TEXAS STATE UNIVERSITY

The rising STAR *of Texas*

M2.4 - 3D Tube Bender

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RH systems

Objective

Problem Definition

- Design and construct an automatic tube bending machine capable of bending 1/4" diameter copper or stainless-steel tubes into geometries such as spirals, for RH Systems to use in their manufacturing facility.

RH Systems "Stretch	Teams Requirements	Requirements Met
Bend 10' of copper and steel	Bend 3' of copper only	Bent 10" of copper
Able to bend 3D in spiral and helical shapes	Z-axis controlled by stepper motor	Z-Axis Manual Control via Allen Wrench
Automatic bending mechanism	Servo motor initial bending mechanism	Servo Motor Programmed to Create Initial Bend
Automatic feed/drive for tube	Linear actuator driving the tube	Linear Actuator Drives Tube via Program Control
Bend pipe with bend radius	Bend pipe with a bend	Bend radius of 1.5"
Reduction of kinking while	Fabricate hard and stable	Dies Machined out of 6061
Feeding mechanism must be continuous	Clamp attached to actuator feeds the tube into bending dies	Vise Clamps onto Tube and is Pushed and pulled by Actuator
Outside Diamter of tube must be at least 0.25"	Outside Diamter of tube must be at least 0.25"	Outside diamter of tube has been 0.25"

Acknowledgements

- Dustin Hardy
- Dr. Austin Talley
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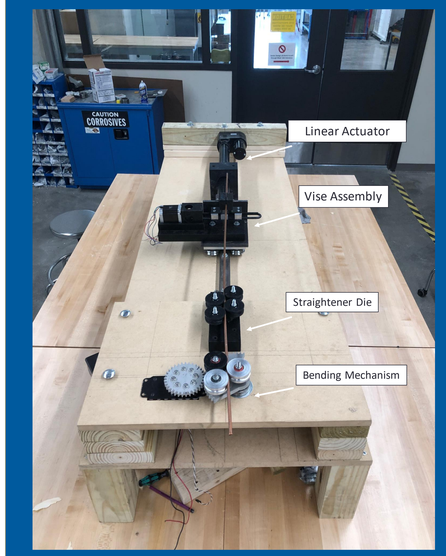
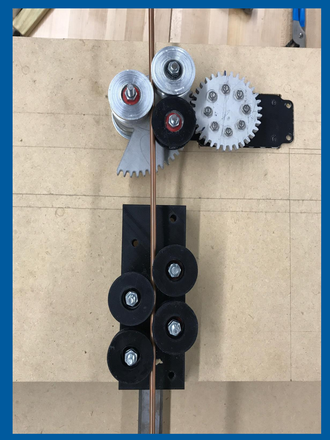
- Jason Wagner
- Mark Summers
- John Ivey
- Nick Wood

Final Design



Bending Mechanism and Straightener Die



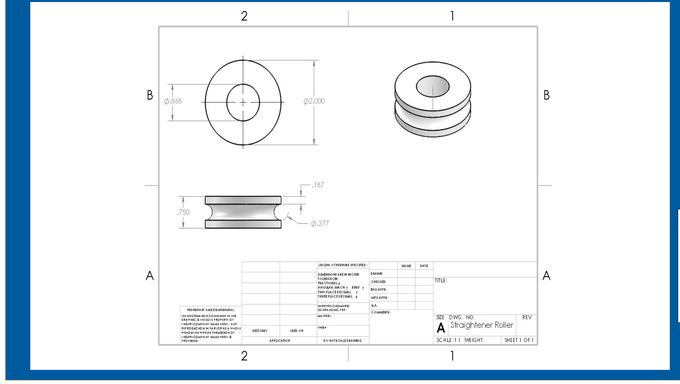
Operation

- Tube gets secured into vise clamps by the stepper motor
- Actuator extends driving the tube into the bending mechanism
- Servo motor rotates driving gear to force the driven gear and bending dies to bend the tube to the desired angle
- Once bent, actuator continues to feed tube through dies to finish the bend of the tube
- Z-axis die catches tube and stepper motor allows die to ascend to create spiral shape

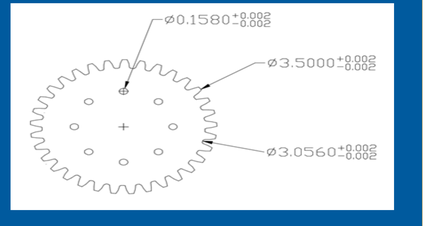
Assembly

- Bearings placed within the dies to allow the dies to spin and decrease friction with feed of tube.
- Dies and gears placed upon 8mm bolts
- Bending dies placed on gear to create initial bend
- Driving gear placed on servo motor to allow for autonomous rotation
- Straightener dies placed between bending dies and actuator to prevent kinking
- Tube gets placed into vise, gets pushed by actuator and feeds into the bending dies
- Linear track placed between linear actuator and bending dies to allow vise assembly to be pushed
- Z-axis powered by stepper motor

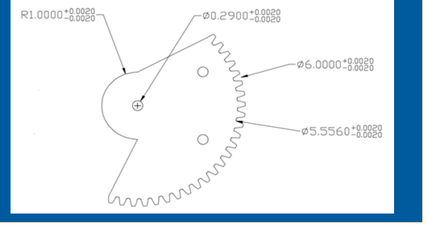
CAD Drawing of Die



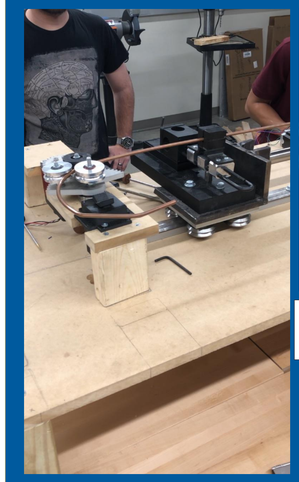
Driver Gear

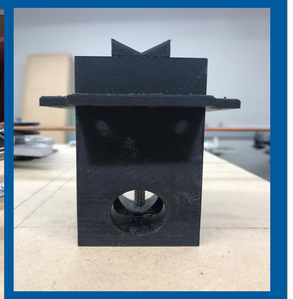


Driven Gear



Process





Z-Axis Design

Successful Bend

Future Implementations

- Stepper controlled Z-axis die
- Ability to bend 10ft of tube
- Ability to bend steel tubing
- Design safety measures
- Continuous feeding
- Adding a second clamp for more stability