

SOP Number PPM_002

SOP Title Injection Moulding Machine Operation

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1. PURPOSE

The purpose of this document is to detail the standard operating procedure for the PPMUC Injection Moulding Machine v1.0 in accordance to safe handling of the machine.

2. INTRODUCTION

The Injection Moulding Machine v1.0 developed by the Precious Plastic Monash University Chapter is intended for use as part of the integrated plastic recycling system. It has been designed for assembly and use on the integrated pallet.

This document will provide detailed instructions on the general assembly, operation and maintenance of the Injection Moulding Machine v1.0. Adherence to the following procedures will ensure that the machine is safe for operators to use with minimal risk of injury.

3. SCOPE

This document covers the intended standard operation of the machine including assembly, set-up, product manufacturing, cleaning, maintenance and storage.

This document does not cover intentional misuses of the Injection Moulding Machine.

This document does not cover modifications made to future versions of the machine.

4. DEFINITIONS

PPE: Personal Protective Equipment

5. RESPONSIBILITIES

PERSON IN CHARGE OF MACHINE Responsibilities

- **Assembly:** assembling machine components including barrel, barrel insulation, barrel cover, hopper, lever sections and plunger.
- **Set up:** PPE, plastic selection, loading of plastic, preheating of machine (and mould optional).
- **Product manufacturing:** turning on machine, selecting correct temperature, waiting for specified amount of time, nozzle cap removal, attachment of mould, injection of plastic, removal of mould, reattachment of nozzle cap, cooling of mould, removal of product.
- **Cleaning:** removal of residual plastic from barrel, removal of residual plastic from nozzle cap, removal of contaminants from barrel.
- **General maintenance:** ensuring components are structurally sound and operating as intended.
- **Storage:** removal and storage of components.

Operator Responsibilities

- **Set up:** PPE, plastic selection, loading of plastic.

- **Product manufacturing:** turning on machine, selecting correct temperature, waiting for specified amount of time, nozzle cap removal, attachment of mould, injection of plastic, removal of mould, reattachment of nozzle cap, cooling of mould, removal of product.
- **Cleaning:** removal of residual plastic from barrel, removal of residual plastic from nozzle cap, removal of contaminants from barrel.

If intended operator has not been inducted into the use of the machine, minimum of one inducted operator OR person in charge of machine is required to supervise.

6. SPECIFIC PROCEDURE

6.1 Initial Assembly or Complete Reassembly

1. Screw the nozzle onto the barrel.
2. Attach the barrel to the horizontal support by placing the two large pine panels in between the large flat members of the barrel and the steel RHS section, and then bolting through the first and last holes.
3. Slide the heating bands onto the barrel and ensure they are tightly attached. Feed the wires through the opening between the two large flat members of the barrel and keep away from contacting the metal surfaces. The smallest bands go highest on the barrel, followed by the medium band. The largest band will attach directly onto the nozzle.
4. Attach the insulation by clipping the insulation to the mesh screen with the metal paper clips. Attach the assembled barrel cover by bolting through the holes in the mesh and the second and last holes on the large flat members of the barrel and the large pine panels. Do not bolt through the insulating wool.
5. Attach the hopper to the barrel by placing two nylon M6 washers in between the angled flat sections at the barrel opening and the hopper at each hole. Attach via screws in the four holes.
6. Attach the vertical support to the table top by bolting it down through the two holes at the base.
7. Attach the pull rods to the vertical support by bolting through the bottom-most holes of the vertical support, and ensuring that the large holes in the pull rod can align with the large hole in the vertical support. Additional washers should be placed in between the pull rod and the vertical support.
8. Attach the main lever by inserting the end of the main lever with one hole in between the pull rods and bolting through all.
9. Attach the plunger to the main lever by first inserting it into the barrel, and then moving the main lever until the flats on the lever align with the holes on the plunger. Bolt through.
10. Attach the secondary lever by sliding the bracketed section of the secondary lever onto the end of the main lever with two holes, and aligning the holes. Bolt through both aligned holes.
11. Attach the handle flats by bolting the flat members to the end of the secondary lever.

12. Attach the handle by aligning the holes of the handle flat members and the handle and bolting through.
13. Raise the lever and lock in place by aligning the large holes of the pull rods to the large hole in the vertical support and inserting the locking pin. The machine is now completely assembled.

6.2 General Assembly

1. Remove the two bolts from the bracket of the secondary lever.
2. Slot the bracketed section of the secondary lever onto the end of the main lever and align the holes.
3. Attach the two sections using the bolts from **Step 1**. Ensure that washers are in the correct placement.
4. Lock the lever in the upright position by inserting the locking pin through the pull rods and the vertical support.

6.3 Set-up

1. Ensure machine is OFF.
2. Prepare heat-resistant gloves (recommended).
3. Ensure lever is upright and locked via the locking pin.
4. Ensure there is a metal bowl underneath the nozzle.
5. Load the selected plastic into the hopper. Use the provided silicone spatula and/or brush if necessary to push the plastic into the barrel. Some plastics such as LDPE may require tamping down in order to allow more plastic to enter the barrel.
6. Replace the hopper lid.

6.4 Product Manufacturing

1. Wear heat-resistant gloves (recommended).
2. Turn on machine and allow to preheat at slightly lower than desired melting temperature. Ensure metal bowl is place below the nozzle.
3. Select correct melting temperature for the specified plastic type. Refer to relevant documentation for melting temperatures and waiting times for each plastic type.
4. Wait the allotted time for the plastic to melt.
5. Attach mould by screwing the mould onto the nozzle thread. Use the mould supporting equipment if necessary.
6. Remove the locking pin from the vertical support. *Leaving the pin in will damage the machine when attempting to inject.*
7. Pull and/or push down on the lever until the plunger can no longer move downwards. Consistent speed and pressure will result in better product finishes. For best results, push down as hard and as fast as you can until the plunger can physically go no further.

8. Return lever to upright position and lock using the locking pin.
9. Unscrew to remove the mould and replace the metal bowl underneath the nozzle to catch molten plastic drips.
10. Reduce the temperature by 20-30 degrees Celsius if idling for more than 10 minutes but less than 20 minutes to prevent plastic burning. Reduce both PIDs temperature settings to **zero** and turn OFF machine if the machine will be idle for **more than 30 minutes**. Otherwise continue to **Step 12**.
11. Allow mould to cool completely (approximately 10 minutes or until comfortable to touch).
12. Detach mould halves and remove product.
13. Return to **Step 6** if there is remaining plastic in the barrel and further production is required. Otherwise continue to **Step 15**.
14. Return to **Section 6.3 Step 5** if plastic refill of the same type is required and further production is required. Otherwise continue to **Step 16**.
15. Extrude remaining molten plastic and return to **Section 6.3 Step 5** if a different plastic is to be used. Fill barrel with new plastic type and prepare to do a "purge shot" to remove as much of the old plastic as possible. Stop when shot runs mostly clear with the plastic. Otherwise continue to **Step 16**.
16. Extrude remaining molten plastic by pushing the plunger all the way down. Raise lever and lock in upright position *before* the machine cools down. Reduce both PID temperature settings to **zero**. Turn OFF machine. Remove any remaining residual plastic from nozzle using provided spatula.
17. Remove secondary lever member for storage.

6.5 Cleaning

1. Ensure machine is OFF and disconnected from the mains power prior to removal of any components.
2. For complete cleaning unscrew nozzle from barrel. If solid plastic is inside, heat the nozzle using a heat gun and wear heat protective gloves. Remove carefully with a large spanner.
3. Remove hardened plastic from nozzle and nozzle cap by heating the plastic. A solvent such as acetone may be necessary for complete machine cleaning.
4. To remove residual plastic that is stuck inside the barrel or stopping the plunger, turn ON the machine and set the temperature required for melting of the plastic.
5. When molten, push the plunger down through the barrel to extrude the melted plastic until the plunger sits beyond the barrel opening.
6. Turn OFF machine and allow to cool.
7. Remove hardened plastic from the end of the plunger once cooled.

6.6 Storage

1. All components should be stored in a dry environment when not in use.

2. The plunger, if detached, should be stored in a protective sleeve.
3. All bolts should be attached to the appropriate components when separated to prevent loss or misplacement of bolts.
4. All components should be stable or securely stored to prevent damage or injury to environment and persons when in storage.
5. General tools (spatula and brush) should be stored with the machine.

6.7 General Maintenance

1. Keep barrel and plunger lubricated.
2. Ensure barrel and plunger are clear of plastic following each use. The nozzle may not be completely clear at the end of use, in which case prepare a purge shot prior to actual injection of products.
3. Ensure all metal components are covered in protective film and renew regularly.

7. REFERENCES

Machine Settings for Thermoplastic Types

8. CHANGE HISTORY

SOP no.	Effective Date	Significant Changes	Previous SOP no.
1	05/08/18	Initial version	N/A
2	04/09/18	Revision 1	1