

MODEL #70 & #75 MINI-JECTOR

Manual Version 2.0

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INTRODUCTION

Dear Owner:

Thank you for choosing the Model #70 or Model #75 Mini-Jector injection molding machine. As with all Mini-Jector machines, your machine represents over 40 years experience in designing and building injection molding machinery. These models are 10 or 12.5 ton clamp capacities, with the choice of 1 or 2 ounce injection units. Because of the versatility of its design, it is frequently built to special customer requirements, which may differ from those outlined in this manual. Those differences will be included in the "Supplements" section at the back of the manual, as well as in the complete machine specifications. A master bill of material is also included to reference the proper assembly and circuit drawings that apply to this individual machine.

Although this is a small machine as injection molding machinery goes, it has many control features both for the protection of the operator and the machine itself. **IT IS RECOMMENDED THAT EVERY OPERATOR OR USER OF THIS MACHINE READ THIS MANUAL THOROUGHLY.** Additional manuals are available from the factory at a modest price.

GENERAL SAFETY PRECAUTIONS

(1) **POINT OF OPERATION GUARDING** - The model #70 / #75 Mini-Jector is equipped with a point-of-operation, automatic guard-opening system that permits the guard to open automatically. It is a pneumatically-operated gate that operates automatically while cycling and also has manual controls. A barrier guard covers the left side of the clamp area. **NEVER OPERATE THE MACHINE WITH ANY GUARDS REMOVED OR INTERLOCKS DEFEATED.** The guarding is designed for both operator protection and utility of operation.

(2) **SAFETY INTERLOCKS** - The point-of-operation guard has (3) independent interlocking systems that prevent certain machine functions from occurring when the guard is open. Only “shuttle in” or “shuttle out” may occur with the safety gate opened. All other machine motions require that the guard be closed and the interlocks activated. The three systems of interlocks are: (a) electrical, (b) mechanical, and (c) hydraulic. These are explained in greater detail elsewhere in this manual.

(3) **MACHINE GROUNDING** - It is recommended that an independent earth ground be provided for this machine to protect its sophisticated electronics. Some common shop grounds may transport voltage “spikes” and other electrical “noise”. A ground lug is provided next to the main disconnect.

(4) **ELECTRICAL DISCONNECT(S)** - A 30 Amp fused disconnect is provided at the machine’s electrical console. This may be locked in the “off” position during maintenance procedures that require “lock out-tag out” steps as recommended by OSHA. It is suggested that a second disconnect at the power source be provided so the main power can be shut off to the console when work is being done inside the console. **ALWAYS SHUT OFF THE MAIN DISCONNECT WHEN WORKING ON THE MACHINE.**

(5) **SAFETY EQUIPMENT** - Operators should use safety glasses with lenses of material approved by ANSI. When heated molds are used, the operator should be provided with gloves of a proper insulating material.

(6) **PURGING** - Always purge the machine when shutting down according to “purging procedures” covered elsewhere in this manual. **NEVER LEAVE THE MACHINE’S HEATERS ON FOR EXTENDED LENGTHS OF TIME WHEN THE MACHINE IS NOT BEING OPERATED.** The machine has a selectable heater cut-back feature, described in the operator interface screens attachment.

(7) **DRYING MATERIAL** - Many materials require pre-drying to remove moisture absorbed during exposure to the air. Even sealed containers do not prevent moisture from being absorbed on certain materials. Dry according to the manufacturer’s recommendations. **CAUTION: WET MATERIALS MAY CAUSE VOLATILES TO BE**

RELEASED WHEN HEATED. Material may burst from the material feed slot or hopper or through the nozzle.

(8) **EMERGENCY STOP BUTTON** - The machine is equipped with an emergency stop button in the operator's control panel, which will stop all motion and functions of the machine. It is a "twist to release" type that requires that the button be twisted in the direction of the arrow on the button to release the switch once it has been pushed in.

(9) **GENERAL SAFETY RECOMMENDATIONS** - Even though the machine is carefully guarded, by reaching over guards into areas with potential pinch points, an operator may be exposed to hazards. **NEVER REACH INTO THE MACHINE WHEN IT IS OPERATING.** The machine was designed for single-operator use. If your operation requires the use of additional operators, please consult the factory for the recommended additional safety features that may need to be added. **NEVER ALLOW MORE THAN ONE OPERATOR TO RUN THE MACHINE AT THE SAME TIME.** Always shut the machine pump motor off when installing molds, removing stuck sprues or parts, or otherwise working inside the clamp area of the machine.

INSTALLATION

The model #70 or #75 Mini-Jector is shipped on hardwood skids that allow the machine to be moved to its location in your shop.

If the machine is equipped with the regular machine stand, it may be moved without re-skidding the machine. Care must be taken to lift from the bottom of the machine, however, in order to support the hydraulic tank. If the bottom of the machine is not supported, the frame may break.

ELECTRICAL POWER - The machine runs on 208-230 Volt three phase power unless special-ordered with a single phase motor or with 460-480 Volt three phase power. It requires a service of a minimum of 30 Amps at 208-230V. A hole is provided in the upper rear top of the control console to bring in your shop power. **IT IS HIGHLY RECOMMENDED THAT AN INDEPENDENT EARTH GROUND BE USED.** This protects the sophisticated electronics of the machine from electrical “noise”. It is also recommended that a separate wall disconnect be provided on the incoming service to permit shutting off all power to the console.

WATER OR COOLANT SUPPLY - The machine requires cooling water or media from a chiller to be brought in at both the hydraulic system heat exchanger and the hopper tube that joins the hopper to the screw barrel. Neither of these areas requires a large volume of water for efficient operation. You may wish to purchase one of the commercially available water manifolds to also provide cooling for your molds. It is recommended that the return water line from the hopper tube have a needle valve or other control mechanism to retain water in the tube by restricting out-flow to allow better heat transfer. The heat exchanger is built into the hydraulic reservoir and has two NPT ports.

GUARDING REAR OF MACHINE - If the rear of the machine faces an aisle or other area with easy access by bystanders, we recommend that a barrier be placed to prevent bystanders from reaching into any of the machine’s mechanisms. The barrier should allow access to the hydraulics for maintenance, however.

VENTILATION – The area around the machine should be properly ventilated to remove gases present from materials such as PVC.

GENERAL DESCRIPTION OF THE MACHINE

The Model #70 Mini-Jector is classified as a vertical clamp, vertical reciprocating screw injection, single-station injection molding machine of the straight hydraulic clamp type. The Model #75 is classified as a vertical clamp, horizontal injection machine. When equipped with the optional shuttle table, it remains classified as a single station machine. The mechanical portion of the machine consists of a clamp assembly, injection assembly, base and safety guard assembly, and an ejector assembly. A hydraulic system and an electrical control system operate these mechanical components. This section of the manual will also familiarize your operators with the industry nomenclatures for various machine components and functions.

CLAMP ASSEMBLY - The clamp assembly is of a four tie rod construction and consists of the lower (stationary) platen, the upper (moveable) platen, and clamp cylinder plates. The mold is attached to the upper platen and the lower platen. If the machine is equipped with the optional shuttle table, the table is mounted to the lower platen, and the lower mold half is mounted to the shuttle. The upper platen is raised and lowered by two 2.5" bore clamping cylinders in the model #70 and one 4" bore cylinder in the model #75. These are plumbed to allow simultaneous movement of both cylinders. The upper platen moves on the four tie bars, guided by greaseless-type bronze bushings. The platens are designed to mount the DME, National, Master Unit Die, and other commercial 8" x 8" mold bases that have mold mounting holes of 1/2" - 13 thread on 6.75" centers and use a 2.00" diameter locating ring (actually, the outside diameter of the sprue bushing itself). Some machines also are designed to mount custom 1" x 1" tooling. The model #75 uses 6" x 8" shuttle bases and 5" x 6" or 5" x 8" N DME bases.

EJECTOR ASSEMBLY - The ejector mechanism mounts beneath the stationary platen. A 1.5" bore, 2" stroke cylinder is attached to a rectangular ejector bar and also to the lower platen. When activated, the cylinder pushes the ejector bar up toward the platen; stripper bolts screwed into the bar strike the ejector plate in the mold. The ejector is returned hydraulically to the down position after the ejection cycle is complete. A limit switch verifies that the ejector has returned before the shuttle can move.

INJECTION ASSEMBLY - The injection assembly is mounted on two long guide rods that are attached to the upper platen at the lower end and to the carriage cylinder plate at the upper end. The carriage cylinder moves the entire injection unit down to insert the nozzle into the sprue bushing in the mold and holds it there under pressure during the injection and extrude cycles. It also retracts the injection unit slightly to break the nozzle contact if the "sprue break" option is turned on (see attachment – Operator Interface Screens). If the injection unit needs to be serviced, the carriage cylinder can withdraw the injection unit up into the "service" position to allow the barrel to be removed, etc. The injection cylinder plate mounts the two injection cylinders that pull the thrust housing (which, through a coupling, mounts the feed screw) down to inject material into the mold. They also raise the housing to "de-compress" the material when that feature is turned on. The screw motor is a direct-drive hydraulic motor that drives the screw

coupling, which runs in two steep row Timken roller bearings. The thrust housing is guided on two tie bars.

SAFETY GUARD ASSEMBLY - The machine has a **Power Guard** assembly that uses a small air cylinder to open or close the guard. On hydraulic shuttle machines, the operator must push the two hand start buttons until the shuttle has pulled the mold into the molding position, engaging the “shuttle in” switch. The guard then closes and a new cycle continues. It opens after die open is completed. The guard (and the left side guard) is made from 0.250“ thick polycarbonate sheet. The side guard remains on the machine unless it needs to be temporarily removed to perform a mold change.

HYDRAULIC SYSTEM - The machine’s hydraulic power unit is mounted directly behind the clamp unit at floor level when using the regular stand. The motor (5HP, 1725 RPM) is mounted vertically, permitting the gear pump to be immersed in the oil reservoir to reduce pump noise. The reservoir holds about 12 gallons of hydraulic oil; the oil level can be seen in the sight gage on the side of the reservoir. A return line oil filter is mounted on the reservoir with a bypass system. The system will light the alarm light when the filter is dirty. The heat exchanger is located in the reservoir (see installation). The pump has a suction line filter to compliment the return line filter. The pump housing contains the main relief valve, which protects the system. Pressures of the various hydraulic functions of the machine are regulated by a proportional pressure relief valve (which is an electronically controlled relief valve), mounted either on top of the power unit or on the main hydraulic manifold. The manifold contains the various directional valves that produce the machine motions, the check valves that hold clamp tonnage and prevent drifting, the back pressure control, the regenerative clamp valve, and speed controls for inject and screw speed. There are various pressures assigned to various machine functions that are permanently programmed into the control. These are pre-set at values that produce the smoothest machine operation without sacrificing speed. Those pressures are listed under machine specifications. All hydraulic fittings are of the “o” ring face seal type. The clamp and carriage cylinders use poly-pack lip seals on the pistons to prevent drifting.

ELECTRICAL CONTROL SYSTEM - The Mini-Jector Model #70 or #75 uses a Mitsubishi programmable logic controller with thermocouple input, analog input, and analog output modules added. The operator interface is a Mitsubishi LCD “touch screen” display, which displays system status, system options, recipes, etc. and has pushbuttons for all motion functions (in manual mode). An emergency stop button, an alarm light, and motor start and stop buttons are mounted on the panel. The console door may be opened by using a screwdriver to unlatch the clamps on either side of the door. Note that the disconnect must be turned off in order to open the console door. The various input and output lights may be observed for troubleshooting by turning the disconnect on (see maintenance section). Machines using 460VAC power have a 3kVA stepdown transformer mounted on the back of the control console. The operator interface sets all positions, times, and temperatures and turns selectable functions on or off. There are six limit switches on the machine: one to determine carriage backtravel on sprue break, one to serve as a back-up mold protection verification, one to monitor the

position of the mechanical safety interlock, one to verify ejector return, and (on shuttle machines) two to indicate whether shuttle is in or out. Linear potentiometers control the motion of the injection and clamp axes.

MANUAL HYDRAULIC CONTROLS- There are several manual hydraulic adjustments that can be made to regulate screw speed, injection speed, and screw back pressure. These controls are located in the various valve “stacks” on the main hydraulic manifold on the back of the machine. The screw speed flow control valve is mounted under the “extrude”-“eject” directional valve. Turning the knob in will reduce screw speed; turning it out will increase it. Under the “inject”-“retract” directional valve is a similar flow control valve for injection speed. In the same stack is an aluminum counterbalance valve for screw back pressure adjustment. Turning the set screw out will reduce back pressure during injection plasticizing; turning it in will increase it. The back pressure can be read on the pressure gauge.

OPERATING THE MACHINE

Due to DOT regulations, the machine is shipped without hydraulic oil. Fill it with ISO 32 or any quality grade of hydraulic oil. Use only oils specified for hydraulic use only; do not use any combination oils. The reservoir holds about 12.5 gallons of oil, and the level may be observed in the combination level and temperature sight gage on the side of the hydraulic reservoir.

MOTOR ROTATION - If the pump motor is running in the wrong direction, it will not produce hydraulic flow or pressure. Turn the main disconnect on and observe whether the operator interface screen display lights up, indicating the machine is under power. Press the motor start button to start the motor, and press **MANUAL** to enter “Manual” mode. Enter Manual Mode: Pg. 2 to close the safety gate, then go to Manual Mode: Pg. 1 for clamp access. Press the **Clamp Open** switch; the mold will open fully. If the mold is already fully open, press the **Eject** button on Manual Mode: Pg. 1, and the ejectors should extend. If neither of these functions operate, the pump is running backwards. To reverse the rotation, swap any two of the motor leads on the motor starter or at the independent wall disconnect (if provided). Since the oil has been drained for shipment, there may be some air in the system, and motion may be jerky until it works out. If the system seems very noisy, it may be necessary to bleed air out of the proportional relief valve (see maintenance section for procedure).

INSTALLING A MOLD - Before you install your mold, be sure that the mold protection limit switch tripper on the left side of the clamp unit is backed out far enough so that switch contact is not made when the mold is closed. Open the mold to the full open position and be sure the carriage is out far enough so the nozzle is above the upper platen. If you are using standard 8” x 8” tooling, place the mold on the lower platen (or shuttle table) with the sprue or top half in place. Align the sprue bushing with the centering hole in the upper platen, **close the safety gate** and carefully close the mold with the manual control. In manual cycle, the clamp will only close at mold protect pressure. Using ½” -13 x 2” socket head screws, bolt the mold to the stationary platen (or shuttle) and the moveable platen. Install all water or heater lines to the mold. Go to Manual Mode: Pg. 1 and observe the **Clamp Position** reading. If, for example, it reads 4.35, set the **Clamp Closed** position to 4.35.

PREPARING TO MOLD - Fill the material hopper with the appropriate resin, and set all the various parameters of temperature, times, etc. as explained in the operator interface section (see appendix). If you do not have cooling connected to the feed hopper tube, do not put material in until the machine is up to operating temperatures. The material may bridge the opening into the screw barrel if it sits there for a prolonged period of time. Remember, you cannot operate any of the injection functions until all heater zones are within the **Heater @ Temp Window** of their set-point temperatures. When the machine is up to temperature with material in the hopper, you are ready to plasticize and prepare the first shot.

To charge the first shot:

- If the machine has a shut-off nozzle, be sure the nozzle is away from the sprue bushing, allowing the shut-off nozzle plug to drop. With the safety gate closed, press **Screw Extrude**, and hold it until the screw housing travels back to the **Shot Size Position**.
- If the machine does not have a shut-off nozzle, press the **Injector Retract** button to retract the injector upward the desired distance. Then press the **Screw Extrude** button until material begins to flow out of the nozzle.

The 1 ounce, 7/8" diameter screw contains about 0.6 cubic inches (or 0.33 ounces) of material for each inch of up-travel. The 2 ounce, 1-1/8" diameter screw displaces 0.994 cubic inches of material per inch of up-travel.

The machine is now ready for a manual cycle.

MANUAL CYCLE –

- **Machines Without Shuttle –**
 - With the safety gate closed, press the **Clamp Close** button until the clamp closes completely. Remember, in manual mode, the clamp closes at low pressure, so the mold will no doubt flash the first shot.
 - Press the **Carriage Close** button until the nozzle is seated in the sprue bushing.
 - Press **Injector Inject** until the mold has filled. The screw will stop moving forward or down when the mold is filled or all material is displaced.
 - If you normally use sprue break, press **Carriage Open** until the nozzle pulls away slightly from the sprue bushing.
 - Press the **Screw Extrude** button and extrude until the next shot is prepared.
 - If you normally use injector decompress, press **Injector Retract** until the injector moves up slightly.
 - Press **Carriage Open** until the carriage reaches its open position.
 - Press **Clamp Open** until the clamp has opened fully.
 - Press **Ejector Eject** enough to extend the ejectors fully. Wait until the ejectors automatically return.
 - Open the safety gate and remove the part.
- **Machines with Optional Shuttle -** Before the procedure outlined above is performed, press the two "shuttle in - start cycle" pushbuttons and the shuttle will travel in until it hits the adjustable stop. Continue on with the procedure outlined above. When the ejectors have returned, push the two "manual shuttle out" buttons, releasing them when the shuttle reaches the out-stop. These buttons have an "anti tie down, anti repeat " feature, and they must be pressed simultaneously.

ADJUSTING THE LEFT SIDE MOLD PROTECTION SWITCH - During the above procedure, the left side mold protection switch has not yet been adjusted. To adjust the switch, perform the following:

- **Machines Without Shuttle** - Press the two “Cycle Start” buttons simultaneously and the front safety gate will close. Release the two buttons when the gate has closed, and the mold will start closing. It will close completely, but at low pressure. Since the low pressure switch has not tripped, none of the rest of the cycle will start. Once it is closed, turn the mold protection threaded tripper cam down until it is about to contact the limit switch plunger. Very carefully and gradually turn the cam until it just trips the limit switch. It takes 0.020” of travel to trip the switch, and you want it to just make contact. You can tell when the switch has made as the hydraulic noise will increase as it makes tonnage, and the injection portion of the cycle will start. After the machine has made a complete cycle, replace the side guard if it was removed. It is now ready to operate on a production cycle.
- **Machines with Hydraulic Shuttle** - The cycle is started by pressing the two “shuttle in, cycle start” buttons and holding them until the shuttle has made the “shuttle in” limit switch. The gate will close automatically. The mold will then close under low pressure. Repeat the former procedure for setting mold protection.

SEMI-AUTOMATIC CYCLE –

- **Machines With Shuttle –**
 - To start a semi-automatic molding cycle, the safety gate must be open, the ejector returned, the shuttle in the full out position, and the machine temperatures within the **Heater @ Temp Window** of the setpoint temp. (If the temperatures are outside the heater @ temp window, a warning occurs).
 - After placing the insert(s) in the mold, the operator presses the two “shuttle in” pushbuttons. **If the shuttle option is on**, The shuttle will travel under **Shuttle Pressure** into the clamping area until it strikes the “shuttle in” limit switch. The pneumatic safety gate will close automatically as soon as the “shuttle in” limit switch is made. **If the shuttle option is off**, pressing the button will cause the pneumatic safety gate to close. The hands can be removed from the pushbuttons once the gate is closed. If they are removed prematurely, the cycle will stop, and the buttons must be pressed again and held until the gate is closed. Please note that if the shuttle option is off but the shuttle is out, pressing the pushbuttons will move the shuttle in. The pushbuttons must then be pressed again to begin the cycle.
 - The mold closes under **Clamp Low Pressure**, and when it reaches the **Clamp Closed** position and the mold protect limit switch is tripped, the machine pressure increases to **Clamp High Pressure** to lock the clamp. The machine is stationary until the **Clamp Hold Time** expires.
 - The carriage (under **Carriage Extend Pressure**) brings the nozzle into the mold sprue bushing and holds pressure for the **Carriage Hold Time**. This allows tonnage buildup and locks the carriage cylinder pressure through dual pilot operated check valves.

- The injection sequence starts, with the initial injection taking place at the **Injector Boost Pressure** setting. The injector then switches to **Injector Pressure**, which is set on the operator interface. (The point at which this pressure changes is determined by the **Injector Boost Time** or the **Injector Transition Position**, depending upon which option is selected on the operator interface. See the operator interface screens attachment for details). When the **Injector Hold Time** is finished, the injection pressure on the material ceases. (Note: If the injector boost option is turned off, then the injector runs at the injector pressure for the entire injector movement).
- The machine sits until the **Mold Set Time** is finished. This allows the part to set in the mold.
- If the **Sprue Break** option is selected, the carriage travels to its “up” position under **Carriage Return Pressure**.
- The completion of the injection cycle starts the “extrude” cycle, where the screw rotates to fill the shot size for the next injection cycle. As the material is fed in front of the screw tip, the screw thrust housing moves back until the **Injector Shot Size Position** is made on the injection axis potentiometer.
- If the **Inject Decompress** option is selected, the injector de-compresses by retracting the screw the **Injector Decompression Offset** distance.
- Completing de-compress energizes carriage up, which moves the carriage under **Carriage Return Pressure** to the distance set on the “carriage back” limit switch. (Note that if sprue break is selected, the carriage will already be in the “up” position and therefore will not move).
- The clamp opens under **Clamp Open Pressure** until it reaches the **Clamp Open** position set in the interface.
- If the **Eject** system option is selected, then the ejector is extended. It remains extended for the **Ejector Hold Time** and then retracts.
- Once the ejector has retracted, the gate will open automatically. **If the shuttle option is off**, the cycle is complete. **If the shuttle option is on**, the operator must press the “shuttle out” pushbuttons to move the shuttle out, which completes the auto cycle.

Machines Without Shuttle –

The machine without a shuttle operates identically to the machine with a shuttle, except the pushbuttons are used to start the cycle rather than to move the shuttle in and out.

INTERRUPTING THE CYCLE - If at any time during a semi-automatic cycle you wish to stop the machine from continuing its cycle, press the **Stop** button on the operator interface screen. This does not stop the hydraulic pump motor, but it does stop the cycle. This causes a warning if the axes are not in their “home” positions, and the axes will need to be manually re-homed before the cycle can begin again. This can be accomplished by using the jog buttons on the manual screen; the buttons turn green when the axis has reached its home position.

If you wish to stop the cycle and halt all movement (including the pump motor), press the **Emergency Stop** button. This causes a fault, which must be cleared by pressing the “reset” button. The hydraulic pump motor must then be re-started, and the axes must be homed as described above before the next cycle can begin.

TROUBLESHOOTING

This machine has many interlocks in its software to protect your operators, tooling, and the machine's mechanisms. The following are a list of checks to make.

CLAMP WILL NOT CLOSE – The following conditions must be met in order for the clamp to close:

- Control power is on (e-stop is not activated)
- Hydraulic pump is running
- Safety gate is closed completely (the proximity switches have a red LED that indicates whether the switches are made by the targets)
- Shuttle is in
- Injector is not pushing
- Screw is not turning
- On machines with the automatic guard opening, the mechanical interlock monitor switch must be tripped and released.

EJECTOR WILL NOT EXTEND – The following conditions must be met in order for the ejector to extend:

- Control power is on (e-stop is not activated)
- Hydraulic pump is running
- Safety gate is closed completely
- Clamp is open
- (Machines with shuttle table only) Shuttle must be in the “In” position, making the limit switch
- (Manual jog only) Carriage is not at mold position
- (Auto mode only) Ejector option must be turned on

CARRIAGE WILL NOT OPERATE – The following conditions must be met in order for the carriage to operate:

- Control power is on (e-stop is not activated)
- Hydraulic pump is running
- Safety gate is closed completely
- Clamp is closed
- Injector is not pushing
- Screw is not turning

INJECT, RETRACT & EXTRUDE WILL NOT OPERATE – The following conditions must be met in order for inject, retract, and extrude to operate:

- Control power is on (e-stop is not activated)
- Hydraulic pump is running
- Safety gate is closed completely
- Heater cutback is not active

- Heaters are at temp OR inject solenoid push is activated / screw extrude solenoid is on
- (Inject only) Shuttle is at in position, clamp is at closed position, and carriage is at mold position

MACHINE WILL NOT RECYCLE - Check to make sure that the ejector has returned, the shuttle is in, the gate is closed, the shot size is filled, the clamp is open, and the carriage is up. Also remember that with automatic gate opening, the mechanical safety switch must be tripped and released.

SHUTTING DOWN

PURGING - When shutting down after a production run, or when changing materials, it is sometimes necessary to purge the resin from the screw barrel. To purge the machine, follow these steps:

1. Empty the material hopper by loosening the 5/16" pivot bolt and removing the 1/4" mounting bolt on the hopper flange. Place a box under the dump tube in the hopper mounting plate and swivel the hopper against the roll pi stop. The contents of the hopper will empty into the box.
2. Use an air nozzle to blow out any "fines" or particles left in the hopper. There will be about 6 cubic inches of material remaining in the hopper tube. The tube can be removed, but it is difficult to catch the material that will fall out. It is easier to purge that material out.
3. If the machine has a non-drool nozzle, press **Carriage Close** (Manual Mode: Pg. 1) until the nozzle seats in the sprue bushing. **Never attempt to purge with the non-drool nozzle pulled away from the sprue bushing.** There is no way to open the nozzle plug to allow material to flow out.
4. Open the mold fully, and press **Injector Inject** (Manual Mode: Pg. 1).
5. After the screw has bottomed, press **Screw Extrude** (Manual Mode: Pg. 2) and hold it while material purges through the sprue. When the material has been vacated from the screw barrel and the hopper tube, the screw motor will speed up and material will stop oozing out of the sprue. Sometimes, materials with high viscosities will not flow through the sprue by extruding, and the screw will return up as it would in regular operation. Under that condition, purge by using alternate **Injector Inject** and **Screw Extrude** until the barrel is empty.
6. Use the air nozzle to blow any leftover pellets down the hopper tube.
7. If you are shutting down, press **Heater Control** to bring up the heater control screen, and press **Turn Off** to shut down the heaters. If you are not going to run the machine any more, you can shut down the heaters prior to the purging process.
8. Press **Carriage Open** (Manual Mode: Pg. 1) to withdraw the nozzle to the service position.

Straight Orifice Nozzle - If your machine has the straight orifice nozzle, you may withdraw the nozzle to the service position to purge the machine. When you remove the purgings from the top of the upper platen, **turn off the pump motor.**

PURGING COMPOUNDS - There are many commercial purging compounds that can be used to clean the screw and barrel when changing materials. **Consult the manufacturer of the material before selecting purging compounds.** Remember that a small amount of the original material will remain in the metering zone and nozzle body after purging, and will appear when you start running again. Two shots usually clears it up.

SHUTTING OFF POWER - After you have purged the machine and shut the motor off, the operator interface screen will remain illuminated. This will not harm or shorten the life of the unit. To shut the screen down, turnoff the main disconnect on the control console.

MAINTENANCE

HYDRAULIC OIL - It is a good policy to replace hydraulic oil after a few years of use. Use a good grade of hydraulic oil, and not a general purpose oil, as the latter tend to have a higher viscosity. The system holds 12 gallons when full. When possible, run the new oil through a filter when pumping it in. New oil will contain some impurities, such as fine lint, created during the refining process. Doing this will lengthen the time the machine will run before it is necessary to change the return line filter built into the machine's power unit. **Do not run the machine with the oil level below the top of the sight gage.**

IN-LINE FILTER - The in-line filter on the hydraulic power unit has an automatic bypass feature that allows oil to flow around the filter when it is plugged. The unit has a monitor that checks whether the unit is bypassing. The alarm light will indicate an alarm condition, and it can be checked on the alarm screen ("Hydraulic Filter Dirty"). Change the element as soon as possible.

BLEEDING SYSTEM AIR - If for any reason air has worked its way into the hydraulic system from either disassembly or from low oil levels, the pump will make noise when the system pressures are in the higher range. The noise will show a pressure oscillation. After the reservoir is brought up to its level, locate the proportional pressure relief valve on either the power unit or on the main manifold. With the machine running, loosen one of the socket head screws in the round, silver part of the valve body. Oil and air will come out of the orifice. Screw the screw back in. Be sure the screw is out enough to allow oil to pass out of the bleed hole. It may be necessary to remove the screw entirely.

REMOVING THE SCREW BARREL - To remove the screw barrel as a unit, inject the screw to its bottom position. It may be necessary to have the heaters on to allow the unit to inject. Press **Carriage Open** (Manual Mode: Pg. 1) to move the carriage to its uppermost position. Remove the shoulder bolt coupling pin to detach the screw from the drive coupling. Retract the thrust housing all the way back to its full up position. Turn off the heaters and allow the unit to cool down. Un-plug the three heater twistlock plugs and unplug the three thermocouples. There is a #10-32 set screw locking the large barrel retainer nut. Loosen it, and loosen the 1/2" socket head screw in the back of the injection cylinder plate. This screw acts as a key to keep the barrel from turning. Remove the hopper tube and hopper to facilitate handling. Remove the large barrel nut using channel lock pliers. The nut is not torqued. The unit should fall freely at this point. To re-install, reverse the procedure.

LUBRICATION - The machine is equipped with greaseless bushings lubed at the factory. There are four in the moveable platen, two in the injection cylinder plate, and two in the thrust housing. It is only necessary to grease these fittings once a year using clear lithium type grease. Wipe any excess off after greasing.

Appendix

GENERAL PRINCIPLES OF INJECTION MOLDING

Injection molding owes its origins to the die casting industry. It is a similar type of thermal process where the material changes its physical state from a solid to a liquid back to a solid again. An excellent analogy would be ice melted into water and frozen back into ice again but in a different shape. Thermoplastics are actually a semi-liquid when melted, having the viscosity of maple syrup. Resins that can undergo physical change such as described are referred to as **thermoplastics**. Resins such as phenolics and epoxies that undergo permanent chemical change are referred to as **thermosetting resins**. This chemical change occurs under heat and pressure and the plastic is liquid for a very short period of time when it flows into the cavity of the mold. The chemical change continues until the part solidifies. Thermosetting material cannot be re-heated and used again. These materials are un-suited for processing in plunger type injection molding machines.

Thermoplastic materials are usually supplied in a pellet or granular form. Certain materials prepared under laboratory conditions are in a powder form, much like talcum. These must be calendered into a ribbon or pellet form, as they do not injection mold well in the powder form. Pellets are made by extruding the resin into strands, adding color concentrates to enhance appearance, and then chopping into pellets as they are cooled at the end of the extruder line.

Thermoplastics can be fully recycled by grinding the scrap or used material into pellet-like chunks. The "re-grind " can be used for molding or extrusion again. If similar materials of different color are blended during re-grinding, screw plasticizing machines (like the Model #70 & #75) will homogenize the mix into a single color, where a plunger machine (like the Mini-Jector Model #45 & Model #50) will produce a product with a marbled appearance. The number of times a material can be re-used is dependent largely on the nature of the resin itself. Some contain stabilizers and volatiles that can be lost during re-processing. Even the most stable resins have a finite processing life, and eventually become un-useable.

Most thermoplastic are excellent insulators and, consequently, resist rapid heating and cooling. The plastic pellets are metered by the hopper and feed mechanism into the funnel and through a feed slot, then into the heating cylinder itself. The pellets contact the heated walls of the cylinder and begin to melt, or **plasticize**. To further assist melting, the material is forced to flow around a device called a spreader, or torpedo, in the nozzle end of the heating cylinder. This spreads the material into thinner layers, exposing more pellets to heated surfaces. The fins on the spreader also produce a shearing effect on the pellets as they are forced through the cylinder. The spreader has a very close fit with the walls of the heating cylinder and is heated by contact.

The heating barrel and nozzle are heated by electrical resistance heaters controlled by **pyrometers**, or heat controllers. Thermocouples feed the barrel and nozzle temperatures back to the pyrometer, which makes the adjustments

necessary to maintain proper temperatures. Unlike a screw plasticizing machine, which converts mechanical energy to heat, a plunger machine transfers most of its heat energy through conduction.

There are two types of injection molds: the **center sprue** type, where a radius tipped nozzle injects through a sprue bushing in the center of the stationary mold half, and the **parting line** type, where the material is injected at the parting, or split line, of the mold. Mini-Jector machines utilize the parting line system. The orifice where the hot material enters the mold is referred to as the **sprue**. Offshoots from the sprue to various cavities are called **runners**. Between the mold cavity and the runner is a much smaller passage, called a **gate**. This assists breaking off the finished part from the runner, and it also increases flow velocity. New molds are generally built with gates that are smaller than needed so they can be enlarged later. The gate freezes before the runner, preventing material flow-back that would cause **sinks**, or voids, in the part.

When the hot material enters the mold, it begins to cool immediately. Most injection molds are operated at room temperature or below to speed cooling. Some materials require mold heat to process. Pressure is maintained on the injection screw after the mold is filled to prevent sinking (mentioned above), caused by the rapid cooling of the piece. It is held only long enough to prevent sink and to freeze off the gates. Excess pressure dwell can over-pack the mold cavity, making the part more difficult to remove from the mold. As a general rule, the longer the injection pressure dwell time, the less the shrinkage of the molded part.

The efficiency of the injection molding cycle is usually limited by the ability of the screw barrel to melt the plastic. That rating is known as the **plasticizing capacity** and is usually rated in pounds per hour. The mold cooling cycle may also limit the molding cycle. Liquid media can be used to cool the mold more rapidly, and hot liquids or electrical heaters can be used to raise the mold temperature when needed.

During the injection cycle, the hot plastic entering the mold is under a very high pressure. Although injection pressures of 20,000 psi or greater are common, the actual pressure inside the mold cavity is considerably less due to the pressure losses in the nozzle or gates and the inefficiency of the pressure transmission by the granular material. This actual pressure is usually in the 4,000 - 5,000 psi range. This force tries to work against the projected area of the mold (the area on the same plane as the parting line), trying to force the mold halves apart. This can produce **flash**, where material squirts out from between the mold parting line. A good rule of the thumb is to have at least two tons clamping pressure available for every square inch of projected area. Up to 5 tons per square inch is recommended when running very low viscosity resins or very thin mold sections. Clamp tonnage is produced by the wedging action of the "V" mold caused by the nozzle force in the "Wasp" Mini-Jectors (Models #45, #50, and #55). The Model #60, #70 and #75 machines use a hydraulic clamp that stretches the machine tie rods, producing stored clamp energy.

After the part cools in the mold, it is removed manually when the mold is removed from the machine in the “Wasp” Mini-Jector, or ejected by the mechanically, hydraulically, or pneumatically-driven ejector pins in the mold, as in the various #60, #70 & #75 model Mini-Jectors. Mold release sprayed on the surface of the molds assists in part removal. A certain amount of draft on the side of the part also assists in part removal.

RECIPROCATING SCREW

The reciprocating screw plasticizer, as used in Mini-Jector models #55, #60, #70, and #75, is a combination of the principle of the extruder and the plunger system. The screw is extremely efficient as it adds shear heat, converted from the mechanical energy produced by the hydraulic motor turning the screw within the barrel. This shearing and mixing allows dry color or color concentrates to be used in your materials, so you can color natural resin with color concentrates right in your machine. The screw also permits lower material temperatures, especially with engineering materials.

The screw is separated into three flight zones: the rear or **feed zone** is deeper to permit efficient feeding of pellets and is about 1/2 the length of the screw’s flighted section. The second or **transition zone** is where shear is introduced. The flights become gradually more shallow. The material is compressed in this zone, which usually contains 1/4 of the total number of flights. The last zone is the **metering zone**, which is the final depth of the transition zone and the remaining 1/4 of the total flights. Its purpose is to filter any remaining un-melted pellets from the melt stream.

Unlike an extruder, which is operated in a fixed position, the reciprocating screw is able to “reciprocate” back as plastic is discharged ahead of the tip. The material fills the void created when the resin pressure pushes the screw assembly back. Back pressure is applied by a hydraulic counterbalance valve to ensure that the material is properly kneaded. The amount of material for the next shot is regulated by electrically stopping the screw return with a limit switch or potentiometer when sufficient material is discharged ahead of the screw tip.

The screw tip consists of a sliding ring assembly, which allows material to flow through it during plasticizing and seals off during injection, when the screw acts as a plunger to fill the mold. The tip is made of extremely hard & durable materials.

GENERAL PROCEDURES FOR MOLDING COMMON THERMOPLASTICS ON MINI-JECTOR SCREW-TYPE INJECTION MACHINES

(1) Polyolefins (Polyethylene, Polypropylene)

As there is a broad range of material densities and melt indexes available in these resins, a variety of molding parameters exist. Polypropylene generally is an inferior conductor of heat, and the maximum plasticizing capacity of the machine should be de-rated to about 65% of its rating in polystyrene. Polyethylene processes in direct portion to its density. The low density materials require less pressure and heat than the high density or linear grades. All polyolefins have a low melt viscosity and should be molded at as low a pressure as possible to avoid flashing. Clamp tonnage should be set at maximum, regardless of the size of the molded part. The low-density polyethylenes should be molded at very low pressures with minimal plunger dwell under pressure to prevent warpage. Molding temperatures may be anywhere from 325° to 650° F; however, it is a good rule of thumb to set the temperature high enough only to eliminate cloudiness and weld lines in the finished part.

If the machine is equipped with an injection speed control valve, set it for maximum flow to eliminate weld lines where two walls of flowing resin meet. Dies can be cooled to a great degree. Non-silicone type mold releases should be used. Do not use any mold release unless it is specifically recommended for polyolefins. These resins can be re-ground and re-cycled many times. Pre-drying of the resin is not necessary.

(2) Polystyrene

Polystyrene resins in general are among the easiest to mold. General purpose materials can be molded anywhere from 325° to 550° F. High impact grades must be molded at 450° F or less to avoid losing the material's high impact properties. Several problems can be experienced running polystyrene. One is difficulty in ejecting from the die. Overpacking the mold by using excessive injection pressure is one cause. Since polystyrene experiences very little shrinkage during the cooling cycle, adequate draft or taper on the molded parts is needed. Extra long injection dwell after the mold is filled will aggravate the problem.

If the machine has hydraulic ejection, set the cylinders to "push" rather than strike the parts due to the material's brittleness. Mechanical ejection can be softened by using the cushion adjustment on the clamp cylinder.

Another problem is "silver streaking" of the part. This is generally caused by excessive material heat or long inventory time. When running very small shots, compensate by lowering temperature settings.

Small gates can generally be used, as they can always be enlarged. Most mold releases can be used, and drying is not usually necessary. Die components such as

cavities, runners, and gates should be hardened, as polystyrene is somewhat abrasive. It makes a good purging compound for that reason. Die heat is usually not necessary.

(3) Nylons (Polyamides)

The molding of nylon can be summed up in one statement: be sure the material is dry! Most problems in molding nylon are the result of excessive moisture in the material. It is very hygroscopic, and sealed containers as supplied by the resin manufacturer contain sufficient moisture to affect molding. When a can or bag is opened, the contents will immediately start to absorb moisture. Before molding, either dry the material in an oven for 10-12 hrs. or use a desiccant type dryer. Hopper dryer/loaders also are useful.

If the moisture content of a material is too high, it will bubble and boil, causing many bubbles to appear in the finished part. It will also result in excessive stringing and drooling at the nozzle. Nylon can be molded at temperatures 500° F and up, but best results are obtained in the very small temperature window where the nylon is actually resinous. This is usually between 500°-520° F. Above that temperature, the material becomes very watery, and tends to flash in the mold. If your cycle is fast and residence time of the material is short, higher temperatures may be necessary to plasticize quickly. Brown streaks indicate too high a temperature. Drooling can be controlled by experimenting with nozzle temperatures. A non-drool shut-off nozzle is almost a necessity. Some added die heat may be necessary. Pressures of over 10,000 psi are also needed.

(4) Cellulosics (Acetate, Acetate Butyrate, & Propionate)

Cellulosics are not particularly hard to mold, but they do tend to be somewhat unstable, especially acetate. Cellulosics were the first successfully molded thermoplastics, and they are still popular for eyeglass frames and similar items. Careful control of temperatures must be maintained, and nozzles, screws and barrels, etc. must be cleaned regularly to prevent accumulation of burnt residue. This can be done by physically cleaning the components or by frequent purging. This is important, as butyrate in particular releases gases that could be corrosive to cylinder components. Pre-drying of acetate is advisable. Good surface finishes may be obtained by using a little die heat and as little injection pressure as possible. A speed control on the injection cycle may be helpful in eliminating "skid" marks on the part surface. Avoid overheating acetate, as its plasticizer will boil. Pressures over 10,000 psi are usually not necessary.

(5) ABS Resins

ABS resins require higher injection pressures than the cellulosics and may require some die heat. These materials mold in a fashion similar to high impact polystyrene. They also must not be overheated, or they will lose their high impact

properties. Do not use gates that are too small, as the material will freeze quickly before the cavity(s) are filled. Pressures over 10,000 psi may be necessary.

Besides the impact properties, one of the most desirable features of ABS resins is their ability to be chrome plated. If your part will be chrome plated, the results will be much better if the material is pre-dried before molding.

(6) Acrylic Resins

Acrylic resins are not difficult to mold and are very popular for applications such as lenses. The optical grades in particular make clear lenses. The melt viscosity of acrylics is very high, and to get a good surface finish, the filling speed of the mold should be consistent. The consistency seems more important than the actual rate. Some die heat improves surface finishes by preventing material skid during filling. During injection, if too small of gates create resistance before the filling begins, there may be a "spurting" of the material through the gates.

To eliminate this tendency, gate sizes may be gradually increased on a new mold. A speed control on injection may be helpful in injecting at a consistent speed. Pre-drying, especially when using optical grades, is beneficial. A simple assist when using material put in the hopper from a desiccant dryer or oven is to mount an infrared heat lamp on the hopper with the light directed at the material. Large gates and high injection pressures are usually needed. Do not use a mold release compound on optical grade parts. Temperatures over 450° F should also be avoided.

(7) Polycarbonates

Polycarbonates have an extremely high melt viscosities, even at the high (up to 550° F) temperatures they sometimes require for molding. The injection pressures required are usually over 12,500 psi, and some die heat is necessary. Die heats up to 250° F are not uncommon. Large gates promote good flow but may also require cutting rather than breaking off due to the toughness of the material.

Polycarbonates are even more hygroscopic than nylons, and they absorb moisture as soon as they are exposed to the air. If your dryer is independent of the machine, it is advisable to dry small quantities at a time to avoid moisture absorption. The material can be kept dry in the hopper by using an infrared lamp, as described in the acrylic section. Hopper/dryer units may actually assist plasticizing by pre-heating the material.

If die or material temperatures are too low, surface scratches will appear. Excessive moisture will appear as bubbles in the material and cause uncontrollable drool. Overheating will also cause excessive drool; if noticed, the cylinder should be purged immediately. Filling speed may have to be reduced if splay marks appear around the gate area. To prevent sink marks in parts with heavy sections, the part can be ejected into a pail of cold water. This also adds a little moisture back to the finished

part to avoid brittleness caused by the excessive drying required for these resins. Nozzle temperatures that are too high may also increase drooling.

(8) Polyvinyl Chloride (PVC) Resins

Plasticized PVC resins can be extremely easy to mold, providing reasonable care is taken in processing. Rigid, or un-plasticized, PVC resin is more difficult to mold due to its heat sensitivity. The relatively low inventory of Mini-Jector barrels makes it less difficult, however. Be sure to purge material whenever the residence time would begin to cause degradation or burning. Rigid PVC processes much like ABS, but at lower temperatures.

Plasticized PVC is also heat sensitive, but to a lesser degree. The hardness, or **durometer**, of the resin determines the processing pressures and temperatures. Low durometer (up to 80) materials are extremely flexible and require very little heat and pressure to mold. This increases proportionately as durometer increases. Molding temperatures can start under 300° F for the very low durometer materials. When PVC degrades, it emits chlorine gas, which unites with any water present to form hydrochloric acid. This can corrode molds, cylinders, and any un-protected metals in the molding area. It is a good practice to provide a fan-type ventilation system over the machine if PVC is the typical material. When it degrades, carbon residue remains in the spreader channels and may have to be removed by disassembly and cleaning. If plasticizing seems reduced, a spreader channel may be plugged. Purging with polystyrene when degradation occurs may remove the residue. Remember, PVC degrades on a time-temperature exposure pattern. If left in residence at low temperatures for a long time, degradation may still occur. The first signs will be smoking at the nozzle and a chlorine smell. Commercial purging compounds contain styrene, mineral oil and Fuller's earth. Use the ones recommended by the PVC manufacturer.

Start at low temperatures, increasing them until the surface of the finished part starts to appear glossy. If gate restrictions are too great (or pressures too high) some degradation due to frictional heat may occur. This is indicated by localized discoloration.

(9) Acetal Resins (Delrin, Celcon, Etc.)

Acetals are relatively hard flow resins that require some of the cautions observed in molding PVC (as outlined above). Acetals emit potentially noxious formaldehyde gas when overheated. Follow the manufacturer's temperature setting recommendations and purge when you suspect overheating (or overexposure) of the material. Usually temperatures below 400° F are safe. The same purging procedures used in processing PVC should be used for acetal resins as well. Due to the high flow resistance of the resin, pressures over 12,000 psi may be necessary. Some die heat may be required to produce smooth, glossy surface finishes. Rapid mold filling, which requires adequate venting of the cavities, enhances the molding of acetals.

Do not use restrictive runner systems in your dies for this material, as it may **pipe**, or chill prematurely in the small runners. Small gates do not seem to affect molding as much as small runners do. **Worming** of the material adjacent to the gate would indicate that the gate is too small. Worming appears as a spiral pattern leading away from the gates.

Mold releases are usually not required, as these materials are self-lubricating. Use caution when purging, as unmelted pellets may burst through the nozzle. Reverse taper or restrictive nozzles seem to drastically reduce effective injection pressures. Venting of machine areas when acetals are being molded is recommended.

(10) Fluorocarbons (Teflon, Kel-F, Etc.)

These resins are not commonly molded and require melt temperatures in the 800° F range, plus die temperatures up to 450° F. A minimum pressure of 20,000 psi is required to mold these materials. Slow mold filling improves part quality. If the granular resin contacts an un-plated or non-stainless steel ferrous part in the injection system, it may discolor the melt. Consult the factory prior to running these materials.

(11) Elastomers (Polyurethanes, Thermoplastic Rubbers [TPRs])

There are as many grades and durometers (hardnesses) of elastomers as there are in PVC resins. Processing low durometer urethanes or TPRs is similar to molding plasticized PVC, with several exceptions: urethanes are hygroscopic and must be thoroughly dried prior to molding. When overheated, they become very watery, causing flashing and drooling. Temperatures are generally much higher than PVC (425° F or more). Some TPRs have thermosetting properties and may prematurely harden in the heating barrel. Rough finishes or excessive drooling indicates that the material is not dry enough.

(12) Thermoplastic Polyesters TPEs)

These resins can be processed with ease if a few precautions are used. If the material is allowed to remain in the barrel under heat too long, it may **carbonize** or solidify in the screw flights in the transition zone, blocking material plastification. This is usually indicated by an inability to feed material. Common polyesters or bulk molding compounds are not recommended in these machines.

(13) Glass-Filled Materials

Fiberglass strands or balls are frequently used to strengthen molded parts by being mixed (in proportions up to 40%) with the parent resin. Always use processing parameters as recommended for the parent resin. Filled materials shrink

less, requiring more draft on mold cavities. Occasionally, nozzles must be disassembled and physically cleaned to remove accumulations of strands of filler. Non-drool nozzles in particular tend to have one or more of the converging passages block after prolonged use with filled materials. These resins are also abrasive; the strands wear down screw flights, nozzle bodies, and other cylinder components. Using higher than normal rear zone heater settings tends to “soften” the glass strands and minimize wear.

(14) Ceramic Materials

Ceramic patterns can be molded by mixing ceramic powders with a plastic or wax “vehicle.” They then are heated to a high temperature to evaporate the plastic (usually polystyrene) or wax, leaving the ceramic piece. Styrene-based materials process much like ordinary polystyrene plastics, but the ceramic is extremely abrasive. Miniature Plastic Molding, Inc. can obtain screw & barrels, etc., for ceramic use that are made of very durable materials. Consult the factory if you expect to run ceramics.

(15) Investment Waxes

Investment waxes used in the “lost wax” casting process can be molded on Mini-Jectors with no problems. Lower power/density heater bands should be used to prevent overshoot of temperatures, which are very low (200° F). Very low pressures are also required. Large screws with a smaller injection hydraulic cylinder are recommended. Investment wax can be thought of as a low temperature, low pressure thermoplastic. The more the raw material resembles a plastic pellet in shape or size, the better it feeds through the hopper system. It is vital to use cooling on the hopper tube.

(16) Thermosetting Resins

Molding of thermosets on a screw-type Mini-Jector requires a zero compression ratio screw and a water jacketed screw barrel. The nozzle is also water-cooled. Do not attempt to run thermosetting resins in your Mini-Jector, as they will harden in the screw barrel and may be impossible to remove.

TROUBLESHOOTING COMMON MOLDING PROBLEMS

1. Problem: Flashing of molded part

Reasons:

- a) Injection pressure too high
- b) Material temperature too high
- c) Injection dwell too long
- d) Irregularities or damage to die faces

2. Problem: Sink marks in molded part

Reasons:

- a) Injection pressure too low
- b) Insufficient screw forward time to allow gates to freeze under pressure
- c) Gates too small or large
- d) Material temperature too high to permit cooling during allotted time
- e) Cycle time too short

3. Problem: Burned or discolored molded parts

Reasons:

- a) Material temperature too high
- b) Nozzle temperature too high
- c) Injection speed too great
- d) Material remaining in inventory too long for temperature setting
- e) Failure to purge or reduce temperatures during machine stoppage
- f) Accumulation of residue from previous material
- g) Material has been exposed to excessive pre-drying
- h) Gates in mold too small causing frictional burning

4. Problem: Short or incomplete shots

Reasons:

- a) Injection pressure too low
- b) Material temperature too low
- c) Die temperature too low
- d) Insufficient material feed setting (extrude back)
- e) Shot size exceeds machine capacity
- f) Gates too small

5. Problem: Small voids or unfilled areas in thin sections

Reasons:

- a) Gates too small
- b) Die temperature too low
- c) Injection pressure or heats too low
- d) Insufficient venting of mold cavity trapping air or gases
- e) Injection rate of fill too high trapping gases in mold

6. Problem: Drooling or stringing of material from nozzle.

Reasons:

- a) Material insufficiently dried
- b) Nozzle or material temperature too high
- c) Use de-compress feature if using straight orifice nozzle.
- d) Use of incorrect type of nozzle - nozzle orifice too large
- e) Nozzle plug and seat full of glass or other filler, or burnrd material preventing proper shut-off. Clean plug and seat.

7. Problem: Splays or surface blemishes

Reasons:

- a) Incorrect material temperature
- b) Die temperature too low
- c) Injection rate too fast or slow
- d) Gates too small
- e) Moisture in material

8. Problem: Bubbles or internal voids

Reasons:

- a) Material insufficiently dried
- b) Improper venting of mold
- c) Injection rate too high trapping bubbles
- d) Injection pressure too low

9. Problem: Parts difficult to eject

Reasons:

- a) Insufficient draft on cavities
- b) Injection pressure too high
- c) Screw forward dwell too long (packs cavity)
- d) Insufficient shrinkage allowance in die
- e) Ejector travel too short
- f) Lack of proper mold release spray

10. Problem: Cloudiness in molded part

Reasons:

- a) Contamination or moisture in resin
- b) Material temperature too low
- c) Excessive or improper mold lubricant
- d) Improper purging procedure

Attachments