



Mechanical Engineering
University of Rochester

Theory of Operations Manual

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Introduction

This document serves as the Theory of Operations Manual for the University of Rochester's plastic shredder. It outlines the guidelines, procedures, and best practices necessary to ensure efficient and effective operation of the system. The manual is intended to serve as a reference for students and staff, helping them understand their roles and responsibilities, maintain consistency, and adhere to organizational standards.

Organization Overview

Project Definition:

Plastic waste generated on campus at the University of Rochester is substantial, with a significant portion coming from single-use plastic containers used at Starbucks. The creation and application of this small-scale recycling machine re-purposes these single-use plastics, diverting them from waste disposal systems like landfills or incinerators.

Organizations Involved:

University of Rochester Department of Mechanical Engineering

Precious Plastic

Roles and Responsibilities

Name	Responsibility	Contact Information
Taryn Langtry	Hopper Plastic Collection	tlangtry@u.rochester.edu
Paul Calderon	Power System Couplers	pcalder4@u.rochester.edu
Cece Vassallo	Shredder Reassembly and Improvements	cvassall@u.rochester.edu

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Standard Operating Procedures

1. Material Preparation

- Collect approved plastic waste materials
- Remove contaminants such as labels, adhesives, food residue, or foreign materials
- Cut plastic into smaller, shreddable pieces (if necessary)

2. Shredder Operation

3. Injection Molding Operating

- Plug in the hot plate and injection molder machine
- Heat up the mold on the hot plate
- Set machine temperature to desired heat (dependent on plastic collected)
- Load shredded plastic into the injection molder
- Inject material into the mold using consistent force and proper pack/hold time
- Allow adequate cooling before opening the mold
- Remove molded parts and inspect for defects, such as flash, shrinkage, or burnt plastic

4. Shutdown and Cleanup

- Power off all equipment
- Return tools and materials to designated storage locations
- Clean machines and workspaces

Technology and Tools

Primary Equipment:

- Plastic Shredder – Used to reduce collected plastic waste into smaller pieces suitable for further processing.
- Injection Molder – Used to melt shredded plastic and inject the material into the mold cavities.
- Mold Assembly – Includes the mold halves, ejector pins, dowel pins, and alignment components used to form the final product

Safety Equipment:

- Safety glasses
- Heat resistant gloves

Training and Development

Review of Theory of Operations Manual

Health and Safety

Safety Protocols:

1. General Safety Guidelines:
 - Review all operating procedures before use
 - Keep the work area clean and organized
2. Required Personal Protection Equipment:
 - Safety glasses
 - Heat resistant gloves
3. Plastic Shredder Safety:
 - Inspect shredder before each use for any loose hardware
 - Ensure everything is properly installed before use
 - Do not place hands or any body part inside or near the blades while in motion
 - Feed plastic into machine slowly to prevent jamming

- If jam occurs, turn off the machine and disconnect from power before clearing material
4. Injection Molder Safety:
- Be aware of hot surfaces
 - Verify mold alignment and secure installation before operation
 - Do not exceed recommended operating temperatures or pressures

Emergency Procedures:

1. Equipment malfunction:
 - Turn off equipment immediately
 - Keep clear of moving or hot components
 - Notify supervising staff or faculty
 - Do not restart the equipment until the issue has been inspected and resolved
2. Fire or Smoke:
 - Shut down equipment if safe to do so
 - Activate emergency response procedures for the facility
 - Use appropriate fire extinguisher only if trained and safe to do so
 - Evacuate the area if necessary and contact emergency personnel
3. Injury:
 - Stop all equipment immediately
 - Provide first aid
 - Contact emergency services or campus safety if needed
 - Report the incident according to facility procedures

Quality Control

Shredded Material:

Shredded plastic must meet the following standards before use in the injection molder:

- Material must be verified as an approved plastic type (such as HDPE or polypropylene)

- Plastic must be clean and free of contaminants such as paper, metal, food residue, or adhesives
- Particle size should be reasonably consistent to allow smooth feeding and melting
- Material should be dry

Molded Products:

Finished molded parts must meet the following standards:

- Parts must be fully filled with no short shots or missing features
- Surface finish should be free of excessive flash, burns, cracks, or major sink marks
- Design features should be visible and clearly formed

Risk Management

Safety Risks:

- Injury from rotating shredder blades or moving mechanical components
- Burns from hot surfaces, melted plastic, or heated molds
- Exposure to fumes from overheated plastic

Equipment Risks:

- Shredder jams or blade damage
- Motor, electrical, or system failure
- Injection molder heater malfunction

Safety Controls:

- Enforce use of PPE
- Provide proper ventilation during molding operations

Continuous Improvement

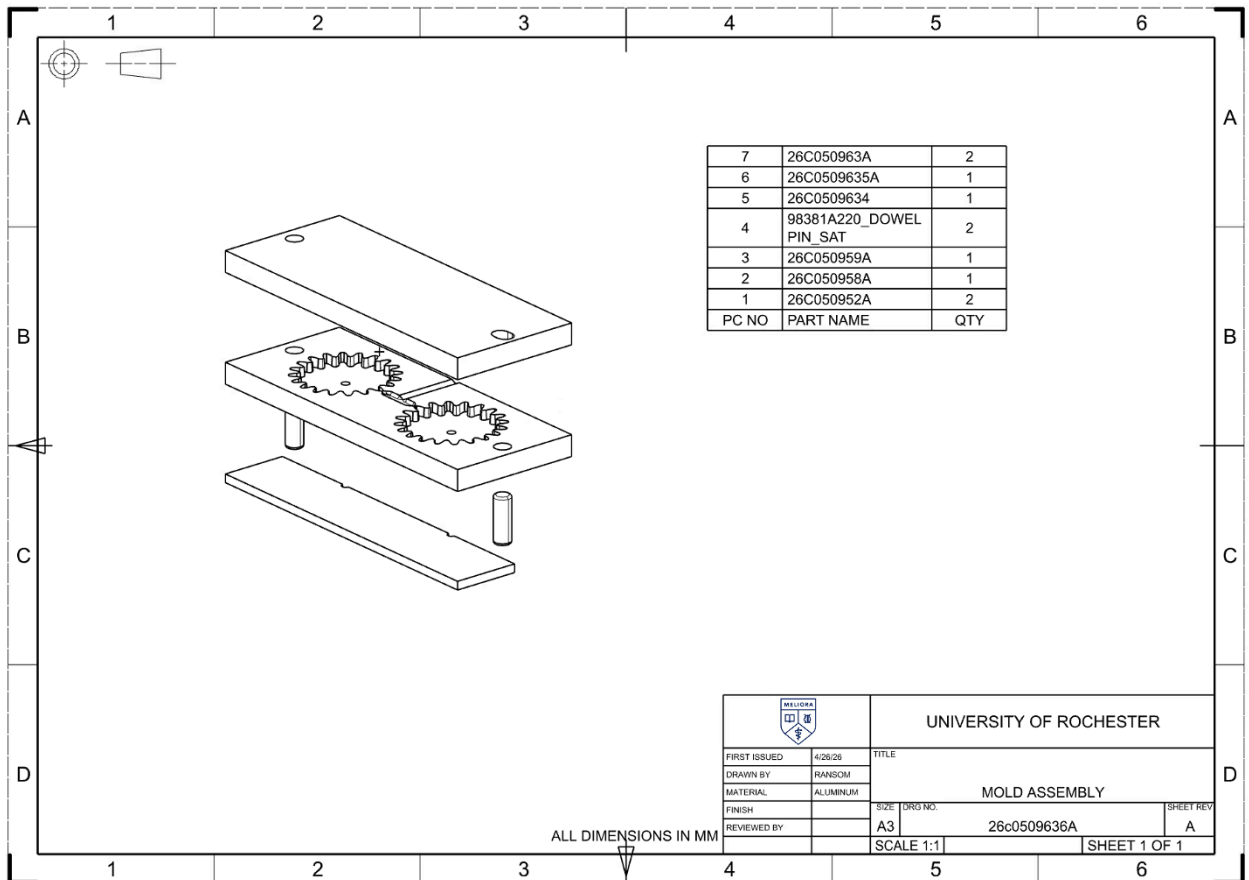
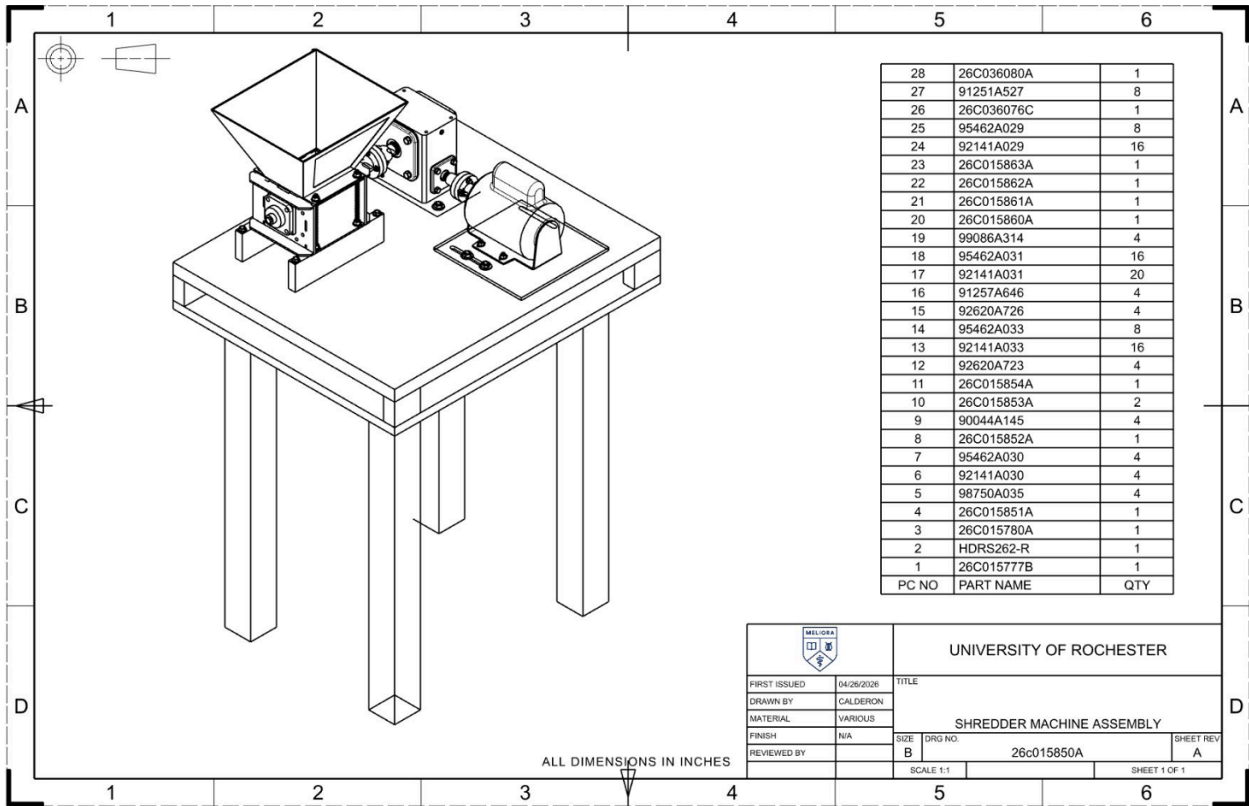
Continuous improvement is essential to enhance the performance, safety, and efficiency of the plastic shredding and injection molding system. Because this project may be developed and operated by multiple groups over time, a structured approach to feedback and iteration is required.

Design and Process Improvements:

- Enhancing mold design to minimize flash, shrinkage, or defects
- Improving consistency of shredded material size
- Improving the shredder blades

Appendices

Appendix A: Assembly of Parts



Appendix B: Operating Parameters

Temperature used for Injection Molding of HDPE: 465°F