Capacitor Assembly Automation

TEAM 6:

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Presentation Overview

- Introduction
- Problem Statement
- Restated Project Scope
- Objectives
- Progress Made
- Designs
- Challenges
- Gantt Chart

Introduction

- 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
  - Capacitors are a part of the ignition systems

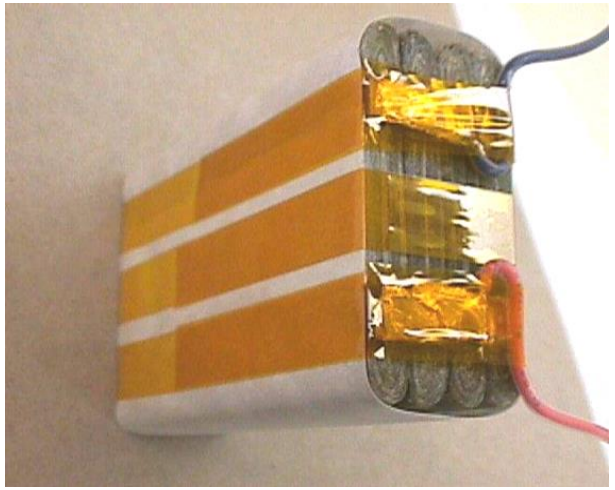


Figure 1: Assembled capacitor

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

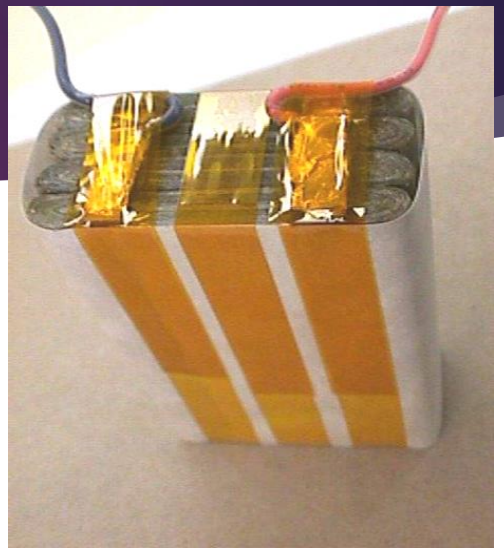


Figure 2: Assembled capacitor

Figure 3: Individual capacitor

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**
  - Placing double sided tape on each capacitor section
  - Stacking the capacitors
  - Soldering the electrical tabs and attaching lead wire
  - Wrapping the stack in insulation paper
  - Placing tape around the entire assembly in 3 places
  - Final dimension check
- **Each step has been analyzed in order to choose the best ones to improve with either automation or a new manual process**

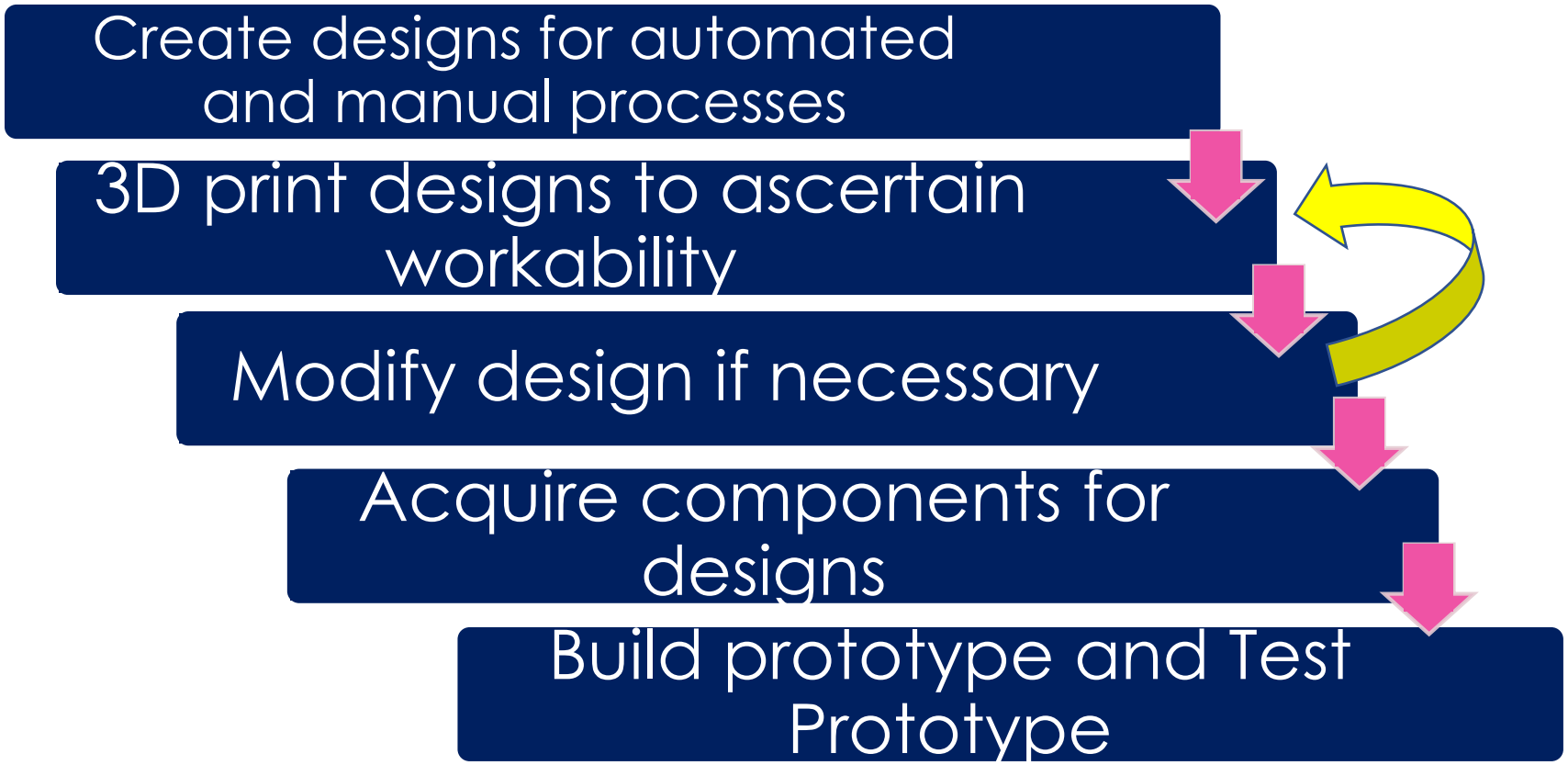
Restated Project Scope/Goals

- **Original Goal:** Design and develop an automated process in order to improve the assembly of the capacitor
- **Updated Goal Statement:** To reduce overall assembly time by adding some automation and updating some of the current manual processes
- **Reasons for Change:**
  - Some steps are certified processes and cannot be automated
  - Other steps would be difficult/expensive to automate, but could be more efficient with new manual process

Project Objectives

- Monitor and ascertain the amount of time in minutes to tape roll individual capacitors and wrapping with the insulation paper
- Running multiple tests with the 3-D printed parts to ascertain its workability before ordering of parts
- Determine an efficient manufacturing process for the automated designs and to ensure hazard free manual processes.
- Design and build working prototype capable of meeting the required needs of the automated and manual processes

Methodology



Progress Made

- Designed automated processes for the tape roller and the wrapping of insulation paper
- Designed improved manual processes for the stacking and dimensional check
- Started 3D printing a few of the parts
- Ordered materials to start building the tape roller

Automated Designs

- Tape roller
  - Powered by motor
  - Roller arms move down the tracks, dispensing tape on each section

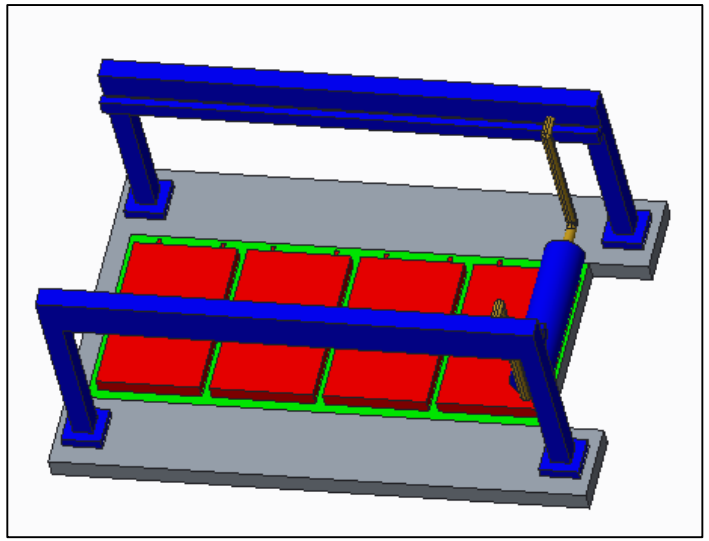


Figure 4: Tape Roller

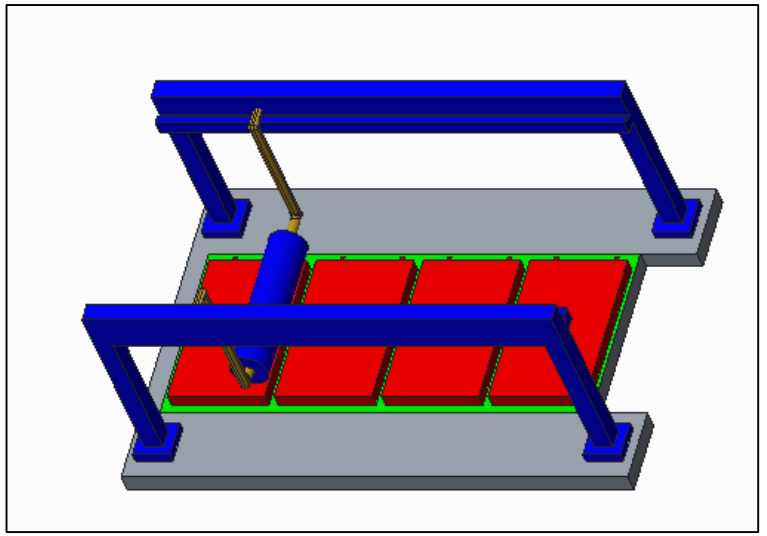


Figure 5: Tape Roller

Automated Designs

- Wrapping of the insulation paper
  - Green arms spin clockwise to wrap assembly
  - Red plate presses against assembly for a tighter wrap
  - Brown insulation paper is held in tension using tape roll

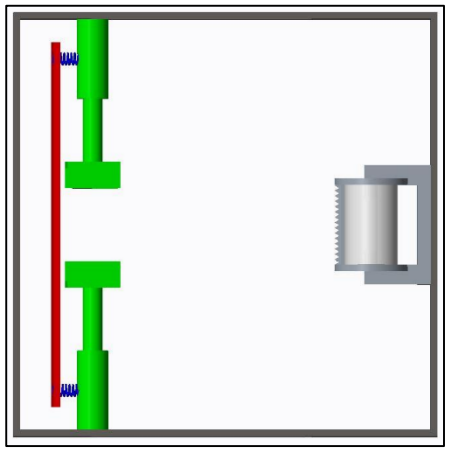


Figure 6: Empty Wrapping Mechanism

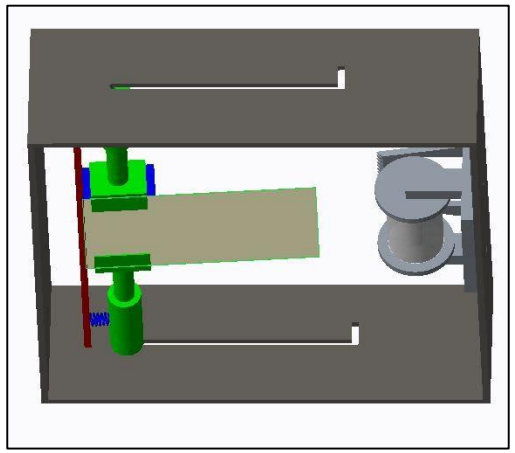


Figure 7: Initial wrapping process

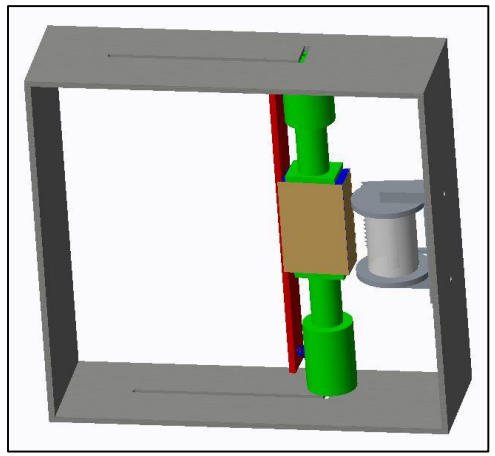


Figure 8: Final wrapping process

Manual Designs

- Stacking
  - Green plate slides into the L-Gauge
  - L-Gauge is used to guide the stacking, helping eliminate error

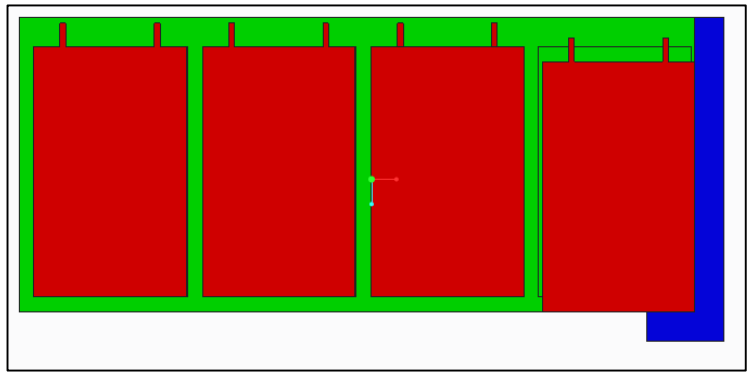


Figure 9: Top view of stacking

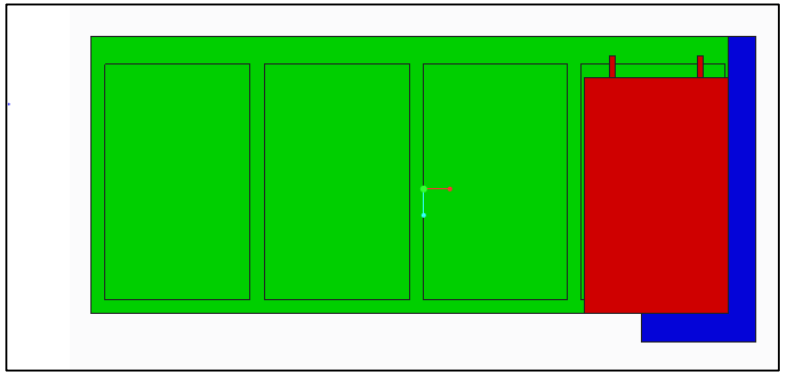


Figure 10: Top view of stacking

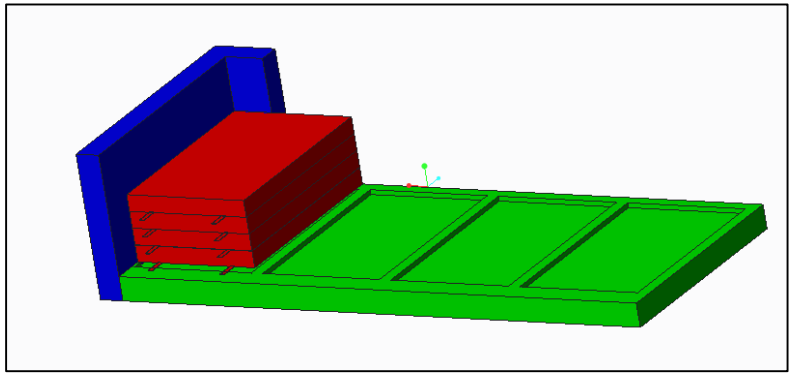


Figure 11: Side view of stacking

Manual Designs

- Dimensional Check
  - Checks all three dimensions at once
  - If the capacitor is able to slide into the gauge, it is within the maximum dimensions

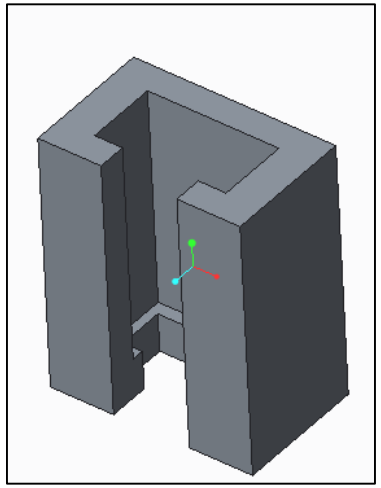


Figure 12: Empty gauge block

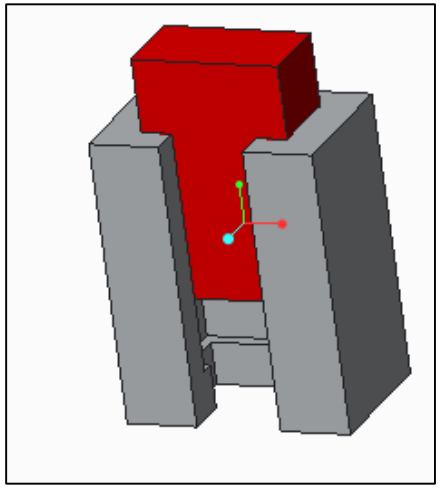


Figure 13: Capacitor sliding into gauge block

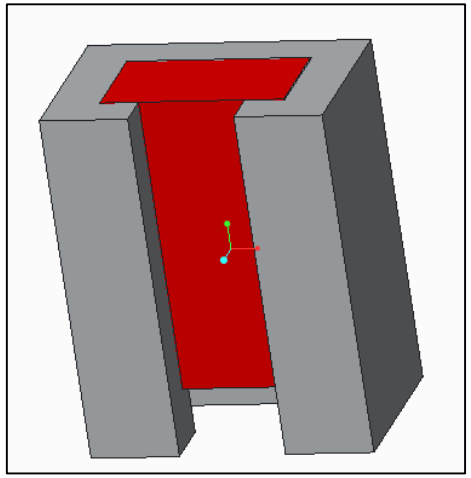
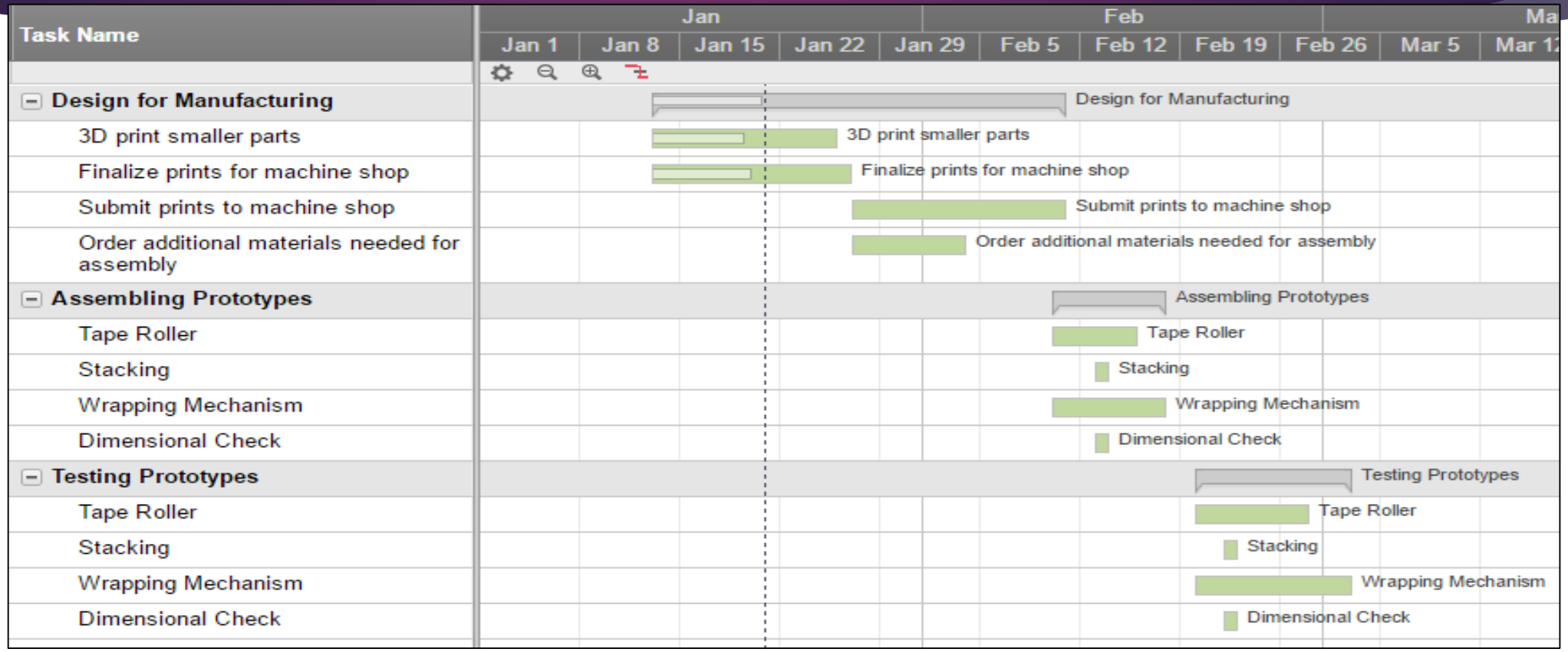


Figure 14: Capacitor fully in gauge block

Challenges/Constraints

- Challenges
- Building the different prototypes
  - Figuring out how to make them machinable and assemble them
  - Prototype may not work effectively
- Adding a process for the tape wrapping
- Constraints
- Machinery built must be both practical and economical
- The process and machinery created must comply with any applicable safety regulations
- Project must be completed by the end of the Spring 2017 semester

Gantt Chart


Task Name
Jan
Feb
Ma
Jan 1
Jan 8
Jan 15
Jan 22
Jan 29
Feb 5
Feb 12
Feb 19
Feb 26
Mar 5
Mar 1
Design for Manufacturing
3D print smaller parts
Finalize prints for machine shop
Submit prints to machine shop
Order additional materials needed for assembly
Assembling Prototypes
Tape Roller
Stacking
Wrapping Mechanism
Dimensional Check
Testing Prototypes
Tape Roller
Stacking
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Stacking
Wrapping Mechanism
Dimensional Check

Summary

- Design of automated process to reduce the assembly time of ignition exciter
- Reduction of assembly time from 27 mins to 15 mins
- 3D prints some parts to ascertain workability
- Determining the time it takes for tape rolling and paper wrapping
- Build prototype for automated and manual processes

References

- Kevin Walker, Assembly Steps Handout

Thank you for your time!

Questions?