“MINI-JECTOR”
Injection-molding Machine

Model #55
Instruction manual

TABLE OF CONTENTS

INTRODUCTION

Dear Owner,

Thank you for choosing the model #55 – 4 oz. “MINI-JECTOR” injection-molding machine. It represents many years of engineering and manufacturing in the injection-molding field. **READ THIS INSTRUCTION MANUAL THOROUGHLY BEFORE OPERATING THE MACHINE.** It is recommended that all personnel operating this machine be given the opportunity of reading this manual. Additional manuals are available at a reasonable cost from the factory.

Any updates of safety features made available will be brought to your attention through mailings, as will any other technical improvements. If you are a subsequent owner of this machine, contact:

Bill Frissell, Denny Spaid, or Ryan Iammarino at:

Miniature Plastic Molding
6750 Arnold Miller Pkwy.
Solon, Ohio 44139
440-498-8465

Please give us the name of its new owner and the machine’s location. As a new owner of record, you will receive our tech bulletins. If you sell your Mini-Jector to another party, please inform us of the identity of the new owner.

MINI-JECTOR PRODUCT LINE OVERVIEW

There are many different Mini-Jector models available for a variety of injection-molding applications. Each model is given a unique identifier that tells you exactly what type of machine it is. This model code comes in two parts: the machine model followed by shot size. For example, model #55-1 is simply a model #55 machine with a one-ounce shot capacity. To specify a one-ounce model #55 with a “C-frame” option, simply adding a “C” after the model denotes this specification and it becomes #55C-1 (the “C-frame” option is summarized on page 35, Appendix C). Note that while the “C-frame” option is available for every shot size offered for the model #45 and #50 machines (as shown in **Table 1**), it is only available in the one and two ounce model #55 machines, and it is not available at all on the #60, #70, or #75 machines (as shown in **Table 2**). Also note, the model #45, #50, and #55 Mini-Jectors are available with a “Wide Mold Option” (no matter the shot size) for any application that would require a mold of up to 6” wide. The model #60 machine is well suited for *DME* (Detroit Mold Engineering) molds, usually the 5”x8” M series up to their 8”x10" molds. Other mold manufacturers such as *National* can also be used effectively. Model #70 machines utilize 5”x6”U, 5”x8” U, and up to 8”x8” center-sprue molds as well as *Master Unit* die sets up to 9”x9”. Both *DME* and *Newbury* manufacture molds that can be used in the model #70 machines. Aside from those mentioned above, there are plenty of other national mold manufacturers that can supply molds for use in Mini-Jector model #60, #70, and #75 machines.

Table 1

Model	45	50
Features		
Shot Sizes		
0.33 oz.	X	X
0.50 oz.	X	X
0.75 oz.	X	X
1.00 oz.	X	X
1.50 oz.	X	X
C-Frame	X	X
Wide Mold Option	X	X

Table 2

Model	55	60	70	75
Features				
Shot Sizes				
1 oz.	X	X	X	X
2 oz.	X	X	X	X
4 oz.	X			
C-Frame (1 & 2 oz. Only)	X			
Wide Mold Option	X			

In addition to the model coding system, it is also helpful to be familiar with the serial number on a Mini-Jector machine. The Mini-Jector serial number is a unique nine-digit number that is broken down into four sections. The first two numbers represent the month the machine was manufactured in. Each machine is also given a sequence number that increases by one for each new machine that is shipped; this is represented by the next three numbers. After that comes the two-digit model number and the final two numbers tell the year of manufacture. With this complete serial number, MPM engineers will be able to quickly locate a large resource of information on a machine that may have been manufactured many, many years earlier.

CAUTION!

Even though the model #55 “Wasp” Mini-Jector is a very simple machine without a moving clamping mechanism, there are moving parts, heating bands, and electrical devices that become potential safety hazards if the guards are removed or the machine is operated in a careless manner. **NEVER OPERATE THE MACHINE WITH ANY GUARD REMOVED OR RENDERED IN-OPERATIVE.** Read the following safety information before you operate the machine.

GENERAL SAFETY INFORMATION

(1) Always wear safety glasses when running this or other types of machinery or equipment. Make sure that the glasses are constructed of ANSI (American National Standards Institute) approved material.

(2) “Wasp” “V” molds are handled by the operator during each molding cycle. The molds can become very warm if the machine is run on a fast cycle. The operator should be provided with insulating gloves of an approved material.

(3) Always use handles on the “V” mold to lessen the need to reach far into the machine to insert or remove the mold.

(4) **NEVER** have more than one person operating the machine at any time.

(5) **NEVER REACH INTO THE MACHINE** when the machine is going through its cycle or at any time other than when loading or unloading the “V” mold. There are potential pinch points, high temperatures and voltages that would present hazards to the operator if the machine is used in a careless manner.

(6) Make sure the machine is securely bolted to its table or workbench before operating. The machine is designed to mount on a workbench in a fashion that places the rear (hopper end) of the machine in a position that makes that portion of the machine inaccessible to persons in the work area. If the machine is mounted in a fashion, such as on a floor stand, that permits access to the rear of the unit, additional barrier guarding must be provided to prevent access.

(7) **ALWAYS SHUT OFF THE POWER TO THE MACHINE** when performing maintenance tasks. An emergency stop button is provided on the operator’s panel that requires re-setting to operate again. This button should not be used for routine shutdowns. Shut off the motor with the motor starter and shut off power with the illuminated breaker switch on the control panel.

(8) **NEVER PURGE THE MACHINE WITHOUT USING THE PURGING FIXTURE SUPPLIED WITH MACHINE.** It is designed to trap the hot molten

material that could come into contact with the operator when the machine is being purged. Hot plastics, especially when they contain excess moisture, may burst from the nozzle with an explosive force when injecting or extruding into the air. Stand away from the front of the machine when purging. See **"PURGING PROCEDURE"** elsewhere in this manual.

(9) **NEVER TRY TO EXTRUDE OR TURN THE SCREW UNTIL THE MACHINE IS UP TO PROPER OPERATING TEMPERATURE.** If material in the screw barrel is not melted, damage to the screw or screw tip may occur.

(10) **NEVER LEAVE THE MACHINE'S HEATERS ON FOR ANY EXTENDED LENGTH OF TIME WHEN THE MACHINE IS NOT BEING OPERATED.** It may overheat the material in the screw barrel, possibly degrading it to the point where it could explode, expelling dangerous gasses.

(11) Always dry the resin to be molded according to its manufacturer's instructions. Many resins absorb moisture when exposed to the air and must be dried prior to molding. Even materials in a sealed container may contain enough moisture to cause blemishes on the finished product. See the "MATERIAL PROCESSING" portion of this manual.

(12) When removing the screw and barrel for maintenance, shut off power, unplug the heater and thermocouple leads, and make sure the unit has cooled down sufficiently before handling. Use properly insulated gloves when handling the barrel.

(13) The screw is driven by a shoulder bolt through the screw coupling that is properly sized for both shear protection and to lay flush with the coupling O.D. **DO NOT USE A SUBSTITUTE IF REPLACING.** Any other coupling pin may create a "grabbing" hazard or cause damage to the screw or coupling.

(14) Use extreme caution when a material jam in the feed throat causes the need to remove the hopper tube, exposing the screw flights. Rotating the screw may cause release of hazardous or explosive gasses. **DO NOT PUT FINGERS INTO FEED OPENING WHEN MACHINE IS RUNNING.** Turn off pump motor before cleaning out bridged material.

INSTALLATION OF THE MODEL #55 MINI-JECTOR

(1) Mounting

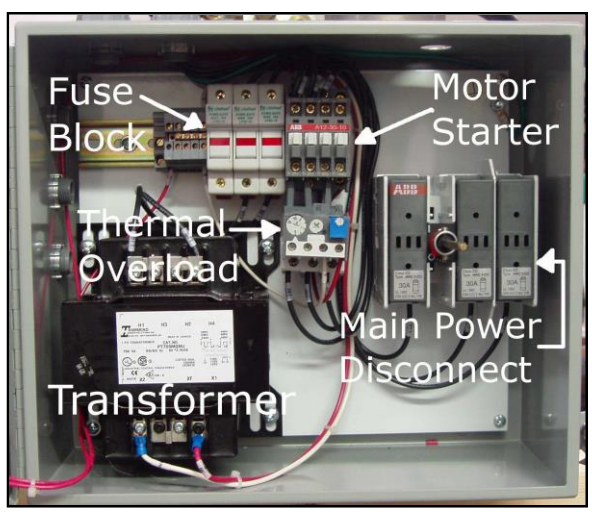
Before operating the machine, it must be securely mounted to your workbench or to the optional floor stand. The optional stand is shipped separately and the (4) carriage bolts used to secure the machine to its shipping skids may be used to mount the machine to the stand. If you are mounting it to a bench, make sure the bench is of a sturdy construction as the model #55 Mini-Jector weighs about 650 lbs.

If you are using the optional floor stand and desire that the machine be portable, you may wish to use heavy clamp-on casters attached to the base tubing of the stand. This allows the machine to be moved out of the way when not in use, provided the electrical connection(s) are flexible. If you mount the machine to a bench, leave at least 6" of space between the front of the machine and the front of the bench to allow your operator to have an area to disassemble the mold. Most machines are run with the operator sitting on a drafting stool. Legroom should be provided under the bench for operator comfort.

(2) Electrical Connection – 208 to 230V Single Phase

The machine is normally used with 208-230 volt single-phase power as you would find on a stove or range plug in your home. The incoming power consists of (2) 115V "hot" leads plus a "neutral " and a ground. At the top rear of the control enclosure on the operator's right on the machine is a 4" square junction box. You will find a black and a red lead of 12-gauge wire (the two hot leads) and a white lead (neutral). Attach to these leads with your power source of at least 30 amps capacity through one of the extra outlet holes in the box either with flexible or rigid conduit. Attach a ground wire to the **green wire in** the box. It is recommended that a 30-amp service be used, as the machine will draw almost 30 Amps at full load. You may elect to place a 30 amp breaker or fused disconnect in the incoming power line to permit shutting off the electrical supply totally. The machine controls and nozzle heater are 115V created by using one of the hot leads plus the neutral. **On some 208 volt ("Y" type) systems, one hot leg is 200 + volts. Do not connect this hot lead to either the red or black.**

(3) Electrical Connection – 208 to 230V Three Phase



When the three-phase option is ordered, it will come with an enclosure that contains all of the necessary electrical components (shown at right). Simply attach the three-phase power supply to the fused main power disconnect (30 amp fuses are used here) and attach the ground wire to the ground lug on the wiring panel. The power requirement for the machine is 25 amps, thus the minimum wire size recommended for incoming power and ground is 10AWG. A breaker or disconnect of that capacity should be provided by the end-user for the incoming source. The machine includes a controls transformer to produce the 115-120V power to run the control circuit.

(4) Hydraulic System Oil

The machine was filled with 5 gallons of **AW32** hydraulic oil for testing. The reservoir holds 5.4 gallons plus the oil contained in the hoses and cylinders. This oil can be obtained at an auto parts store and before running the machine, remove the filler-breather at the left top front of the reservoir and fill until the sight gage and thermometer at the right end of the reservoir is covered. Filling completely also immerses the pump to reduce noise. Oil should be changed after hard use (see maintenance section).

(5) Water Connection

The hopper tube leading from the hopper to the screw barrel has two water connections (1/8” NPT) where it bolts to the barrel. It is usually not necessary to cool this area, but if running high temperature or soft sticky materials permits the resin pellets to start to melt in the tube causing blockages, connect one of the ports to cold tap water and place a needle or globe valve in the return line to restrict water flow coming out. This causes the water to have time to absorb the excess heat.

(6) Moving the Machine

If the machine is to be moved, do not lift it by any portion of the mechanism. Insert tow motor forks under the base plate or slide the unit off the bench onto a cart or platform.

OPERATIONAL PRINCIPLES - MODEL #55 MINI-JECTOR

(1) General Machine Operation

The Mini-Jector Model #55 “Wasp” is a self-contained hydraulically operated injection molding machine. It requires only electrical power to operate. It develops a clamping force of 11.75 tons, will inject up to one ounce (general purpose polystyrene) of plastic per cycle, operate at material temperatures up to 700° F, and can mold a piece with a projected area of up to 6 in^2. Temperature of the material is controlled by three (3) auto-tuning pyrometers, which are labeled “rear zone”, “front zone”, and “nozzle”.

Pushbuttons and selector switches are provided to allow manual cycling of the various machine motions. Two timers are provided that time (1) the overall machine cycle interval plus (2) the injection forward time.

(2) Functions of Elements on the Control Panel (at right)

The various control elements on the operator’s control panel allow for the manual or semi-automatic operation of the machine. Starting at the top they are as follows:

(A) Breaker - The illuminated 15 Amp breaker acts as a power on-off switch plus providing overload protection for the machine’s electrical components. When it is turned on, it will illuminate indicating power is on. (NOTE - on machines wired for 3 phase power, the switch will not illuminate, as the switches two poles split the hot lead from the independent 115V source, and do not form a complete circuit.) On single-phase machines, the switch must be “on” to start the pump motor. On three-phase machines, the motor starter operates independently.

(B) Heaters On/Off - This toggle switch turns on the three pyrometers that control the heats. No current can pass through the outputs unless this switch is on.

(C) Timers On/Off -This toggle switch activates the two timers to permit the running of a semi-automatic cycle. The switch should be turned to the “off” position when running the machine on a manual cycle.

(D) De-compress On/Off - This toggle switch enables you to select whether the screw “de-compresses” or retracts ¼” after it has reached the “extrude” limit switch at the end of the plasticizing cycle. (See description of “de-compress” elsewhere in this manual)

(E) Extrude – When pressed this pushbutton allows the screw motor to rotate - NOTE: To use manual extrude, inject, or retract, the carriage selector switch must be first turned to the “in” position. Unless this is done, the hydraulic system will “unload” oil pressure through the “carriage” directional valves, and no motion will occur.

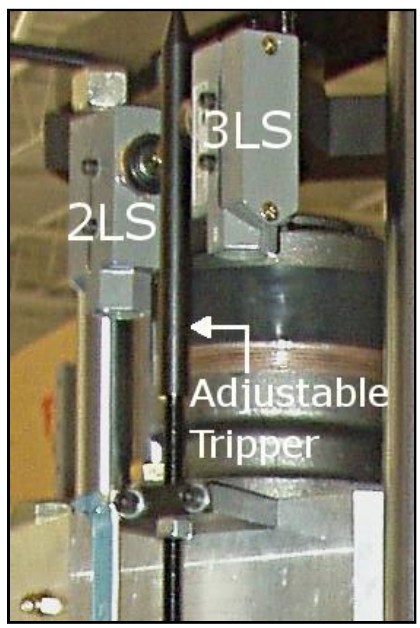
(F) Inject/Retract - The selector switch so marked permits operating the screw forward (inject) or back (retract) by turning the pointer to the desired function. As soon as this switch is released, it will return to the center or neutral position.

(G) Carriage In/Out - Cycle Start - This is the selector switch used to raise or lower the entire injection unit and to start the semi-automatic cycle. Turning the lever switch down to the “in-start cycle” position will lower the injection unit nozzle onto the mold and the switch, being detented, will remain in that position. Turning the lever up to the “carriage out” position will raise the injection unit. It will spring return to the center position when released.

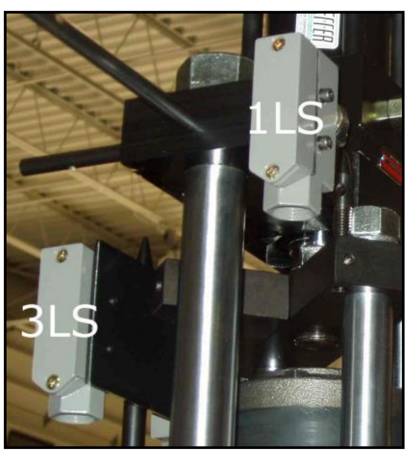
(H) Emergency Stop - The red mushroom head “emergency stop” pushbutton will cut all machine power when depressed on single or three-phase machines. It is of the twist to release type, and must be turned in the direction of the arrow and pressed to release to return to normal operation.

(I) Motor Starter - The motor starter above the control panel is of the non-magnetic type on single-phase and magnetic type on three-phase machines. To reset if the thermal overloads trip stopping the motor, wait a few minutes to allow the coils to cool and depress the “stop” button and hold it in briefly.

(3) Machine Limit (Micro) Switches

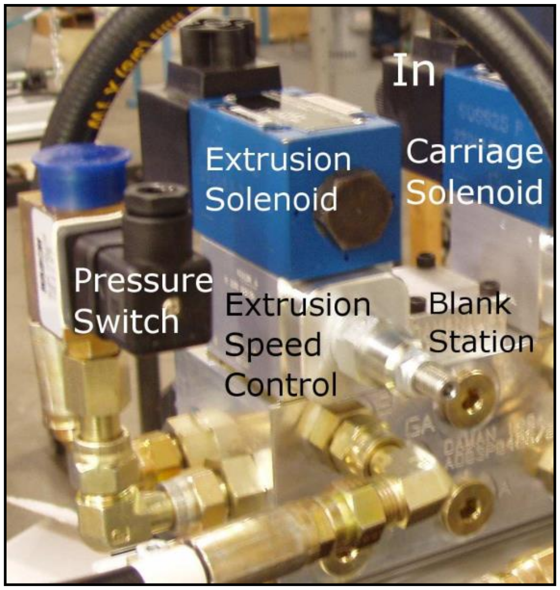


There are three limit switches on the machine. They are identified as 1LS “Out”, 2LS “Extrude” and 3LS “De-compress”. 1LS is mounted on the top cylinder mounting plate at the right rear. It is tripped when the injection unit returns to the “up” position at the completion of a semi-automatic cycle sequence. When it is tripped, it de-energizes the solenoid valve “carriage out” to allow the hydraulic pump to return to idle pressure. 2LS and 3LS are mounted on a bracket attached to the push plate. They are tripped by the adjustable tripper visible to the operator and attached to the screw thrust housing. When 2LS is tripped, it de-energizes the “extrude”

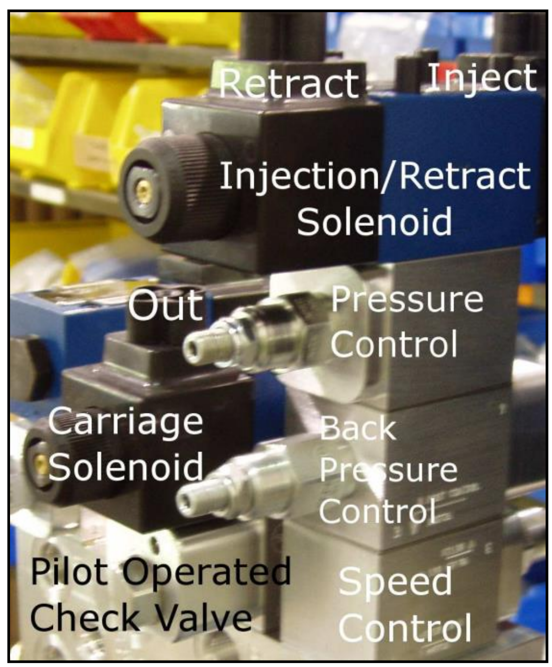


solenoid valve, stopping screw rotation. It also will energize the "retract" solenoid valve when the "de-compress" switch is turned on. When the screw drive unit retracts ¼", the tripper strikes 3LS, which de-energizes the "retract" solenoid. A fourth switch "start injection hold" is used on the two-pressure injection option.

(4) Hydraulic Power Unit



The machine's hydraulic power unit is mounted on the rear of the base plate. Its reservoir holds 5.4 gallons of hydraulic fluid (see "recommendations for hydraulic oil"). The gear pump is immersed in the fluid reservoir, which reduces pump noise, and the machine's solenoid operated directional valves are mounted on an aluminum manifold block. Under each of the three valves are four small "O" rings to seal the junction with the manifold. Observing from the front of the machine, the blue valve mounted on the left side of the reservoir is a pressure switch, which is used to signal the control that the carriage is "in", and pressure has been achieved to seat and clamp the mold. The furthest left valve (a single solenoid type) controls the "extrusion" function. Under this valve is a "sandwich" flow control valve that regulates the volume of oil flowing to the screw drive motor, which determines screw rotational speed. The next station is capped with a blank for possible later use. The third station has a double solenoid valve and controls the "carriage in/out" function, under which is mounted a pilot operated check valve that prevents the carriage from drifting down during machine idle. The furthest right double solenoid directional valve controls the "inject" and "retract" functions. There are three "sandwich" valves underneath the directional valve. The upper valve controls injection pressure, the lower valve controls injection speed, and the middle valve regulates screw backpressure. There is a sight glass at the right end of the reservoir that both indicates oil level and shows the oil operating temperature. Further explanations of the hydraulic system are included in the detailed "sequence of operations".



(5) Clamping System

The unique feature of all “Wasp” Mini-Jectors is the absence of a moving clamping system. The force produced by the carriage cylinder on the injection unit is transferred against the top of the mold by the injection nozzle. The “V” molds have a 7.5° taper on each side and the wedging effect of the nozzle pressure from the carriage cylinder is amplified roughly 8 times by the mechanical advantage of the wedge. The mold is held between the two clamping shoes during injection. Two tie bars join the two side plates and shoes and stretch slightly during clamping to maintain a pressure to hold the die halves together during injection. The recommended maximum casting, or projected area of the mold cavities is 6 in^2.

(6) Injection System

The two hydraulic injection cylinders drawing the thrust housing toward the cylinder plate cause injection of plastic material. The plasticizing screw has a non-return valve in the tip that allows the screw to act as a plunger, injecting the material accumulated during plasticizing into the mold. The screw is driven by a hydraulic motor directly coupled to the screw shank through a pair of steep row thrust bearings in the housing. During extrusion, the housing is driven upward as material accumulates ahead of the screw tip. The entire injection unit travels on two guide rods attached to the clamp unit. The two push bars attached to the thrust housing and push plate act as a guide for the thrust housing and transfer pressure to the unit by the carriage cylinder. Raw material is fed into the screw barrel by the hopper and hopper tube.

SETTINGS AND ADJUSTMENTS - MODEL #55 MINI-JECTOR

(1) Hydraulic Pressure Settings

There are two pressures that are set each time that the machine is used to run a dissimilar part. The first is **INJECTION PRESSURE**, this setting limits the maximum pressure on the molten material during injection. The injection relief valve described earlier that is sandwiched under the right hand directional valve has an Allen-head set screw with a knob to adjust pressure. Turning the screw clockwise increases pressure: turning it counterclockwise decreases pressure. Pressure may be observed on the pressure gage in the backpressure valve. To read this pressure when setting up requires that a mold or the purging fixture be placed in the "V" slot and the carriage selector switch turned to the "In-Start Cycle" position. Shifting the carriage directional valve is necessary to develop hydraulic pressure. Once the carriage is in, leave the selector switch in the "in" position and turn the inject selector switch to the "Inject" position to read injection pressure. When set to the desired pressure, lock the adjustment with the jam nut on the setscrew.

BACK PRESSURE is sometimes required to enhance plasticizing of the plastic resin. When the screw is turning, it forces oil out of the cap end of the injection cylinders as the thrust housing raises to make room for the melt. The backpressure valve forces the oil to reach a preset pressure before it can flow out. To increase backpressure, turn the screw adjustment IN (or OUT to decrease). That pressure can also be read on the gauge. Remember that back pressure or resistance is created by the fact that the screw return must also lift the weight of the thrust housing and screw motor, so do not set more than 100 PSI. That adjustment can be locked with its jam nut.

MAIN SYSTEM PRESSURE is set at the pump manifold at the factory. The adjustment need not be touched unless the pump is replaced. Normal setting is 2050 PSI. If there is any need to set this, a cap must be removed. The cap is the only sealing device around the relief valve screw, and must be replaced prior to running the motor. On machines Serial no. 041795501 and later, a second relief valve at 2000 PSI is inserted in the main manifold. **PRESSURE SWITCH SETTING** is through a vernier type spindle in the pressure switch cavity. It is graduated and clearly marked, and is set at 1750 PSI at the factory. It should also never need adjustment.

(2) Hydraulic Flow Settings

Screw speed is set on the flow control sandwiched under the middle directional valve. Turning the handle clockwise decreases screw speed. Turning it all the way out (counterclockwise) allows maximum screw speed (170 RPM). The injection speed control is mounted in the injection valve stack with its adjustable knob facing to the rear and is adjusted in the same way.

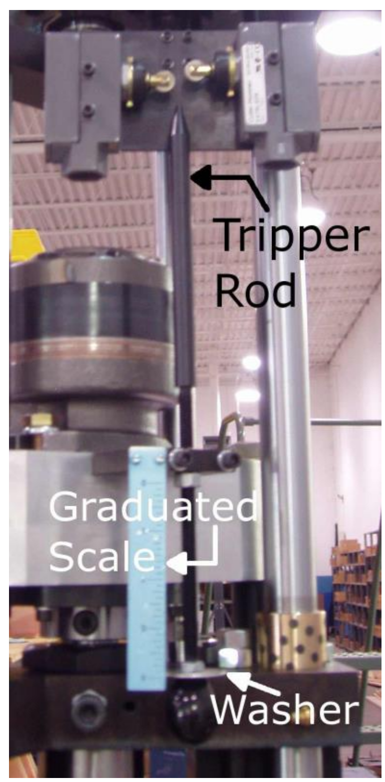
(3) Adjustable Mold Stop

The design of the "V" mold system permits the offsetting of the sprue (see mold making tips) from the mold centerline. The mold stop adjustment at the back of the left hand clamping shoe has a 3/8" -16 cap screw to act as a positive stop to slide the mold against. There is a line penciled on the top of the mold clamping shoes at the factory to help you locate the nozzle centerline. For convenience, scribe a line on the top of your mold to correspond to the center of the sprue opening. When the two are lined up, turn the adjusting screw until it contacts the back of the mold. Lock that adjustment with the nut provided. The alignment need not be perfect. If the sprue is larger than the nozzle orifice (1/8") there will be no loss of material due to a poor seal.

(4) Mold Ejector Bars

The "V" molds are inserted into the machine on the mold ejector bar. This bar is attached to the injection cylinder plate through two 1/2" diameter rods and is lifted by the bars when the carriage is retracted. The lifting breaks the mold from the "V" slot using the force produced by the carriage cylinder. The distance of lift is adjusted by using the two pairs of lock nuts to adjust the lift point. **DO NOT ADJUST THESE WHEN THE MACHINE IS RUNNING.** The nuts have been adjusted at the factory to lift the mold sufficiently to break the mold away, but not high enough so the mold will hit the nozzle tip. When the carriage is lowered, the rods allow the ejector bar to fall, permitting the mold to be forced into the "V" slot. **CAUTION,** if the machine has been sitting idle for some time, the carriage may drift down due to hydraulic leakage and the mold cannot be inserted in the "V" slot. **DO NOT RE-ADJUST.** Start the motor and turn the carriage selector switch to "Out" which will raise it sufficiently to install the mold.

(5) Material Feed and Shot Size Adjustment



The material feed, or shot size, adjustment at the front of the thrust housing uses a washer on the tripper to indicate the position of the tripper in relationship with the "extrude" and "De-compress" limit switches. Lowering the level of the washer increases the size of the shot just as raising it decreases shot size. For a more accurate shot size measurement, a graduated scale may be mounted next to the tripper. The values on the scale represent the stroke length (as shown at right). For example, if the washer is aligned with the 1" mark, it will indicate that there is 1" of the total of 5" of screw stroke being utilized. In other words, you are using 1/5 or 20% of the available machine shot capacity. If you are using the decompression feature the screw will travel another 1/4" after extruding, and that must be subtracted from the total available stroke. The screw is 7/8" in diameter, so every inch of travel displaces 0.601 in^3 of material. In order to generate a one-ounce shot, the washer should be set at the 3” mark. There is a loss of about 10% of the shot size due to material lost in operating the sliding non-return valve in the screw tip, so that must be taken into account.

It is not necessary to set the shot size so precisely that you “starve” feed or exhaust the entire shot column. A slight amount of cushion is desirable. This can be observed by watching the travel of the screw when injecting. If it “bottoms” at the end of the stroke, you will not completely pack out the molded part. To increase the shot size, turn the tripper knob counterclockwise. To decrease, reverse that procedure. Be sure to secure the lock nut after you set the adjuster or the tripper will not interface properly with the limit switches. **ALWAYS MAKE THIS ADJUSTMENT WITH THE MACHINE IN MANUAL.** Do not attempt to set the tripper when the machine is in motion.

(6) Setting the Pyrometer Heat Controllers

The three pyrometers that control the nozzle, front, and rear zone temperatures have two display panels. The lower panel displays “Setting Value” which you set to the temperatures you desire to use. The upper display is “Process Value” which indicates the actual temperature at the time. The pyrometers have been “auto-tuned” at the factory, to provide an ideal set of proportional, integral, and derivative (PID) constants for the typical temperatures being encountered. These should not be touched unless you always operate at very high temperatures (600° F or more), or temperatures below 250° F. Consult the manufacturer’s instruction pamphlet for this procedure.

The machines are supplied with Athena, Barber Coleman, CAL, or Gefran pyrometers. To set the temperatures, the “heaters” toggle switch must be in the “on” position to activate the instruments. To set the Barber Coleman units, wait until the unit displays a value in the “Process Value” display, press the “mode” key and use the up arrow key to raise temperatures or the down arrow to lower. When the desired temperatures are set, press the mode key again to record those settings. When the machine is equipped with Athena units, the procedure of adjustment is the same, but there is no mode key. The changes are made directly with the up-down keys. The CAL & Gefran units require the * key being pressed with the up-down arrows to change.

(7) Timer Settings (at right)

The machine is equipped with two timers. The upper timer (1TR) is the cycle timer and starts (when the timer switch is on) when the carriage selector switch is placed in the “In-Start Cycle” position. When this times out, the carriage retracts, allowing the mold to be removed. Be sure to set enough time on 1TR to allow the screw to finish plasticizing the material before it times out. If extrusion is not complete and the timer times out, the carriage will not retract automatically, and must be manually retracted with the selector switch. The second (2TR) timer starts when the pressure switch indicates that the mold is clamped and its setting governs how long pressure is on the material. When it times out, extrusion begins. The right buttons set the timing mode. We set the mode at 0.1 second for most uses. The upper buttons increase time and the lower reduces time. If your values are set at 165 your actual time will be 16.5 seconds.

GETTING STARTED - SEQUENCE OF OPERATIONS

(1) Turn on the machine's illuminated breaker, activating the control system.

(2) Turn the heaters switch to the "on" position and set the desired temperatures as previously described.

(3) After the machine has come up to its proper molding temperatures, put the resin to be molded into the hopper. If the run is to be short, do not put in excess material that will need to be removed later.

(4) Start the motor by pressing the start button. Put either your mold or your purging fixture into the machine, aligning the nozzle with the sprue or hole in the fixture. It may be necessary to energize carriage out to put the mold in.

(5) Turn the carriage selector switch to "in-start cycle". When the carriage brings the nozzle down against the mold or fixture, press the "extrude" pushbutton. The screw will start plasticizing material. If you are using a mold, the material will partially fill the sprue, then the thrust housing will raise, accumulating the first shot.

(6) Visually observe the position of the extrude tripper and scale and when you feel you have accumulated a shot, release the extrude pushbutton and turn the carriage selector to "out" and release it as soon as it is up.

(7) Remove the mold or fixture and remove the partial molding or purging. If you used the purging fixture, you may not accumulate a shot, as the material may continue to extrude through the opening. If you have run another material prior to starting, this is a good way to purge it out. (See purging instructions). If you are starting from scratch or you are using the same material, you may use your mold.

(8) Turn the injection selector switch to "inject". If the mold does not fill, your pressure setting (or temperatures) may be too low. If the mold fills and then flashes out of the mold parting line or around the nozzle, the settings may be too high.

(9) Press the "extrude" pushbutton and hold it until you have accumulated the next shot. Observe the position of the tripper and the times required to set a cycle on the timers.

(10) Turn the carriage selector switch to "out", lifting the carriage and breaking the mold loose from the "V" slot.

(11) Remove the mold and open it, observing the results of your molding.

(12) Adjust the extrude tripper to just contact 2LS at the point you have established as sufficient volume to fill your mold. Lock that adjustment with the jam nut.

(13) Set the cycle and injection timers to the values observed during your manual set-up. Injection time should be sufficient to have the screw motion stop. If your cavities are of thick section, both longer injection dwell and overall cycle time should be lengthened to prevent “sinking” of the part.

(14) Make other adjustments to temperature or pressure as deemed necessary by your observations during manual operation.

(15) Turn on the “timers” toggle switch. Turn the carriage selector switch to the “in start-cycle” position. The switch is detented and will remain in that position. The carriage will come down so that the nozzle presses on the top of the mold and clamps it in the “V” slot. When the hydraulic pressure in the carriage cylinder reaches 1750 PSI and indicates that the mold is seated, the pressure switch contacts close, starting the injection timer.

(16) The machine will inject, holding pressure until the injection timer times out. At that time, the extrude solenoid will be energized and the inject solenoid valve de-energized. The screw will rotate until the motion upward of the thrust housing trips 2LS at the point you have set it. The extrude solenoid will be de-energized, and if the “Decompress” switch is turned on, it will retract another 1/4” to strike 3LS. The retract solenoid is de-energized and the machine remains at idle. When the decompression or extrusion cycle is completed, a relay in the machine will de-energize the “carriage in” solenoid, idling the hydraulic system.

(17) When the cycle times out, “carriage out” is energized, which lifts the injection unit off of the mold. When the injection unit has pulled out, it will trip 1LS, de-energizing the “carriage out” solenoid.

(18) Remove the mold and remove the molded part. Observe the results and make any adjustments necessary. Put the mold back in the “V” slot and turn the “carriage” selector switch to the middle position, return it to the “in-start cycle” position to initiate another cycle. Turning the switch to the center position is necessary to reset the two timers for the next cycle.

(19) You are now ready to repeat the previous sequences from 15 through 19 and run the machine on a semi-automatic cycle. Record your best settings for future set-ups in a log.

(20) When you have completed operation, remove the material from the hopper (if you are planning to use another material or color) and remove the ¼” screw from the front of the hopper flange, loosen the 5/16” screw and swivel the hopper over the dump tube against the roll pin to allow material to empty into a container.

PURGING PROCEDURES

“Purging” is the term used to describe the method of either changing material or emptying the screw barrel prior to shutting down. It is a proper practice to purge at the end of a shift or for any shut down time. If you want to purge the machine, but do not want to empty the hopper, swivel the hopper halfway between its normal position and the roll pin stop that lines the hopper opening up with the dump tube. This will shut off material flow from the hopper. The dump tube is 1” in diameter and a 1” ID plastic hose can be clamped to it to allow dumped material to be routed away or into a box. At this point, there will be material remaining in the hopper tube and in the screw flights.

(1) **ALWAYS USE THE PURGING FIXTURE WHEN PURGING.** The machine has a shut-off non-drool nozzle that must be pressed against a surface such as a mold or the purging fixture to operate the shut off plug. Observe the injection assembly print to acquaint yourself with its design. If you attempt to inject or extrude with the nozzle in the open air, the plug will be closed, creating a dangerous pressure condition.

(2) With the purging fixture in place in the “V” slot, bring the carriage down with the selector switch and either press and hold the extrude pushbutton, or turn the timer switch on, start a cycle and the machine will continuously extrude into the fixture. When the tube and barrel are empty, the screw motor will speed up due to no load.

(3) Turn the carriage selector to “out”, and remove the purging fixture. It will contain hot molten plastic, so be very careful not to touch the purged material. The orifice in the fixture is tapered, so you can take a drift or screwdriver and knock the sprue portion out.

(4) If you are using another material, put some of it into the hopper tube and extrude until the new material appears in the purgings and traces of the old material are not visible. Make temperature settings that favor the new material being introduced. The shear heat from the screw turning will help clear the previous material even if it is a higher temperature one.

(5) When your parts require optic quality, or your resin has a tendency to degrade rapidly, you may wish to purge with an intermediate material, such as clear polystyrene, which is very temperature tolerant and abrasive. There are many fine purging materials on the market. **ALWAYS CONSULT THE MATERIAL MANUFACTURER’S SPECIFICATIONS ON PURGING MATERIALS.** There are certain resins that could react with each other and cause a hazardous chemical reaction, which could damage the machine and possibly producing dangerous fumes.

(6) **ALWAYS WEAR EYE PROTECTION WHEN PURGING.** Stand clear of the purging area and make sure it is well ventilated.

MAINTAINANCE AND TROUBLESHOOTING - MODEL #55

GENERAL MAINTAINANCE

(1) Lubrication

The machine requires very little in the way of lubrication, as the injection plate and thrust housing bushings are a composite semi-greaseless type that require lubrication once every 6 months to a year. The thrust housing has two linear bushings; one accessible from the front, one from the rear. The injection cylinder plate also has two bushings with staggered access. Use a lithium-based grease and inject only enough grease to force the old grease out. This removes any dirt accumulated in the bushings. Wipe the old grease off of the guide rods.

(2) Thrust Housing Bearings

The screw drive consists of a direct drive between the Parker/Nichols hydraulic motor and the screw coupling. The forces created by screw rotation and the static forces of injection are absorbed by a steep-row, tapered, Timken roller bearing at the lower end of the thrust housing. The proper retaining tension on this bearing is created by tightening a smaller thrust bearing located at the top of the thrust housing with a lock nut. The lock nut has a #10-32 set screw locking its position. The bearings were packed with grease at the factory, and if they become noisy, there is a grease fitting at the back center of the thrust housing that can be used to inject additional grease into the system. If noise is not reduced, it may be necessary to remove the screw drive motor and tighten the lock nut. Do not over tighten the bearings as to cause binding. Refer to drawing #530010 in the print package.

(3) Hydraulic Oil

The oil shipped with the machine is ISO-32 hydraulic oil designed to work with off road hydraulic equipment. By observing the sight gauge at the end of the reservoir, you will be able to tell if the oil becomes discolored indicating it is contaminated. Overheating the oil may also destroy its properties. Burned oil has a distinctive odor and should be drained and replaced. The capacity of the system and the surface area of the reservoir negate the need for a heat exchanger. The only way the oil could overheat is by allowing the level to get too low. If you wish to change the machine oil, remove the plug under the sight gauge to drain it. Replacement oil should be of a similar type. The machine uses a gear pump, which is very tolerant of dirt and other contaminates, but new oil should be strained through a 10-micron filter before putting it in the tank because it has lint and other byproducts of its manufacturing procedure. When filling the machine, remember that a certain amount of oil remains in the cylinders and the only way this oil can be removed is by detaching the individual hoses and draining. If you drain the cylinders, the system will require its 5.4 gallons plus another 0.10 gallons to fill completely.

(4) Clamping Shoe Adjustment

The two castings that form the “V” slot could, after years of use, wear to the point that the original angle (7.5° per side) is lost. Take a relatively new mold as a gauge and check with a feeler gauge to determine if shimming is necessary. When placing shims behind the contact between the side plates and the shoes, remember that besides the two 3/8” cap screws holding the side plates and shoes there are two ¼” socket head screws bolting the shoe legs to the base plate. These can only be accessed from the underside of the machine. Shim wherever the wear has occurred. In most cases, the wear is even and the mold will sit slightly lower into the “V” slot. The injection carriage has sufficient travel to adjust to wear.

(5) Removal and Cleaning of the Feed Screw and Barrel

Occasionally, it may become necessary to physically remove the screw and barrel to clean them or to replace worn components. Inadvertent burning of material may leave burnt residue that purging will not remove. First, inject the screw to the furthest down position. Shut off all the heats before removing anything and allow the barrel to cool down. Raise the carriage to its uppermost position and remove the heater shield from the cylinder plate.

Using an Allen wrench or key, remove the shoulder bolt from the screw coupling. This will detach the screw from the drive system. You may restart the pump motor and retract the thrust housing to its uppermost position to allow more working room. Shut the motor off and remove the large nut holding the screw barrel in. This nut is secured with a #10-32 set screw to keep it from loosening, so be sure to loosen it first. Unplug all the twistlock heater plugs from the back of the control panel and unplug the thermocouples from their jacks. Next, remove the large 1/2-13 Allen head screw locating the barrel to the cylinder plate. The entire barrel-screw unit should fall down sufficiently far to clear the cylinder plate and be lifted out to the front. If the unit does not fall enough to clear, it may be necessary to remove the nozzle body using a 1 ¾” open-end wrench.

Take the unit to a workbench with a large vise. It may be necessary to heat the barrel again to remove the screw and the nozzle assembly. Use the heater bands on the unit to heat it enough to remove the screw. **Pull the screw out the feed, not the nozzle end, by inserting a screwdriver or drift in the coupling pinhole, pulling, and then twisting.** When the unit is apart, the screw can be cleaned physically with a soft wire brush using a small propane torch to heat the residue. The screw is chrome plated; so do not use anything abrasive enough to damage the plating. Residue does not usually adhere to the screw barrel but to the screw and nozzle components.

If your machine is equipped with a non-drool nozzle, remove the small nozzle tip with a 1” open-end wrench. To remove the nozzle body, be sure to remove the thermocouple from the hex section. It is secured with a #6-32 set screw that must be loosened to remove the thermocouple. The small nozzle plug should be removed and the passages cleaned by running a 3/32” drill through the angled holes, and a 1/8” drill through the center hole. If you remove the screw non-return tip, remember that the threads are **LEFT HAND THREADS!** If the tip is to be replaced, do not over torque the threads. When the screw rotates under normal operation, there is a natural tightening. Use a suitable anti-seize compound on the tip threads when installing.

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 calendared into a ribbon or pellet form, as they do not mold well in the powder form. Pellets are made by extruding the resin into strands, adding color concentrates to enhance appearance, and then chopping the strands into pellets as they are cooled at the end of the extruder line.

Thermoplastics can be fully re-cycled 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 will homogenize the mix into a single color, where a plunger machine like the Mini-Jector will produce a product with a marbleized 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 thermoplastics 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, 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 is heated by contact with the walls of the heating cylinder and has a very close fit with it.

Electrical resistance heaters controlled by “pyrometers”, or heat controllers, heat the heating barrel and nozzle. Thermocouples feed the barrel and nozzle temperatures back to the pyrometer where it makes adjustments necessary to maintain proper temperatures. Unlike a screw plasticizing machine, a plunger machine transfers most of its heat energy through conduction, where a screw machine converts mechanical energy to heat.

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 then there is 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”. Off shoots to various cavities from the sprue 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 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 some mold heat to process. Pressure is maintained on the injection screw after the mold is filled to prevent sinking, mentioned above, that is 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 is, the less the shrinkage by 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 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 to 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) to pry 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 “Wasp” Mini-Jectors. 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 in the #60, #70 & #75 model Mini-Jectors it is ejected by ejector pins in the mold that are mechanically, hydraulically, or pneumatically driven. Mold release sprayed on the surface of the mold assists part removal. A certain amount of draft on the side of the part also assists part removal.

RECIPROCATING SCREW

The reciprocating screw plasticizer as used in the model #55, #60, #70, and #75 series Mini-Jectors, is based on combining 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 flighted section. The second, or “transition” zone is where shear is introduced and the flights here become gradually shallower. The material is compressed in this zone, which usually has 1/4 of the total number of flights. Last is the “metering” zone which is the final depth of the transition zone and occupies 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. Backpressure is applied by a hydraulic counterbalance valve to insure 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.

APPENDIX A

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 proportion 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, only high enough to eliminate cloudiness and weld lines in the finished part is a good rule of the thumb.

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 recycled 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, but high impact grades must be molded at 450°F or less to avoid losing its high impact properties. Several problems can be experienced running *polystyrene*. One is difficulty in ejecting from the die. Over packing the mold by using excessive injection pressure is one cause of this. Since *polystyrene* experiences very little shrinkage during the cooling cycle, adequate draft or taper on the molded parts are 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 its brittleness. Mechanical ejection can be softened by using the cushion adjustment on the clamp cylinder.

Another problem with *polystyrene* 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 hours or use a desiccant type dryer. Hopper dryer/loaders also are useful.

If the material has too much moisture, it will bubble and boil and many bubbles will appear in the finished part. Excessive stringing and drooling at the nozzle will also result. *Nylon* can be molded at temperatures from 500°F and up, but best results are obtained in the very small “window” where the *nylon* is actually resinous. This is usually between 500-520°F. Above that temperature, it 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 the temperature is set too high. Experimenting with nozzle temperatures can help to control drooling, but a non-drool shut off nozzle is almost a necessity. Some added die heat might be necessary in some cases. Pressures of over 10,000 PSI are also needed.

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

Cellulosics are not particularly hard to mold but tend to be somewhat unstable, especially *acetate*. *Cellulosics* were the first successfully molded thermoplastics, and are still popular for eyeglass frames and similar items. Careful control of temperatures must be maintained, and nozzles, screws and barrels must be cleaned regularly to prevent accumulation of burnt residue. This can be done by physically cleaning the components or frequent purging. Cleaning is important as *butyrate* in particular releases gasses that could be corrosive to cylinder components. Pre-drying of *acetate* is advisable, and 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*. It also must not be overheated, or it will lose its high impact properties. Do not use gates that are too small, as the material will freeze quickly before the cavity(s) get completely filled. Pressures over 10,000 PSI may be necessary.

Beside 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 optic 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, since the consistency seems more important than the actual rate. Some die heat improves surface finishes by preventing material “skid” during filling. During injection, if undersized gates are used a resistance is created before the filling begins. This resistance causes an unwanted “spurting” of the material through the gates. To eliminate this spurting, 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 optic 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 optic grade parts. Temperatures over 450° F should also be avoided.

(7) Polycarbonates

Polycarbonates have extremely high melt viscosities even at the high (up to 550° F) temperatures they sometimes require to mold. The injection pressures required are usually over 12,500 PSI and some die heat is necessary. Die heat requirements of 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 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 the infrared lamp as described in the above section on *acrylics*. 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 drooling from the nozzle. Overheating will also cause excessive drool and 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 set too high may also increase the occurrence of drooling.

(8) Polyvinyl Chloride (PVC) Resins

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

Plasticized PVC is also heat sensitive but to a much 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, but for very low durometer materials molding temperatures can start at less than 300° F. When PVC degrades, it emits chlorine gas, which unites with any water present to form hydrochloric acid. This can corrode molds, cylinders, and any unprotected metals in the molding area. It is a good practice to provide a fan type ventilation system over the machine if PVC will be the primary molding 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, but remember that 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. Consult PVC manufacturer for purging compound recommendations.

For best molding results, start at low temperatures and increase 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 formaldehyde gas when overheated which can be noxious, so follow the manufacturers' temperature setting recommendations and purge when you suspect overheating (or over exposure) of the material. The same purging procedures as used in processing PVC should be used here as well, but temperatures below 400° F are usually safe from overheating. 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, or a spiral pattern leading away from the gates, would indicate undersized gate diameters.

Mold releases are usually not required with *acetal* resins, 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 and die temperatures of up to 450° F. A minimum pressure of about 20,000 PSI is required to mold these materials. Using a slow mold filling process usually helps with 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 with the factory prior to running these materials.

(11) Elastomers (Polyurethanes, Thermoplastic Rubbers [TPR’s])

There are as many grades and durometers (hardnesses) of elastomers as there are in PVC resins. Processing low durometer *urethanes* or TPR’s is similar to molding plasticized PVC with several exeptions: *urethanes* are hygroscopic and must be thoroughly dried prior to molding, and when overheated, become very watery, causing flashing and drooling. Temperatures are generally much higher than PVC (425° F or more). Some TPR’s 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 (TPE’s)

These resins can be processed with ease if only 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 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 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 and the strands can wear down screw flights, nozzle bodies, and other cylinder components. Using higher than normal rear zone heat settings tends to “soften” the glass strands and minimize wear.

(14) Ceramic Materials

Ceramic patterns can be molded by mixing ceramic powders with plastic or wax “vehicles”. 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. Mini-Jector screws and barrels can be made of very durable materials for ceramic use. 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 watts/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 hydraulic injection 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. Use cooling on the hopper tube. **THIS IS A MUST!**

(16) Thermosetting Resins

Molding of *thermosets* on a screw type Mini-Jector requires a zero compression ratio screw and a water-jacketed screw barrel and the nozzle must also be 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.

APPENDIX B

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

APPENDIX C

INSERT MOLDING ON “WASP” MINI-JECTORS

Insert molding, which is the process of injection molding plastic in or around another object, is easily done with the various models of “Wasp” Mini-Jectors. Items such as cord sets, grommets, slip ring, brush assemblies, fishing lures, and handles on utensils can be successfully molded on them. The “V” mold allows the operator to place the inserted object(s) in the mold halves and then assemble the two halves together before placing them in the machine. This insures that the inserts will remain in their proper place until the mold is filled.

When the insert (take a knife handle mold, for example) is placed in the mold, there are several ways to locate it. If the knife blade has a shoulder, it makes a convenient point to register with part of the mold to insure its proper depth into the handle. A small hole in the blade can also be placed over a corresponding pin in the mold to locate it.

Once the insert is properly located, the next problem is sealing the juncture where the molding is to end. The ability of the mold to seal off at that point is highly dependent on the tolerances held in manufacturing the insert. Where dimensions cannot be held to any degree of precision, a high temperature plastic such as Teflon can be used as a seal at the “kiss” point. This allows some give, the sealing material conforming to the irregularities of the insert. This also works well sealing around wire as in a cord set mold.

On moldings around wire, you want the machine to squeeze the wire slightly, not only to seal it off, but also to prevent the pressure of material in the mold from blowing the wire out of the mold. Remember, however, that the self-clamping “V” mold must undergo its wedging action before this squeeze is applied. If the wire insert requires a large degree of compression, the molten material may flow out between the mold halves before the nozzle force can clamp the mold.

If the mold has a tendency to blow the insert out, **DO NOT PLACE YOUR BODY DIRECTLY IN FRONT OF THE MOLD.** Move off to one side to prevent being burned. Initiate the cycle standing off to the side.

When the object to be molded requires that the insert passes through the back of the machine (such as a cable splice or grommet on a wire harness) it may be necessary to remove the mold stop mechanism to clear the insert. When an entire object is to be encapsulated (such as a mini-circuit) and the components are fragile, the encapsulation can be done in two stages. First, the object is encapsulated with a soft, easy to mold material such as plasticized PVC. This is similar to epoxy potting. The potted part can then be encapsulated with a harder material at much higher pressures, producing a sandwiching effect. This is referred to as over molding.

Always use the lowest injection pressures that will produce a quality part. Where inserts have a tendency to blow out, use the manual cycle or minimal injection timer settings on the models #45 & #50. The manual control may give you a better feel over the mold filling. If the insert starts to blow out or the mold begins to flash, release the inject selector switch to stop filling.

The models #45C, #50C, and #55C machines are a variant of the models #45C, #50C, and #55C designed to mold splices on repaired or joined cables. The mold is at right angles to the normal position and the injection unit is mounted on “C” supports to allow the cable to be lifted into the molding area without machine parts interfering with the cable.

Very large cables or cables with many wires may have to be stretched between the two sides to prevent the hot plastic from pushing the wire down, creating a void. This stretching can be accomplished by putting two compound machinists vises at each side of the mold area. The cable can be clamped in the vises and stretched by moving the compound slides.

In cable repair or other insert molding around wire, heating the mold or the ends of the wire may assist in sealing the ends of the molding around the wire. On the model #45C, the optional mold heat package heats the mold by heating the “V” slot (which is insulated from the machine base) which transfers heat to the mold. On other “Wasp” machines, the mold can be pre-heated in an oven. Always use proper insulated gloves when handling hot molds.

Typically, the squeeze of soft insulated wire by the mold should be at least 0.010”. This would be for PVC or *elastomer* coated wire. If you have a wire diameter of 0.375”, the hole in the mold surrounding the wire should be no more than 0.365”. Make the clearance smaller on new molds. They can always be enlarged if the squeeze is too great.

APPENDIX D

MOLD CONSTRUCTION TIPS FOR “V” MOLDS

The “V” molds used in “Wasp” Mini-Jectors are not only adaptable to standard mold construction technology but they also have some unique features of their own. The unique feature of “Wasp” machines is the self-clamping “V” mold that is removed from the machine each cycle. Items commonly associated with injection molds, such as heating and cooling passages and part ejection systems are not applicable to these compact tools. The unique requirements are dictated by the fact that the mold comes in contact with three surfaces every cycle:

(1) The two mold clamping shoes
(2) The injection nozzle
(3) The mold ejector bar

Taken in order, the mold clamping shoes are made from #80-60-03 ductile iron. This is a material compatible to the wedging and ejecting action of the machine when using high or low carbon steel molds or molds made of bronze. *Aluminum* can be used (see alternative materials) but will abrade after prolonged use.

The standard Mini-Jector mold blanks; 2 5/8” x 6” part #121230, 3” x 7” part #420170, and the cavity plates of the part #420180 insert mold base, are built from SAE 4150 annealed medium carbon steel. This material is free machining, may be heat treated up to Rockwell C 55-60, and polished to a smooth finish. The surface contacting the mold clamping shoes (the 7.5° angle surface) does not require heat-treating to work well against the ductile cast iron shoes. If the mold is to be heat-treated anyway, the angle sides will wear longer if they are heat-treated also.

The injection nozzle, either straight bore or non-drool is very hard. The bearing surface where the nozzle contacts the top of the mold is a 9/16” diameter round. This means there will be a force of nearly 25,000 PSI on the top mold surface where the sprue opening is. This force will indent or “coin” the top of the mold. See drawing #300030, which shows a replaceable sprue plate made from a hard material such as H-13. The sprue plate can be replaced if necessary without having to regrind the rest of the mold. The 9/16” diameter is an optimum size selected because greater areas would not seal the sprue-nozzle interface. Under no circumstances should any recess be machined into the mold to receive the nozzle. **A flat surface is required.**

The mold ejector bar is 1” wide and 7” long, so adequate contact area is available for the ejection force. Since the bar contacts both mold halves, be sure that the bottom surface of the mold halves are uniformly machined to insure the ejector bar contacts both sides.

If you use any of the mold blanks supplied by Miniature Plastic Molding, the side angles are precisely ground to the correct taper. If you or your toolmaker build your own mold base, the 7.5° angle must be held to plus or minus 0.05° (or 3 minutes of angle). Spread over a 3" length, a 0.05° variance would cause the base to be out of parallel by 0.0024". Any greater error would prevent uniform surface contact during clamping.

If you heat-treat the mold after completion, it may be necessary to re-grind both the "V" and the parting line surfaces of the mold, because it is possible that some warpage may occur during the heat-treating process. Molds that are to be used for long periods of time or for molding materials such as PVC can be hard chrome plated for greater resistance to wear and corrosion.

When planning the construction of your mold, consider the following factors during the design period:

(1) How many parts are required during the life of the mold?

(2) What materials are to be run and what are their characteristics?

(3) Is the product a prototype that will require a great deal of possible modification?

(4) Is it being used to establish shrinkage and other molding parameters for a future production mold?

(5) How quickly is production needed from this mold?

Refer to drawing #300030 "Mold Construction Features" included with this manual to see visual representations of the following suggestions:

(1) Conventional mold construction with cavities cut directly into the blank mold

This type of construction is recommended if the mold is for a product or procedure of an on-going nature. An example of this would be molding color step chips. A permanent mold would be desirable since there would be no need for interchangeable cavities. A high quality mold for color step chips would be fully heat-treated, polished, chrome plated, and fitted with a replaceable sprue plate as illustrated. The latter can be replaced without having to resurface the top of the mold.

(2) Insert type construction with interchangeable cavities

Many times you may wish to produce parts that are required in a large number of variations but are similar in size or configuration. By interchanging just the cavities and utilizing the same mold base for a series of parts, you can greatly reduce your tooling costs. Precision machining of the pocket holding the cavities is necessary to insure proper matching.

Another case for the interchangeable cavity design would be if the cavities were of a fragile nature. An example would be an epoxy cavity for a very short production run (see alternative mold materials). The parent metal must surround the cavity to prevent breakage. The support of the metal wall produces a mold almost as sturdy as the permanent cavity system.

(3) Part removal and mold handling

The “V” molds do not provide for any type of ejection of the finished part, so other techniques must be used to get the finished part out of the mold. When the mold is removed from the machine, the two halves must be separated to remove the part. Only two diagonally placed dowel pins are used in the mold base and these need to be inserted just 0.125” into the hole. Wiggling the two mold halves usually allows you to pry them apart and an adequate draft or taper on the molded part perpendicular to the parting line will assist the separation.

Note in drawing #300030 the handles at the left (which would be the side facing the machine operator) end of the mold. These, along with the short dowel at the right end, can be used as pry devices if mold separation is difficult. The handles can be bolts, long dowel pins, or a wooden file handle. Notice that they are placed adjacent to the mold locating dowel pins. The handles also aid the operator greatly in handling the mold, which can become very warm after prolonged operation. The pairs of protruding handles (or dowels) can be pried upon with hand tools or pushed onto an auxiliary fixture with two wedges that pass between the pairs of pins.

When designing your mold, remember that large flat parts are more difficult to remove from molds. The gate into the mold should be large enough to allow you to remove the entire shot, with runners and sprue, without having the gate break off. Proper mold release compounds greatly assist removal of the parts.

An alternative to the protruding dowels would be to place screwdriver slots at the ends of the mold. This does not provide the mold handling convenience of the other method.

(4) Insert molds (see Insert molding with “Wasp” Mini-Jectors elsewhere in this manual)

(5) Alternative mold materials

(a) *Aluminum* is very popular for prototype tooling due to its free machining and the potential of casting complex cavities from models. This material would be recommended for prototype cavities as well as short production runs for up to several thousand pieces. Plastics are somewhat abrasive, so gate and cavity wear will occur using *aluminum*. If the cavity walls are thin, they should be fully supported by the parent steel mold frame. Mold bases constructed entirely of *aluminum* are feasible if you realize that the “V” sides of the mold will wear more quickly than steel.

(b) *Bronze* is another popular material with many of the same pluses and minuses of *aluminum*. It can be highly polished where prototype optic parts are being molded. *Bronze* cavities can also be cast.

(c) Non-metallic materials, such as *epoxies*, or combinations of *epoxy* and powdered metal fillers can make surprisingly durable short run cavities. The method commonly used for cavity construction would be casting, although these materials can also be machined. Life of these cavities is one thousand parts or less, but an inserted cast *epoxy* cavity is an instant mold in a situation where time is crucial.

(6) Tooling sources

Many customers come to us to secure their tooling. We have a list of specialists in short run prototype tooling, plus ones who specialize in ASTM test specimen molds that we can provide to you. Most molds require small modifications when initially run, and we recommend that you use a tooling source near to your facility to speed up "de-bugging" of the tool.

We are available for consultation with your toolmaker at any time to insure your satisfaction with our equipment. We are also more than willing to examine your tooling drawings for possible suggested changes.

(7) Heating and cooling "V" molds

Due to the limited size of the "V" mold, it is impractical to run cooling lines to the mold itself. Molds run for a period of time soon become fairly hot, but seldom over 105° F. Some owners use a pair of molds to allow cool down time, and fan can be used to cool the extra mold between cycles. It is possible to use small cooling hoses flowing cold tap water into the mold, but remember these must be removable every cycle along with the mold. Cooling passages in the "V" mold clamping shoes do not effectively remove mold heat. Cartridge heaters in the shoes will heat the mold by contact, but require insulating the shoes from the machine frame if mold temperatures over 300° F are used. We supply an optional auxiliary control package to provide mold heat. The package includes (2) 200-Watt cartridge heaters to insert into your mold, (2) thermocouples, and (2) additional heat controllers. Pre-heating molds in an oven will also allow the mold to reach a stabilized temperature if cycle times are kept consistent.

APPENDIX E

SEQUENCE OF OPERATIONS: MODEL #55 MINI-JECTOR

The Model #55 uses a parallel hydraulic system, where all tank and pressure ports are on common lines. The system unloads pressure at idle through the carriage directional valve. For any movement of either the screw motor or the inject/retract circuit, the carriage valve must be energized to either the “in” or “out” position, otherwise no pressure can be developed within the system. The carriage in-out start cycle selector switch is of the maintained detented type in the “in-start cycle” position. To run the machine on a manual cycle, the carriage is usually turned to the “in” position until inject, extrude, and decompression are finished. The long end of the switch is pulled down simulating the down motion of the carriage. If the carriage is allowed to remain in that position, the hydraulic system will remain under maximum pressure load. Turn the switch to the center or briefly to the out position to end the injection cycle. The switch is a spring return to center in the “out” position.

SEMI-AUTOMATIC CYCLE

With the timer switch turned on, the mold is placed in the “V” slot up against the adjustable mold stop. Turn the selector switch to the “in-start cycle” position. This energizes solenoid “A” carriage in, bringing the nozzle against the mold and cycle timer 1TR is also started. Its instantaneous contacts 1-3 close and when the nozzle force on the mold reaches 1950 PSI the pressure switch contacts are closed. This starts the injection timer 2TR and energizes 1CR injection relay. 1CR latches through its normally open contacts and the normally closed contacts of the 2CR cure relay permit “in” to be energized.

When 2TR injection timer starts, its instantaneous contacts 1-3 close, energizing solenoid “inject” causing the screw to inject material into the mold. If the machine is equipped with the optional dual injection pressure, the “initial inject” solenoid is also energized, causing the dual relief valve to meter pressure at its initial setting. As the screw injects, the forward movement trips 4LS, breaking the contacts and de-energizing “initial inject”. The normally open contacts of 4LS now energize solenoid “hold” which shifts the dual relief valve to the “hold” pressure position, which is normally lower than initial but may be set higher on specific applications.

When the injection timer 2TR times out, delayed contact 11-8 is opened, de-energizing the inject solenoid (and “hold” pressure with the option) and energizing the “extrude” solenoid through contact 11-9. As the screw plasticizes the shot, it travels back and trips 2LS “extrude”. Solenoid extrude is then de-energized stopping screw rotation. If the “decompress” switch is turned on, the normally open 2LS contacts (through normally closed contacts in 3LS) energizes the “retract” solenoid, retracting the screw another .25 inches tripping 3LS “decompress”. The normally closed contacts are broken de-energizing retract and when the normally open contacts are closed, 2CR cure relay is energized. The normally closed 2CR contact is broken, de-energizing solenoid “in”, putting the hydraulic system at idle pressure. The normally open contact of 2CR is closed, which latches 2CR. If “decompress” is not turned on, 2CR will energize at the end of the extrude cycle.

When the overall cycle timer 1TR times out, timed contact 11-8 opens and 11-9 closes, energizing solenoid “out” through the normally open contact of 2CR lifting the nozzle off the mold until 1LS “carriage out” is tripped, which de-energizes “carriage out”. In event that the overall cycle timer times out before extrude (and de-compress) are completed, such as in the case of running out of material, the carriage will not pull out because 2CR is not energized and the normally open contact of 2CR remains open, preventing “carriage out”. The carriage may be withdrawn manually with the selector switch.

At the end of the cycle, returning the carriage selector switch to the center position allowing NC contacts in 1SS to close, resets 1CR, 2CR, 1TR and 2TR. Another cycle cannot be started until the switch is turned to the center or briefly to the out position. When setting the overall timer, set enough time to allow the completion of the extrude and/or decompression cycle.

APPENDIX F

WIDE MOLD OPTION

The wide mold option enables the user to utilize cavity halves that are 0.938” wider than the standard mold bases. It also permits lengths up to 10” long versus the standard 7” length. With the adaptors option installed, the machine is able to utilize the standard mold bases. The adaptors are made of the same high-grade ductile iron as the mold clamping shoes, so they are compatible with the same range of mold materials.

The adaptors are installed using two (2) ¼”-20 socket head screws that attach each side to the mold clamping shoes. This is a very tight fit and may require cutting down a standard Allen head wrench to. The right hand adaptor is also a close proximity with the nozzle thermocouple when installing and removing. The adaptors must be lowered around the tie bars, and rotated slightly to clear. The legs contact the base plate to take the clamping load off the screws.

The system requires an extended mold stop bracket. When using 7” long molds, the 3/8”-16 socket head screw will extend toward the front of the machine to adjust for nozzle alignment. When using a 10” mold, the screw can be removed altogether and the bracket used as the stop. This works only if the sprue is centered and not offset. It may be necessary to use a special stop screw to accommodate offset sprues. Refer to drawing no. **420020** for parts.