

# PCEC Senior Design Projects 2022

## TEAM 20: Winton Washer Recycler

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Sponsor: Swoboda

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GRAND VALLEY  
STATE UNIVERSITY  
SCHOOL OF ENGINEERING

swoboda  
technologies

### Project Background

Swoboda produces an extraordinary amount of Winton Solenoids, yet they have no process for in-house disassembling and recycling of the solenoid. Currently, Swoboda recycles the over-molded coils, steel washers, and the plastics head at 0.30 per lb. The solution proposed will be disassembling and sorting Winton Solenoids by means of shear separation, followed by a step-by-step process for sorting the disassembled components. The solution includes 2 rotation blades, a vibrating rail delivering mechanism, a trap door sorting mechanism, and many electrical components. This project will increase the price of solenoid's recyclability to \$1.50 per lb. ultimately increasing the profitability of the Winton solenoid line.

### Specifications

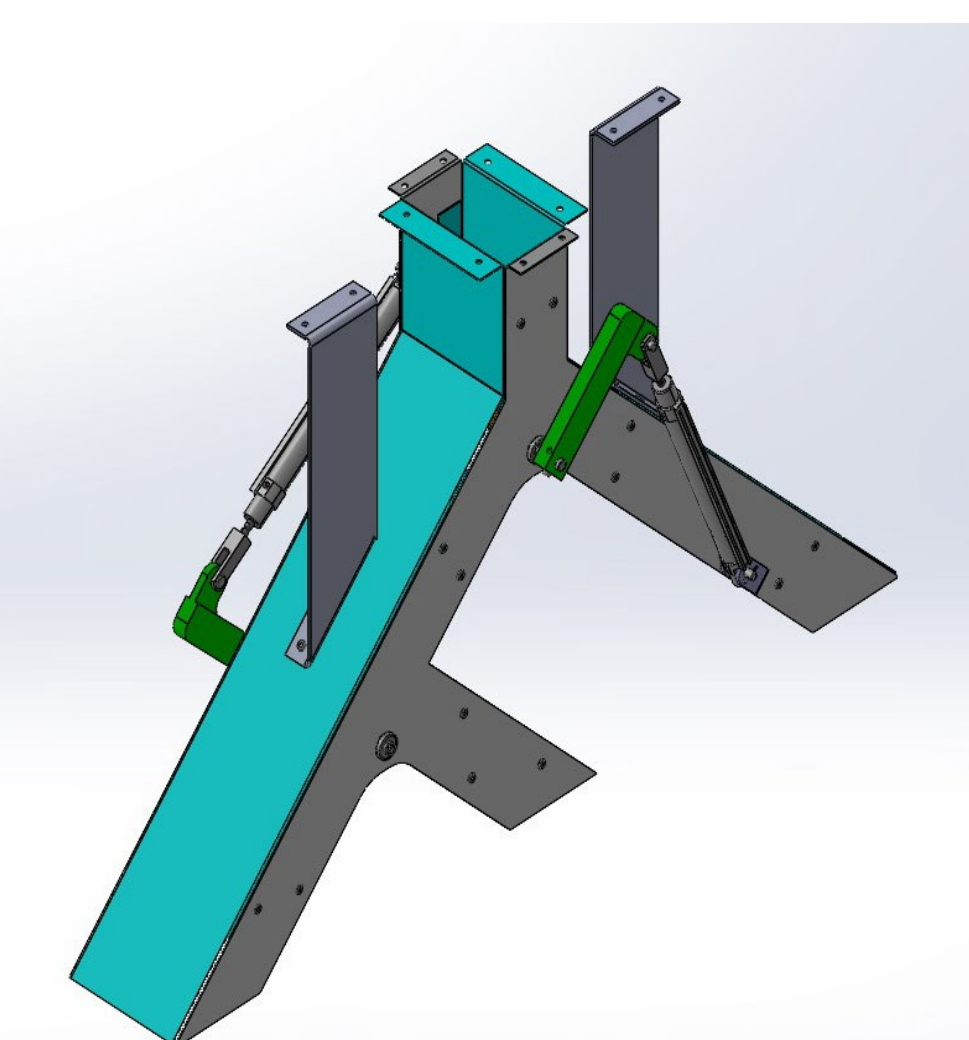
#### Specifications

- Must separate the over-molded solenoid into 3 parts (Head, Washer & Coil).
- Cycle time of 10 seconds per solenoid
- The machine must be portable
- Air pressure can not exceed 7 bars (700 kPa)

#### Design Constraints

- Maximum machine footprint of 0.9 m X 1.0 m X 2.2 m
- Maximum machine mass of 400 kg
- Budget of \$7,000
- All automated movement must be controlled using a PLC Controller
- Machine must be mobile

### Sorting Mechanism



#### Trap Door:

- 3 phases are cycled through using a PLC controller for each component of the Winton Solenoid
- 3 Chutes which correspond to disassembling phase of the solenoid shown to collect the disassembled solenoid
- Default in the Plastic Head phase
- Checks in place to confirm parts have been collected before moving to the next phase
- Made from 14 Gage Sheet Stainless Steel



Figure 1: Winton Washer Recycler



Figure 2:  
Winton Solenoid  
[Fully Assembled]

### Solenoid Separation

#### Head Removal

- Must separate the over-molded solenoid into 3 parts (Head, Washer & Coil)
- Air pressure can **NOT** exceed 7 bars (700 kPa)
- Shears 2mm below washer (upside down orientation)
- 16,000+ lb of force over cross sectional area
- Constant pressure built over time, not instant trigger

#### Washer Removal

- Hole punch after shears are retracted
- Moves laterally in a short range of motion, with minimal force to clear washer out of plastic seating if necessary

### Part Orientation & Transfer

#### Vibrating Rail:

#### How it Works

- Magnetic block rings against the rail, producing vibration
- Frequency of vibrating rail is tuned using fiberglass dampeners
- Distance between rail and magnet alters the vibrating frequency

#### Specifications

- Made from 1060 Cold Drawn Steel (Hardened)
- Cycle time of 10 seconds per solenoid
- Distance between the magnetic block and magnet is 15mm

