

Capacitor Assembly Automation

TEAM 6:

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Outline

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- ▶ Problem Statement/Goal Statement
- ▶ Product Specs
- ▶ Current Process
- ▶ Improved Process with Updated Operations
- ▶ Time Improvements
- ▶ Proposed Floor Layout
- ▶ Progress/Future Work
- ▶ Budget Report

Introduction and Background Information

- ▶ Unison Industries
 - ▶ Subsidiary of GE
 - ▶ Special in electrical components for jet engines, ignition systems and generators
 - ▶ 80% of jet engines are installed with ignition systems produced by Unison Industries
- ▶ Capacitor Manufacturing Automation
 - ▶ Making a manual process automated in order to reduce assembly time
- ▶ Capacitors store energy as an electrostatic field
- ▶ Options of fully automatic versus semi automatic
 - ▶ Fully automatic requires no operator
 - ▶ Semi automatic requires some use of the operator

Problem Statement/ Project Goal

Problem Statement

- ▶ The current process of assembling capacitors takes approximately 27 min
 - ▶ The goal is to reduce this time to 15 min
- ▶ The assembly process has multiple steps involved
- ▶ Each step has been analyzed in order to choose the best ones to improve with either automation or a new manual process

Project Goal

- ▶ Goal Statement: To reduce overall assembly time by adding some automation and updating some of the current manual processes

Product Specs

- ▶ 4 individual sections
 - ▶ Layer of insulation paper and double sided tape in between
- ▶ Electrical tabs soldered together
- ▶ Insulation material wrapped around whole thing
- ▶ Dimensions: 4.25"H x 2.6"L x 1.38"W

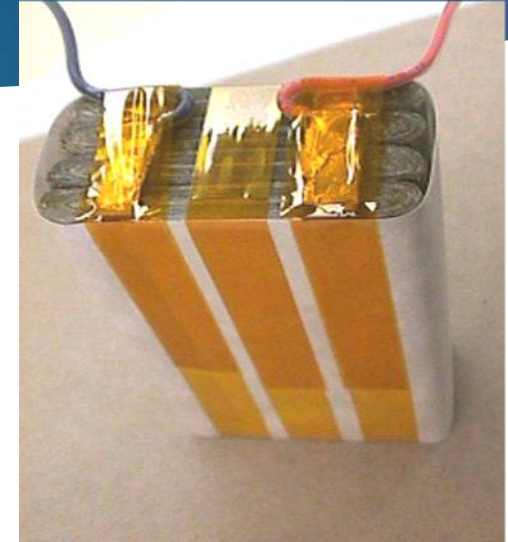


Figure 1



Figure 2

Current Manual Assembly Steps

1. Select 4 capacitor sections and attach clipped tabs together and verify capacitance is within range. If not select different capacitors to meet capacitance range
2. Cut a piece of tape and place between each capacitor section. The clipped tabs must line up on one side. (Form capacitor tabs and solder)
3. Attach and solder wire to clipped tabs and wire to unclipped tabs
4. Assemble sleeving wires
5. Assemble tape over both soldered tabs
6. Form safety loop in both wires shown

7. Wrap a piece of insulation around sides of pack
8. Secure insulation and wires in place using Tape
9. Final Inspection
 - A. Using verniers, check the following dimensions:
 - a. 4.25" max, 1.38" max, 2.60" max
 - B. Visually inspect the following:
 - a) Correct and complete assembly
 - b) Damage to wires or assembly

Updated Assembly Process

Tape Rolling

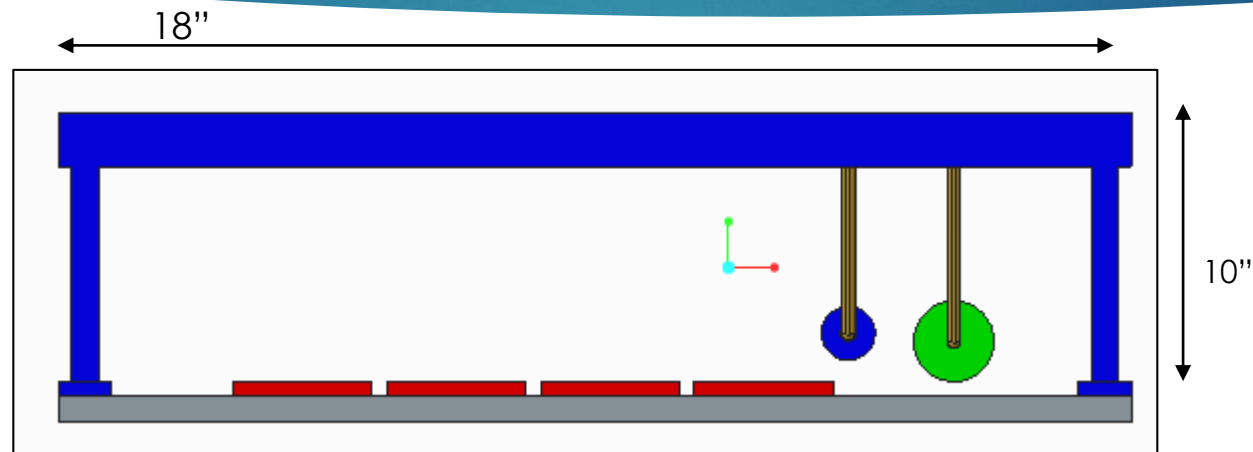


Figure 3

- ▶ Powered by motor
- ▶ Tape (blue) rolls onto individual capacitors
 - ▶ Roller (green) rolls behind the tape to ensure tape sticks

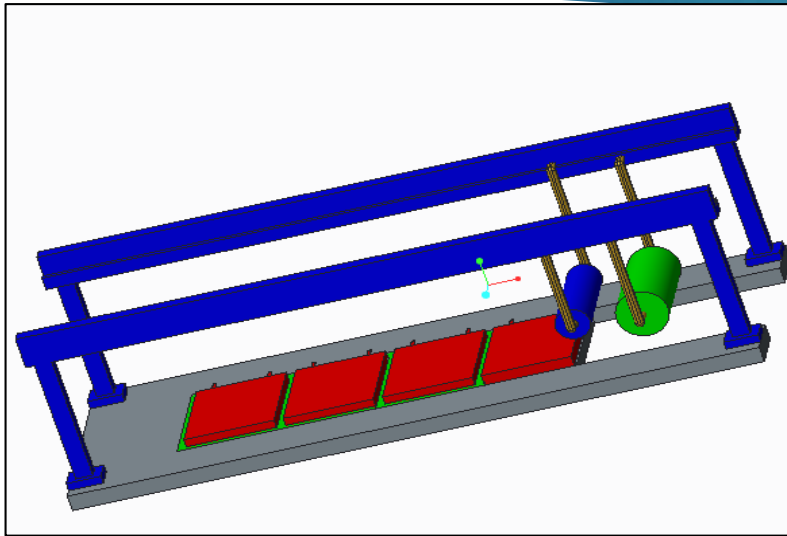


Figure 4

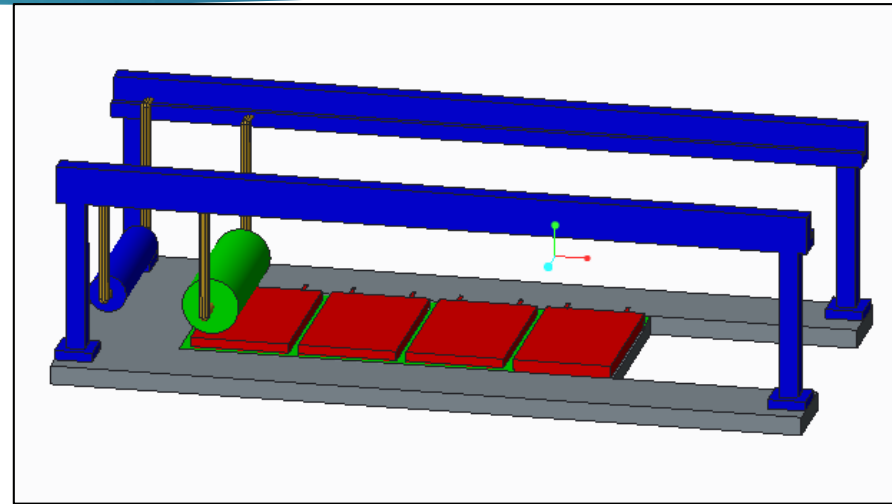


Figure 5

- ▶ After tape is placed on capacitors, operator will peel back sealing layer
- ▶ After this, the operator will cut the tape in between the sections
 - ▶ Scissors will be guided by grooves in the plate

Tape Rolling to Stacking

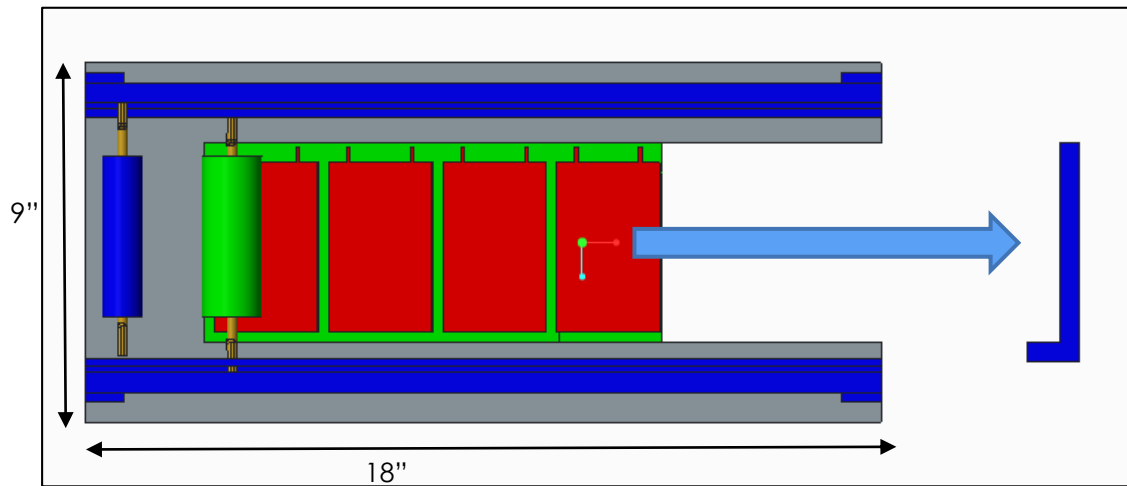


Figure 6

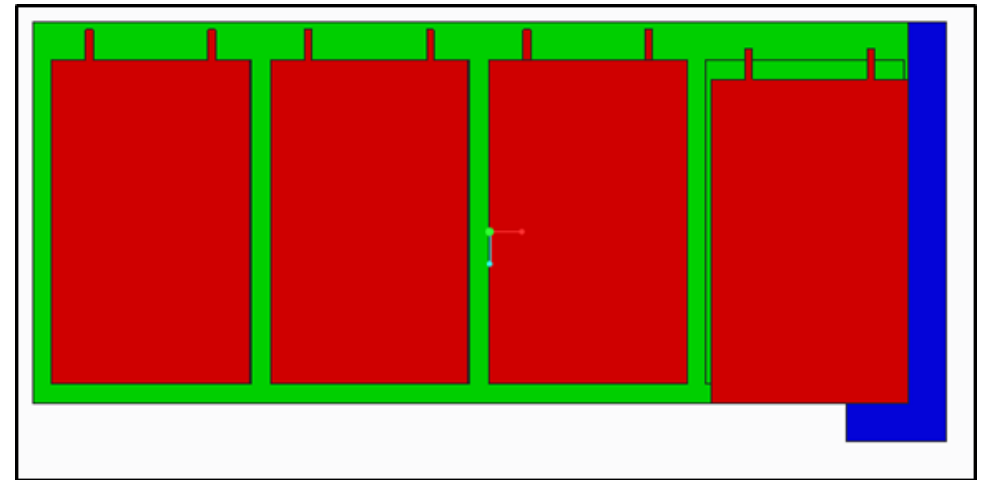


Figure 7

Stacking

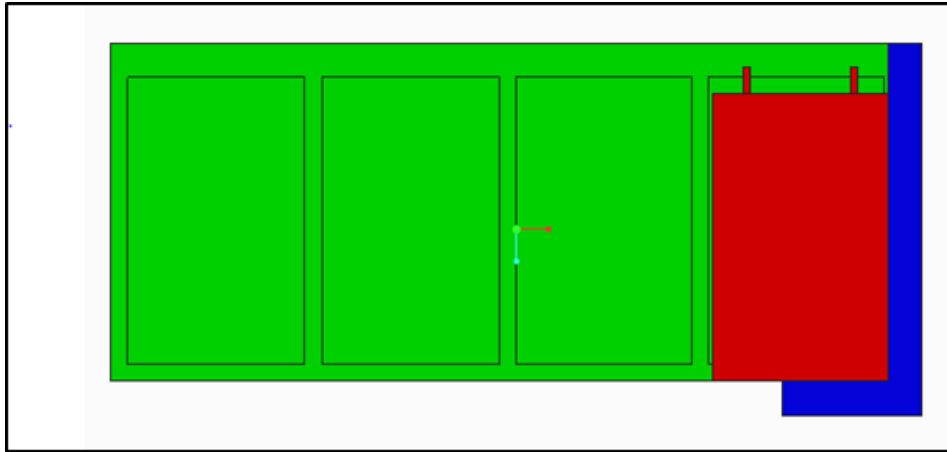


Figure 8

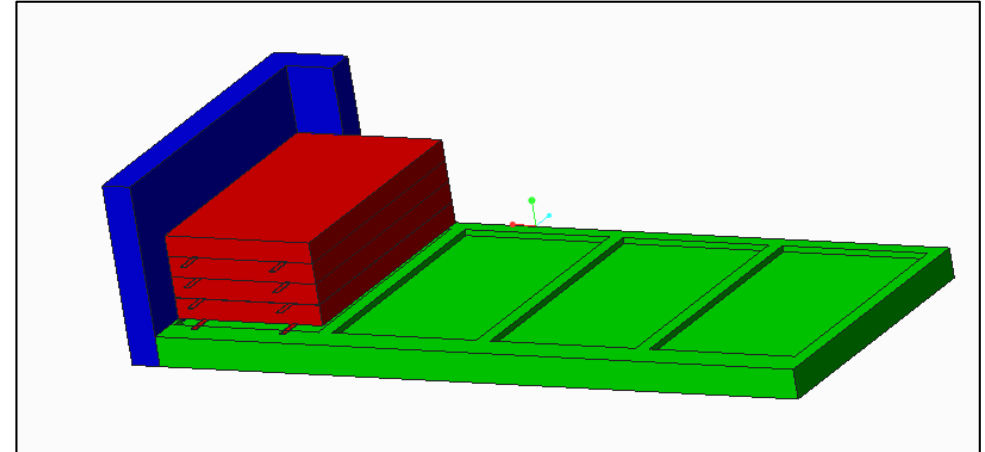


Figure 9

- ▶ L-Gauge will guide the stacking of the capacitors

Stacking to Soldering/Attaching Lead Wire

- ▶ After stacking, the operator will move the capacitor to the next work station
- ▶ At this work station, a second operator will begin soldering the tabs, attaching lead wires and forming the safety loops
 - ▶ These are intricate processes and will not be updated

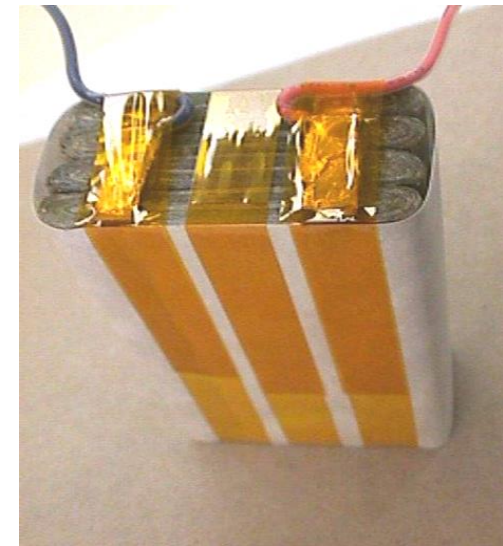


Figure 10

Soldering/Attaching Lead Wire to Insulation Paper Wrapping

- ▶ After soldering, operator will bring the capacitor to the next work station
- ▶ The next operator will then load the capacitor into the paper wrapping machine to begin that process

Paper Wrapping/Tape Wrapping

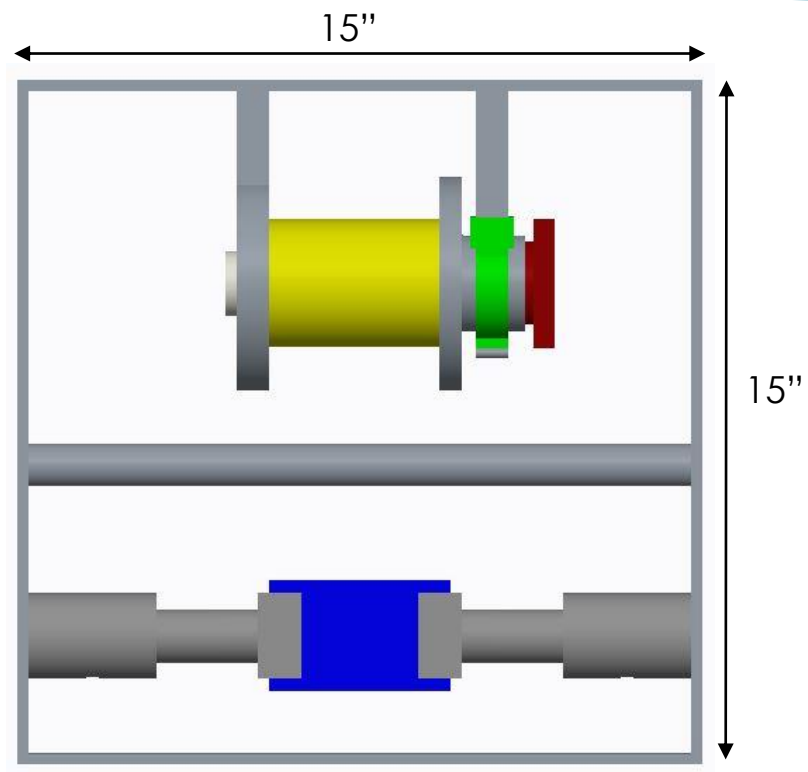


Figure 11

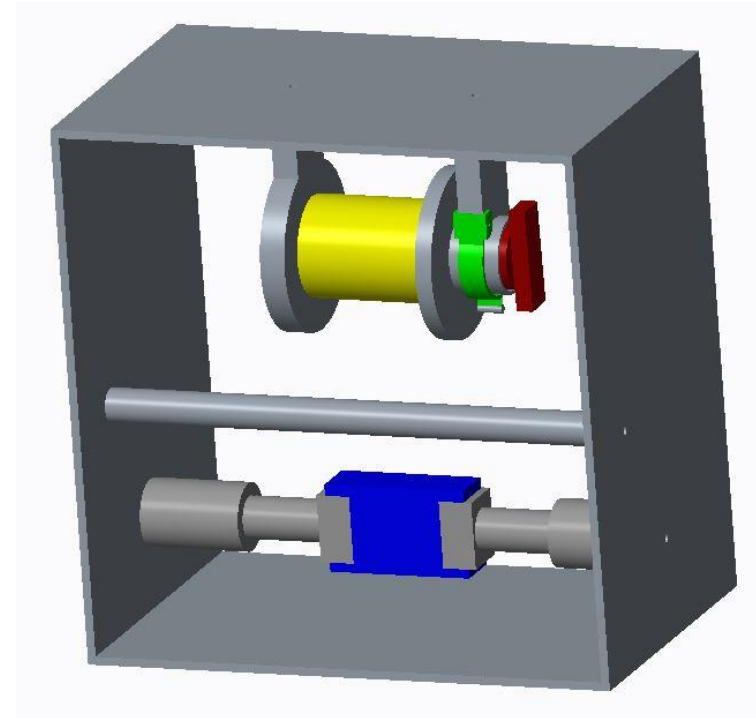


Figure 12

Paper Roll

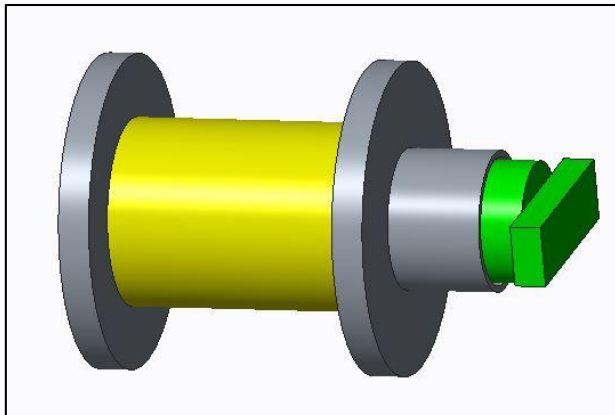


Figure 13

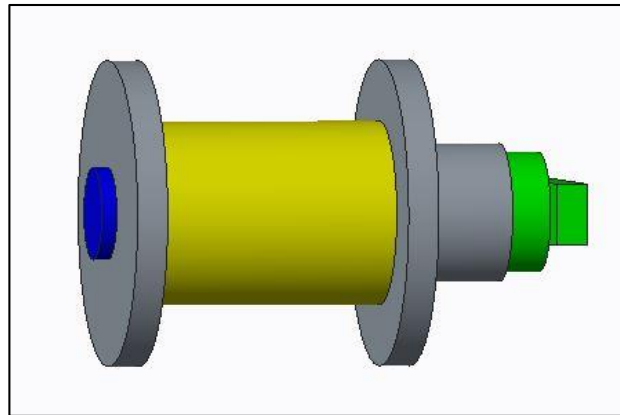


Figure 14

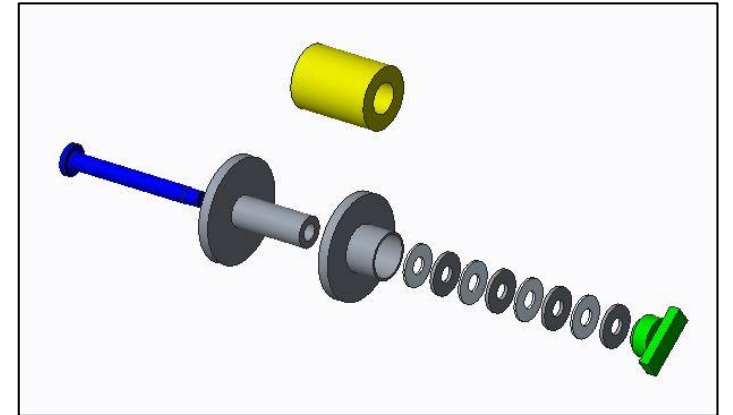


Figure 15

Paper Wrapping to Dimension Check

- ▶ Immediately after wrapping the paper and tape, the operator will unload the capacitor and place it into the gauge block for the final dimensional check
 - ▶ Maximum dimensions are 1.38" x 2.60" x 4.25"

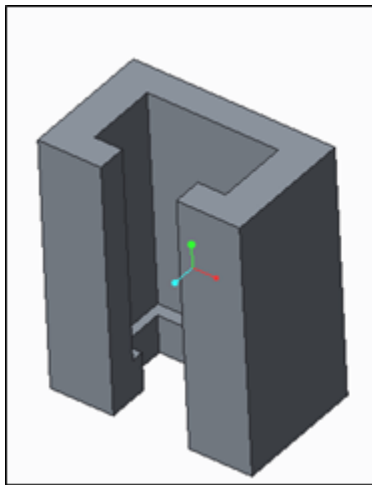


Figure 16

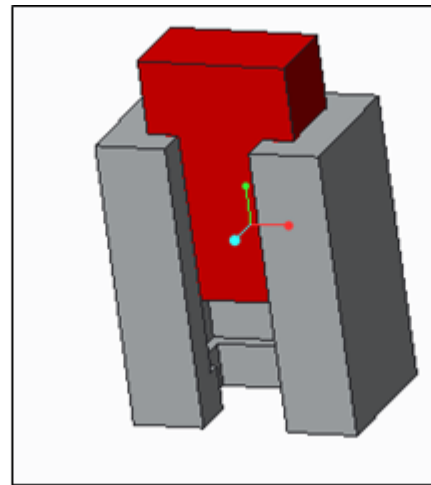


Figure 17

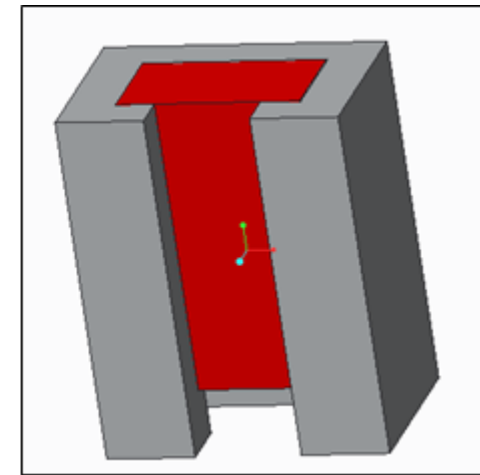
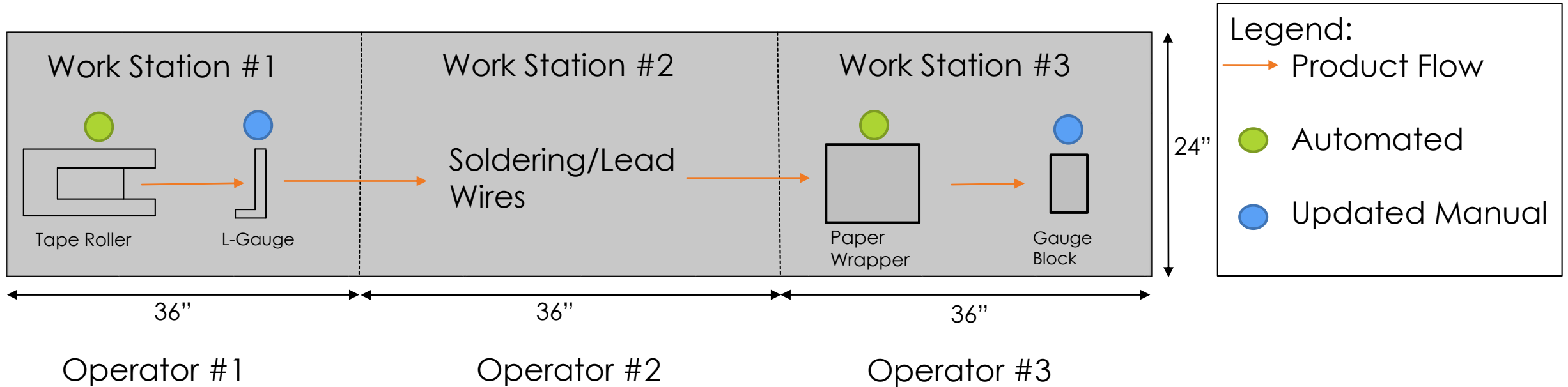


Figure 18

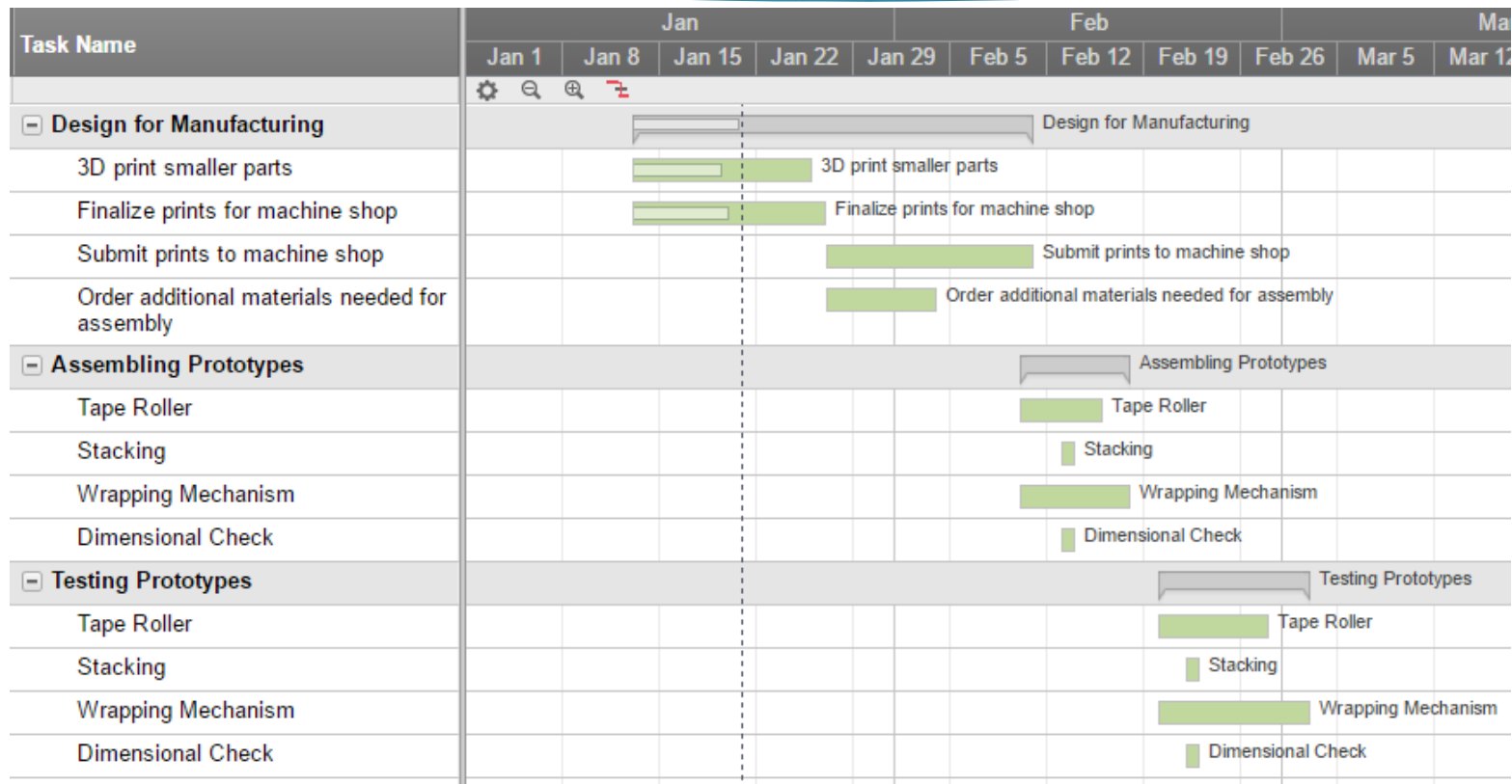
Estimated Times

Assembly Step	Current Time	Improved Time
Tape Roller	2 min 15 sec	35 sec
Stacking	25 sec	12 sec
Paper Wrapping	2 min 50 sec	1 min 25 sec
Dimension Check	1 min 4 sec	15 sec

Proposed Floor Layout



Progress/Gantt Chart



Future Work

- ▶ Finish ordering materials
 - ▶ Still need parts for paper wrapping
- ▶ Send prints into shop
- ▶ Build prototypes
- ▶ Test prototypes
- ▶ Make any changes

Current Budget Report

Item	Cost
Guide Rails	\$89
Track Rollers	\$63.84
Posts	\$18.84
Tape	\$37.15
Base Plate	\$144.20
Paper Roll Washers	\$64.81
Total	\$417.84
Remaining	\$1582.16

Summary

- ▶ Finalized designs
- ▶ Began ordering parts
- ▶ Finishing prints for machining
- ▶ Created floorplan layout for assembly

References

- ▶ **Kevin Walker, Assembly Steps Handout**

Questions?