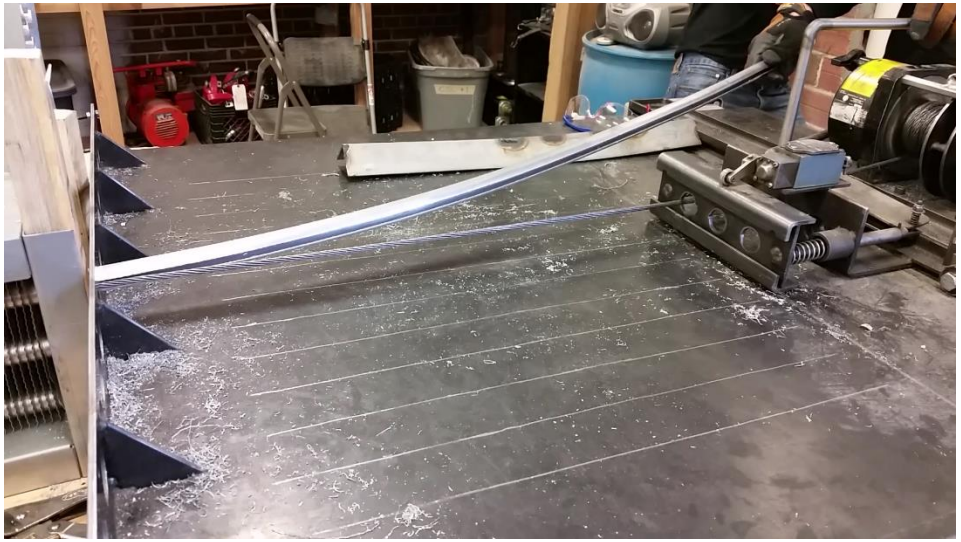
THE PLUG

- Objective – Use Winch and plug to pull the pipe out.
  - Requirements
    - Removed strip
    - Crimped pipe end
- 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



COLMAC COIL
Manufacturing Inc.

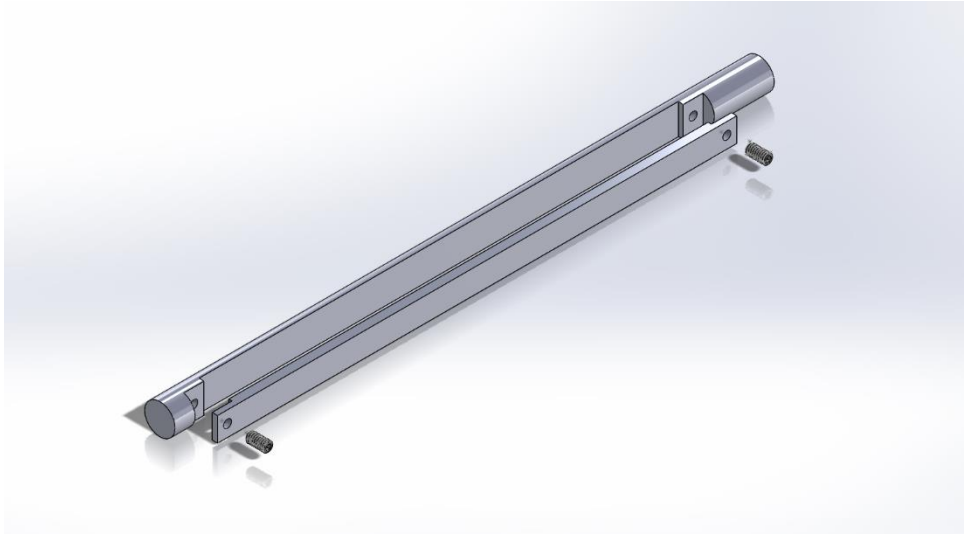
PLUG VIDEO EXPLANATION



COLMAC COIL
Manufacturing Inc.

FUTURE HACKSAW DESIGN

- Utilizes full length of hacksaw blade with each cut
- Uses removable “shims” for depth adjustments
- Will require 10” 18TPI hacksaw blades



COLMAC COIL
Manufacturing Inc.

THE SHIMS

- 4 shims
  - Maximum Depth – .1875”
    - Measured from bottom of shim to ledge
    - First tooth does not engage
  - Minimum Depth - .3175”
    - Blade cuts though pipe
    - Blade may score the fins
  - Change in depth
    - .031” per shim
    - Aims to engage teeth the entire cut

COLMAC COIL Manufacturing Inc.

PROJECT SCHEDULE

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Starting	Jan 11	Jan 18	Jan 25	Feb 1	Feb 8	Feb 15	Feb 22	Feb 29	Mar 7	Mar 14	Mar 21	Mar 28	Apr 4	Apr 11	Apr 18	Apr 25	May 2	May 9
Phase One		Review with client																
			Detailed design review															
			Determine best extraction method															
					logbooks 2/17													
Phase Two						Review With Client												
								Scale tool to other sizes										
													Logbooks 4/17					
									Build all remaining hardware									
															Wiki review			
													Test each size, Qualifications met?					
																Wiki 5/5		
																Expo 5/1		
Phase Three																	Final Deliverables due 5/9	

COLMAC COIL
Manufacturing Inc.

BUDGET

- Currently have spent $500
- Parts ordered
  - Steel rod, hack saw blades, lathe cutting teeth, tool steel, low-carbon flat stock, 7/8” drill bit.

TRIALS AND FAILURES

But Trial and Failure Brings…

COLMAC COIL
Manufacturing Inc.

SUCCESS

COLMAC COIL
Manufacturing Inc.

QUESTIONS?

Thank You

COLMAC COIL
Manufacturing Inc.