



## Standard Single Screw Extruder Start Up, Shutdown, and Emergency Shutdown Procedures

### INTRODUCTION:

An extruder is used to convert raw plastic products into semi-finished or finished products. A semi-finished product would be material extruded as part of a compounding or mixing operation. Examples of finished products are film, pipe, sheet, profiles, foam products and coated wire.

### SAFETY

Normal safety precautions for working around any moving machinery are to be observed.

1. Avoid loose clothing such as unbuttoned shirtsleeves, lab coats, or dangling ties.
2. Jewelry, such as bracelets and rings, should be removed.
3. Inspect tools and electrical equipment such as heater bands, variacs, etc. for defects.
4. Use "hot mill" gloves and kevlar sleeves when making die adjustments and changes.
5. Never place fingers or metal probes in the feed throat. If necessary, use a plastic probe for clearing the throat.
6. Because of possible overpressure, clamp or bolt failure, never stand directly in front of any extruder during start up, operation, or shutdown.
7. Use a vacuum for cleaning and an air hose with low-pressure nozzle for cleaning inaccessible areas.
8. Keep the floor area around the extruder clean of compound and water, which could cause a slipping or electrical shock hazard.
9. Do not exceed 7000 psi back pressure and have shear pins set at 7200-7500 PSI.
10. Check the pressure gauge in the head of the extruder to be sure it is indicating pressure correctly.

### START-UP PROCEDURE:

1. Before starting to set up for a run, examine the extruder to be sure all power is shut off. Examine the inside of the barrel and hopper to check for dirt or debris. Remove any debris with a vacuum or air hose.
2. Gloves and Kevlar sleeves should be worn during assembly to avoid cuts from metal parts.
3. Inspect pressure gauges. Make sure all transducers are working by checking for bent shafts and/or material built up on the diaphragm.
4. Select the proper screw and insert it in the front end of the barrel. The screw should slide in easily by hand. Use a brass hammer to tap the screw into place if the fit is a little snug. DO NOT FORCE!
5. Do not use excessive force to push the screw into the extruder. Look for obstructions or call maintenance for assistance.
6. Inspect the die and the breaker plate carefully before assembly to ensure cleanliness and good mechanical condition.

7. Assemble the die and install it on the extruder, inserting correct screens and breaker plate. Screen packs should be assembled with the largest opening screen downstream. Make sure that the screens are seated properly and are not interfering with the metal to metal seal, which is necessary to provide a good seal during operation. Manually tighten the bolts in a star pattern when applicable.
8. Assemble the heater bands and thermocouples on the die and plug them into the appropriate receptacles.
9. Turn on the water to the feed throat section.
10. Turn on the main power, the power on the panel board and for the heater band plugs.
11. Set the barrel, die, and adapter zones to achieve the correct melt temperature as recommended on the PolyOne product data sheets. This is generally 360°-380° F for rigid compounds and 310°-330° F for flexible compounds. NOTE: The melt temperature should be measured by means of a pyrometer on the surface of the hot melt as it exits the die. As a rule of thumb, an ascending heat profile is generally recommended. Below is a good starting point for extruder set points when processing rigid PVC.

BZ1	BZ2	BZ3	BZ4	BZ5	Die/Adapt
290 – 300F	300 – 310F	310 – 320F	320 – 330F	330 – 340F	340 – 350F

12. These are conditions typically run on 2.5 and 3.5” machines at 20-30 RPM, but they may need to be adjusted slightly based on the size of the profile, die design and screw RPM. Higher screw RPM will increase the melt temperature. The MOST important factor is the measured melt temperature at the die exit.
13. Make sure that heat is being applied and that the temperatures are beginning to climb. Allow a heat and soak time of at least 1 to 1-1/2 hours to allow the extruder to heat and equalize.
14. While waiting for the extruder to heat up, set up all the needed down stream equipment, such as pullers, air table, water table, sizers, vacuum tank, and saw. Start all of the downstream equipment to ensure they are operating properly before trying to process material through them. Ensure that the saw is set to the proper size for the profile to be extruded. Unplug and disconnect the air from the saw to make any needed changes or adjustments.
15. Retighten all of the die bolts and clamps after the extruder has heated and soaked.
16. Fill the hopper with the material to be processed.
17. Press the “START” button and start the extruder at a minimum speed (approximately 1-3 rpm). Closely watch the amps and die pressure as the material begins to work up and pass through the extruder. Do not exceed the amp limit of the extruder, or the pressure limit (7000 psi.).
18. WARNING! Use common sense when starting up. If the material takes too long to come out, something is wrong. The temperature set points on the barrel or die may be too low to flux the material. Don't always rely on the gauges to be 100% correct. DO NOT STAND IN FRONT OF THE DIE.
19. When material is freely coming out of the front of the die, gradually increase the screw RPM to the desired set point. Watch the amps and pressures closely!
20. String up the profile through the water or air table, puller, and saw.
21. Never stick hands near the saw blade or puller belts to remove jammed pieces. Turn the equipment off first.

## SHUTDOWN

1. Use “hot mill” gloves and kevlar sleeves during shutdown procedure.
2. Empty the fed hopper and lower the heats on the barrel to about 300 0 F. Turn off all the power to the heater bands while running the remaining material out of the barrel. Turn off the water on the feed throat.
3. Run all of the remaining material out of the barrel. Some material might adhere to the barrel or screw requiring you to run a flush or purge compound to clear out the barrel. In this case the die heat may be turned back on.

4. After the barrel is purged, turn the power off to the heater bands and unplug them. Turn off the barrel heaters and hit the "OFF " button to turn off the screw drive motor.
5. Disconnect thermowells, pressure transducers and wires. Remove the heater bands from the die.
6. Blow air on the die face to harden the extrudate enough to pull it out of the die land with pliers.
7. Take bolts out of the face of the die and remove the die.
8. Turn the extruder on and push out any core if applicable and shave any extrudate plug from the breaker plate.
9. Turn the extruder off and unbolt the die clamp and remove it from the extruder.
10. Turn the extruder back on and push out the breaker plate. Apply air to the face of the breaker plate and slowly pry the plug out.
11. Turn the extruder speed up and run out any material remaining by blowing air into the feed hopper. Be sure no one is standing in front of the extruder.
12. Clean the die parts with a brass scouring pad and spray with neutralizer.
13. After the screw is empty, turn off the main power switches. Push the screw out of the extruder from the back using a long steel rod or use a hydraulic "pusher". Tap the screw out with a hammer.
14. Clean the screw with a brass scouring pad and blow out the barrel with air. In extreme cases, a motor driven wire brush may be used to scrub material out of the barrel.
15. Take out the pressure transducers, if necessary, to clean plastic out of the thread wells.

## **EMERGENCY SHUTDOWN PROCEDURE;**

### **INTRODUCTION:**

Typically rigid vinyl compounds are thermally stable at the recommended melt temperatures (measured at the die exit with a hand held pyrometer) of 360-380° F. In general they will remain stable up to 390 to 395° F as long as the material is not allowed to sit, or stagnate in the equipment. i.e. as long as the screw is turning and material is exiting the die. If the material is allowed to sit idle in the extruder or die at the recommended processing temperatures (barrel and die heats @ 280 to 320° F) it should remain stable for approximately 20 to 30 minutes.

\* NOTE: During the decomposition process Hydrogen Chloride gas is emitted, which is an irritant to the eyes, nose, and throat, and is corrosive. In the case of a severe burn-up, the area should be evacuated, doors and windows should be opened and fans should be used to dissipate fumes if possible. Any persons entering the area should wear a self-contained breathing apparatus. Any severely overheated or degraded material removed from the equipment should be immediately placed in a fume hood, placed in a water bath, or moved outdoors to cool.

### **SITUATION #1- If, due to a power outage or equipment failure, the vinyl cannot be purged from the barrel, the following steps should be taken immediately:**

- Shut off all barrel and die heaters.
- Disassemble the die and adapter and remove the vinyl slug.
- Close the hopper gate.
- If the equipment is available, the screw can be pushed out with a hydraulic ram system.
- If the screw cannot be pushed, closely monitor the extruder as it cools down to ensure degradation does not begin.

As soon as power is restored:

- Reset barrel heater controllers to 230 to 250° F to soften the vinyl in the barrel; in the case of a short power interruption the material may not have set-up.

- As soon as the controller set points are reached, increase screw RPM to 1.0. Monitor motor amps to avoid overload damage.
- The barrel can either be purged with a commercially available purge compound or fresh vinyl compound.
- As soon as the barrel is completely purged of the stagnant or degraded material, close the hopper gate and run the screw until empty.
- Push the screw out of the barrel, inspect and remove any material that is stuck or burned on the screw.
- Inspect the screw, barrel, and die assembly for pitting, or removal of chrome plating. Any damaged components must be repaired to avoid sticking and burning problems in the future.

**SITUATION#2-If degradation begins to occur due to an errant temperature controller or similar problem during production:**

- Close the feed hopper gate.
- Shut off all barrel and die heaters.
- Run at normal screw RPM until barrel and screw are empty.
- Remove the die and adapter assembly.
- Push the screw out of the barrel; inspect and clean.
- Locate and replace the faulty controller, or component.
- Resume using normal start-up procedures

**For further information contact your PolyOne Technical Service Representative.**

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