To: Professor Sarah Oman

From: Kadeja Alhossaini,

Nathan Firor,

Edwin Smith,

Ethan Vieane

CC: Leah Liebelt

Date: December 6, 2019

Re: Final Prototype Summary

Introduction:

The purpose of our project is to create a braze-welding jig for a company called SunTrac, USA, that can hold copper pipes together in certain orientations while they are being welded together. There are six vertical pipes that will be welded between two horizontal pipes. The vertical pipes are manufactured in three different sizes, 4 foot, 6 foot, and 8 foot, therefore our design must be adjustable to contain these sizes. The jig needs to also be able to rotate and lock in various positions thus a mechanical element must be added to satisfy this requirement. The team came up with a design that satisfies all these requirements and a prototype of the major subsystems were constructed to verify the functionality of the design.

First Prototype:

The first prototype that was constructed was for the purpose of demonstrating the appearance of the jig and did not contain the actual working subsystems. Figure 1 shows the first prototype the team constructed.

Figure 1. The first prototype

As seen in figure 1, the prototype stands on a three legged tripod and rotates about a pivot point in the center. Another feature that can be seen is that the square tubes that make the skeleton of the jig can elongate and collapse as desired. On these square tubes, there exists a horizontal bar with six equally spaced insertions where the vertical pipes will be held in place. The actual functionality of these components are not demonstrated in this prototype but it will be discussed by different subsystem models.

Subsystem 1: Elongation of Tubes

To elongate and adjust the size of the jig, the tubes are designed to be expandable on both sides. Each elongation is 1 foot long. To lock them into the desired configuration, pins will be inserted on each end of the square tubes. Figure 2 shows how these elements will be put together.

Figure 2a. 4 foot tubes

Figure 2b. 6 foot tubes

Figure 2c. 8 foot tubes

Figure 2. Expandable tubes

In figure 2, the tubes are constructed using the same width of the actual jig, but the length is scaled down. In figure 2a, when no tubes are expanded, the jig will contain the 4 foot pipes. In figure 2b, the tubes are elongated on either side once, which holds the 6 foot pipes, and in figure 2c, when it's fully elongated, it can carry the 8 foot pipes. Moreover, these pins do not need nuts

behind them since they will be facing the front of the jig and it is oriented such that it holds a 10 degree angle.

Subsystem 2: Rotating and Locking

To rotate and lock the jig, the team came up with a design that includes a gear and a foot pedal. When the foot pedal is pressed, it releases a gear which allows the user to rotate the jig to the desired location, and when the pedal is released, it will lock the gear again. Figure 3 represents the functionality of the pedal and gear.

Figure 3. Rotating and locking mechanism

In figure 3, the clamp's upper tooth, that is circled in red, represents the foot pedal and the green block on the top represents the location of the jig. The foot pedal will be placed on one of the legs of the stand that was shown in figure 1 and the cord that is attached to it will be traced to the back of the gear where the pivot is. The gear will be placed as shown in figure 4.

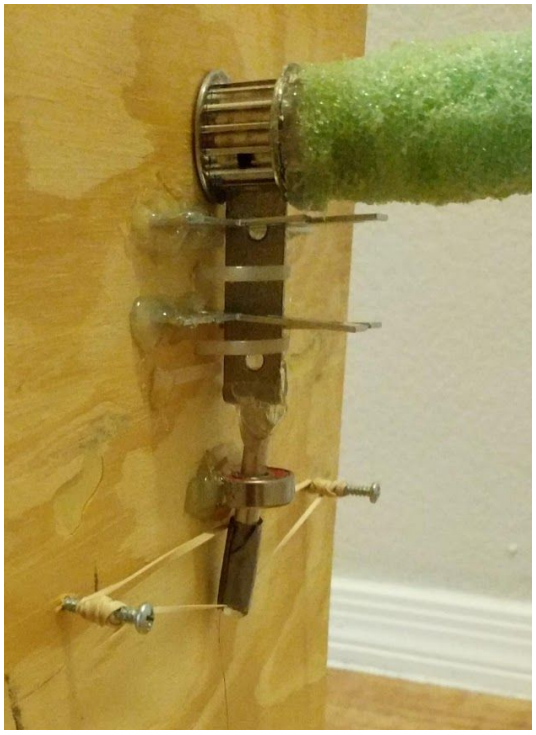

Figure 4. Gear behind the jig

As seen in figure 4, the gear is locked by a metal plate. When the clamp in figure 3 is pressed, the cord will be pulled thus creating tension in the rubber band which pulls the metal plate down and in turn releases the gear. By releasing the gear, the jig can be rotated in any preferred position. Now when the clamp is released, the tension in the rubber band will dissipate thus returning the metal plate in its original position which locks the gear. In the atual jig, the functionality of this subsystem is quite similar, however in place of the rubber band, a spring will be placed, and the clamp (foot pedal) will not be spring loaded.

Subsystem 3: Locking Horizontal pipes

As discussed before, there are vertical and horizontal pipes that need to be welded together. The vertical pipes will be locked by using a rigid horizontal bar that were represented in the first prototype in figure 1, however to lock the horizontal pipes, the same design will not suffice as the jig will be rotated. Therefore, to lock the horizontal pipes, the team has designed a power screw lock. Figure 5 shows the power screw lock.

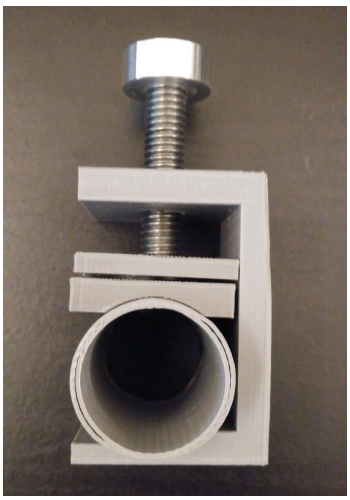

Figure 5a. Side view

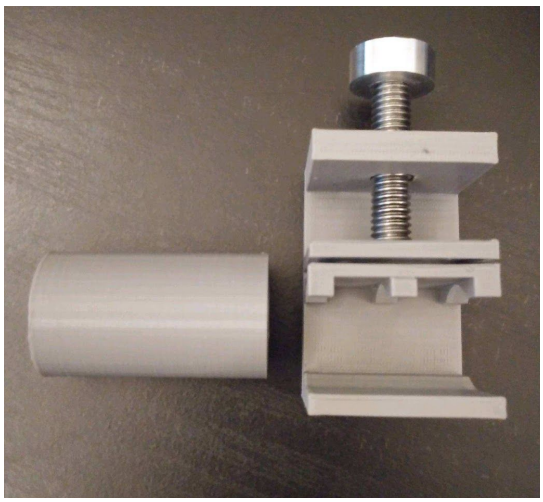

Figure 5b. Front view

Figure 5. Power Screw lock

As seen in figure 5, the power screw locks the pipes by utilizing a bracket and a movable plate. In figure 5a, the horizontal pipe is locked by applying a compressive force from the plate and the bracket which was a result of screwing the bolt. In figure 5b, the pipe is released by unscrewing the bolt and releasing the force on the pipe. Moreover, this subsystem was constructed upto scale, so it is similar to the actual design with the difference of materials used for construction as this model was 3D printed.

Conclusion:

The goal of our project was to hold pipes while they are being welded together for a company called SunTrac, USA. The pipes come in three different sizes, therefore the design needs to adjust as needed. The team came up with a design that had three major subsystems to satisfy the clients requirements. The first was the adjustable square tubes to accompany the different alteration of sizes, the second was a rotating and locking mechanism using a gear and foot pedal to maneuver the jig, and the third was a power screw bracket that applies pressure on the horizontal pipes to lock them into position. All in all, these major subsystems verify the functionality of the jig design before the actual device is constructed.