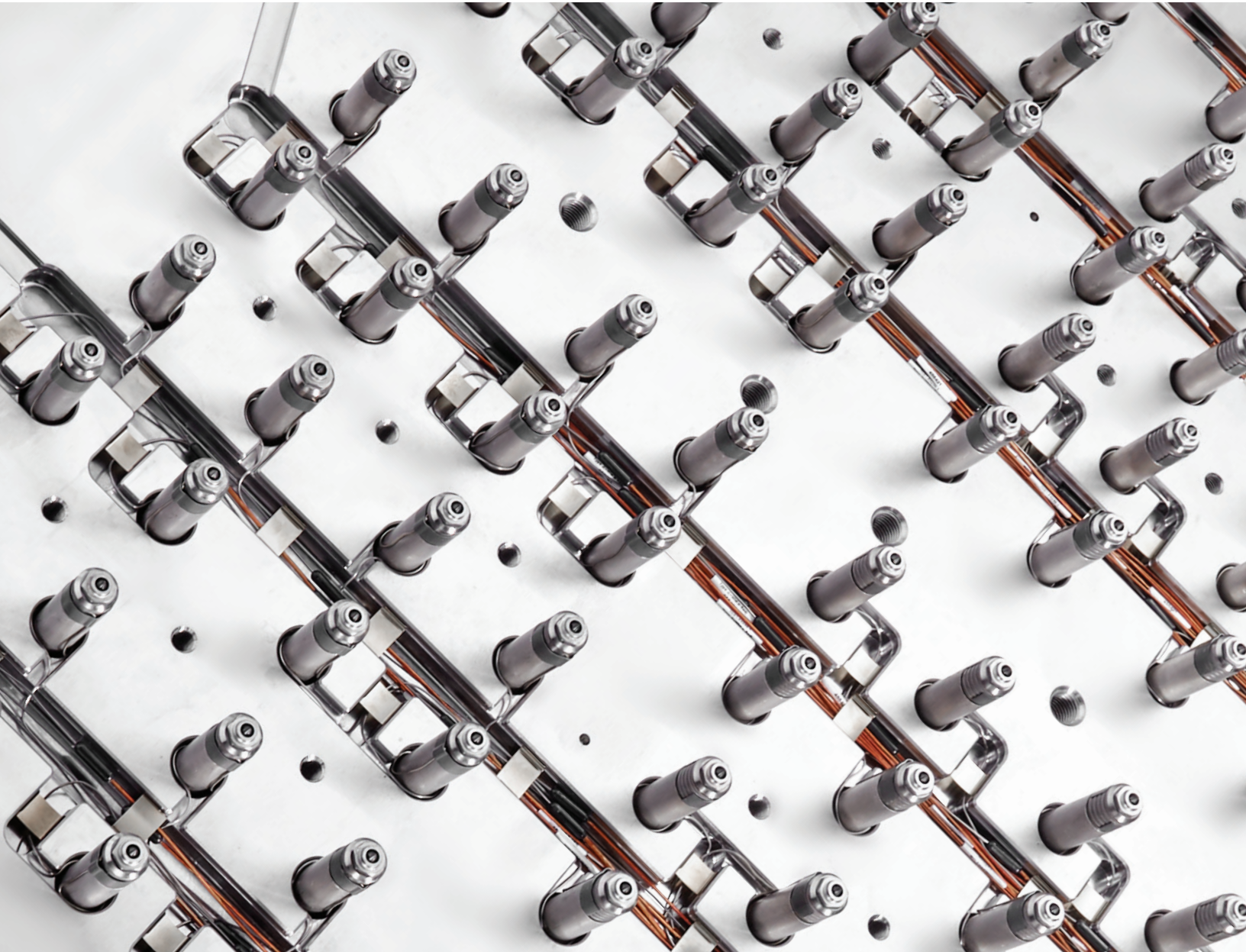




# Sprint™ Gen 2

## User Manual

version 1



## IMPORTANT

Before proceeding you must Identify your system. Using the wrong User Manual may result in damage to your hot runner system.

There are two Sprint hot runner systems:

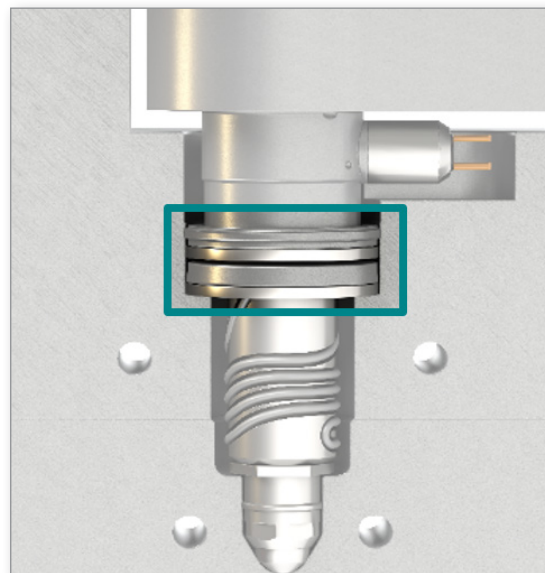
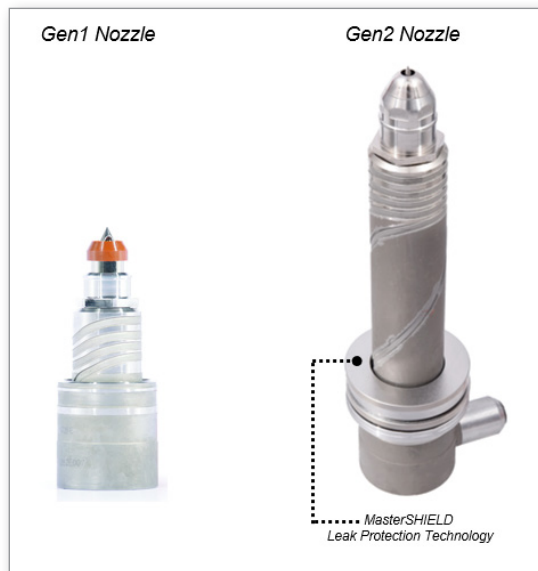
- Generation 1: Standard design 2019 or earlier (ID orders). Please refer to the Mold-Masters Hot Runner User Manual.
- Generation 2: Standard design as of 2019 and later. Please refer to this Sprint User Manual only.

This user manual focuses on Generation 2. Do not refer to any other user manual. Doing so may result in performance issues and/or damage to your hot runner system.

### How To Identify Your Sprint Generation 2 Hot Runner System

Identify MasterShield Leak Protection Technology

Only Generation 2 Sprint hot runner systems are supplied with MasterShield Leak Protection Technology, which is a spring pack that sits on the nozzle flange. This can be identified by referencing your GA drawings or by disassembling the hot runner system. If your Sprint hot runner system is equipped with these components you have a Generation 2 system and you must use this user manual.



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# Section 1 - Introduction

The purpose of this manual is to assist users in the integration, operation and maintenance of a Hot Runner. This manual is designed to cover most system configurations. If you need additional information specific to your system, or information in another language, please contact your representative or a *Mold-Masters* office.

## 1.1 Intended Use

*Mold-Masters* Hot Runner systems have been built to process thermoplastic material at the required temperature for injection molding and must not be used for any other purpose.

This manual is written for use by skilled persons who are familiar with injection molding machinery and their terminology. Operators should be familiar with plastic injection molding machines and the controls of such equipment. Maintenance persons should have sufficient understanding of electrical safety to appreciate the dangers of 3-phase supplies. They should know how to take appropriate measures to avoid any danger from electrical supplies.

## 1.2 Documentation

This manual is part of the documentation package for your order and should be referenced along with the following documents included in the package:

- The Bill of Materials (BOM). Together with the General Assembly drawing, the Bill of Materials should be referenced when ordering spare parts.
- General Assembly drawing used to integrate your Hot Runner system into the mold.
- Hot Half drawing used to integrate Hot Half to cavity plate.
- CE declaration of conformity and declaration of incorporation (EU only)



### NOTE

This manual should also be used in conjunction with other relevant manuals, e.g. Mold Machine Manual and Controller Manual.

## 1.3 Release Details

When ordering this manual, please reference the document number below.

Table 1-1 Release Details		
Document Number	Release Date	Version
SPT-UM-EN-00-01	September 2020	01

## 1.4 Warranty

For current warranty information please refer to the documents available from our website [www.moldmasters.com/support/warranty](http://www.moldmasters.com/support/warranty) or contact your *Mold-Masters* representative.

## **1.5 Returned Goods Policy**

Please do not return any parts to *Mold-Masters* without pre-authorization and a return authorization number supplied by *Mold-Masters*.

Our policy is one of continuous improvement and we reserve the right to alter product specifications at any time without giving notice.

## **1.6 Movement or Resale of Mold-Masters Products or Systems**

This documentation is intended for use in the country of destination for which the product or system was purchased.

*Mold-Masters* takes no responsibility for documentation of products or systems if they are relocated or resold outside the intended country of destination, as stated on the accompanying invoice and/or waybill.

## **1.7 Copyright**

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## 1.8 Units of Measure and Conversion Factors



**NOTE**

The dimensions given in this manual are from original manufacturing drawings.

All values in this manual are in S.I. units or subdivisions of these units. Imperial units are given in parenthesis immediately after the S.I. units.

Table 1-2 Units of Measure and Conversion Factors		
Unit	Abbreviation	Conversion value
bar	Bar	14.5 psi
in.	Inch	25.4 mm
kg	Kilogram	2.205 lb
kPa	Kilopascal	0.145 psi
lb	Pound	0.4536 kg
lbf	Pound force	4.448 N
lbf.in.	Pound force inch	0.113 Nm
min	Minute	
mm	Millimeter	0.03937 in.
mΩ	Milliohm	
N	Newton	0.2248 lbf
Nm	Newton meter	8.851 lbf.in.
psi	Pound per square inch	0.069 bar
psi	Pound per square inch	6.895 kPa
rpm	Revolutions per minute	
s	Second	
°	Degree	
°C	Degree Celsius	0.556 (°F -32)
°F	Degree Fahrenheit	1.8 °C +32

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For support in regions not listed above, please contact the nearest headquarters and they will connect you with the appropriate representative.

## Section 3 - Safety

Please be aware that the safety information provided by *Mold-Masters* does not absolve the integrator and employer from understanding and following international and local standards for safety of machinery. It is the responsibility of the end integrator to integrate the final system, provide necessary e-stop connections, safety interlocks and guarding, to select the appropriate electrical cable for the region of use and to ensure compliance with all relevant standards.

It is the responsibility of the employer to:

- Properly train and instruct its personnel in the safe operation of equipment, including the use of all the safety devices.
- Provide its personnel with all necessary protective clothing, including a face shield and heat resistant gloves.
- Ensure the original and continuing competence of personnel caring for, setting up, inspecting and maintaining injection molding equipment.
- Establish and follow a program of periodic and regular inspections of injection molding equipment to ensure it is in safe operating condition and proper adjustment.
- Ensure that no modifications, repairs, or rebuild of portions are made to the equipment that reduces the level of safety existing at time of manufacture or remanufacture.

### 3.1 Safety Hazards



**WARNING**

Refer to all machine manuals and local regulations and codes for safety information.

The following safety hazards are most commonly associated with plastic injection molding equipment (see European Standard EN201 or American Standard ANSI/SPI B151.1).

Refer to the illustration of hazard areas below when reading the “Table 3-1 Safety Hazards” on page 3-3.

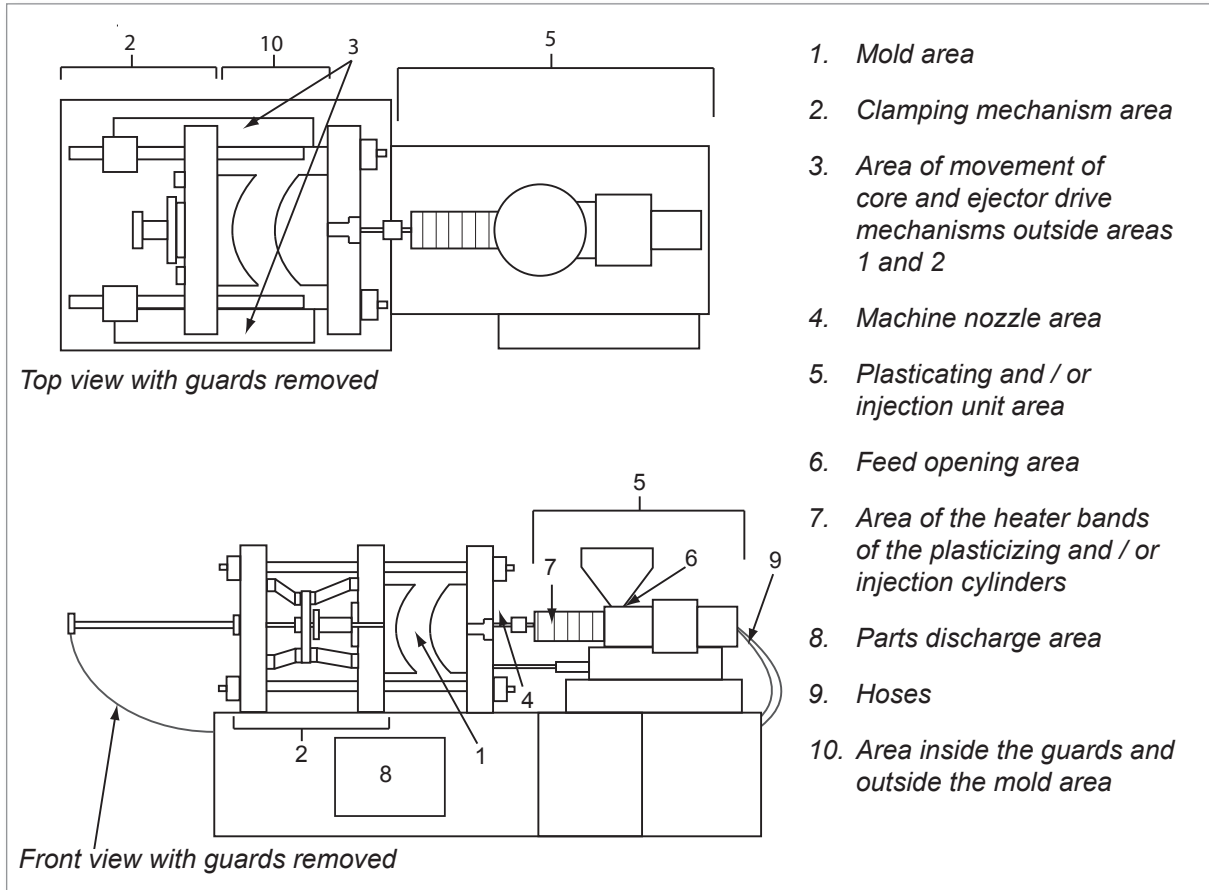


Figure 3-1 Injection molding machine hazard areas.

<b>Table 3-1 Safety Hazards</b>	
<b>Hazard Area</b>	<b>Potential Hazards</b>
<p><b>Mold Area</b> Area between the platens. See Figure 3-1 area 1</p>	<p><b>Mechanical Hazards</b> Crushing and / or shearing and / or impact hazards caused by:</p> <ul style="list-style-type: none"> <li>• Movement of the platen.</li> <li>• Movements of the injection barrel(s) into the mold area.</li> <li>• Movements of cores and ejectors and their drive mechanisms.</li> <li>• Tie bar motion.</li> </ul> <p><b>Thermal Hazards</b> Burns and / or scalds due to operating temperature of:</p> <ul style="list-style-type: none"> <li>• The mold heating elements.</li> <li>• Plasticized material released from / through the mold.</li> </ul>
<p><b>Clamping Mechanism Area</b> See Figure 3-1 area 2</p>	<p><b>Mechanical Hazards</b> Crushing and / or shearing and/or impact hazards caused by:</p> <ul style="list-style-type: none"> <li>• Movement of the platen.</li> <li>• Movement of the drive mechanism of the platen.</li> <li>• Movement of the core and ejector drive mechanism.</li> </ul>
<p><b>Movement of Drive Mechanisms Outside the Mold Area and Outside the Clamping Mechanism Area</b> See Figure 3-1 area 3</p>	<p><b>Mechanical Hazards</b> Mechanical hazards of crushing, shearing and / or impact caused by the movements of:</p> <ul style="list-style-type: none"> <li>• Core and ejector drive mechanisms.</li> </ul>
<p><b>Nozzle Area</b> The nozzle area is the area between the barrel and the sprue bushing. See Figure 3-1 area 4</p>	<p><b>Mechanical Hazards</b> Crushing, shearing hazards, and / or impact hazards caused by:</p> <ul style="list-style-type: none"> <li>• Forward movement of the plasticizing and / or injection unit including nozzle.</li> <li>• Movements of parts of the power operated nozzle shutoff and their drives.</li> <li>• Over pressurization in the nozzle.</li> </ul> <p><b>Thermal Hazards</b> Burns and or scalds due to operating temperature of:</p> <ul style="list-style-type: none"> <li>• The nozzle.</li> <li>• Plasticized material discharging from the nozzle.</li> </ul>
<p><b>Plasticizing and / or Injection Unit Area</b> Area from the adapter / barrel head / end cap to the extruder motor above the sled including the carriage cylinders. See Figure 3-1 area 5</p>	<p><b>Mechanical Hazards</b> Crushing, shearing and / or drawn-into hazards caused by:</p> <ul style="list-style-type: none"> <li>• Unintentional gravity movements e.g. for machines with plasticizing and / or injection unit positioned above the mold area.</li> <li>• The movements of the screw and / or the injection plunger in the cylinder accessible through the feed opening.</li> <li>• Movement of the carriage unit.</li> </ul> <p><b>Thermal Hazards</b> Burns and or scalds due to operating temperature of:</p> <ul style="list-style-type: none"> <li>• The plasticizing and / or injection unit.</li> <li>• The heating elements e.g. heater bands.</li> <li>• The plasticized material and / or vapors discharging from the vent opening, feed throat or hopper.</li> </ul> <p><b>Mechanical and / or Thermal Hazard</b> Hazards due to reduction in mechanical strength of the plasticizing and / or injection cylinder due to overheating.</p>

<b>Table 3-1 Safety Hazards</b>	
<b>Hazard Area</b>	<b>Potential Hazards</b>
<b>Feed Opening</b> See Figure 3-1 area 6	Pinching and crushing between injection screw movement and housing.
<b>Area of the Heater Bands of the Plasticizing and / or Injection Cylinders</b> See Figure 3-1 area 7	Burns and / or scalds due to operating temperature of: <ul style="list-style-type: none"> <li>• The plasticizing and / or injection unit.</li> <li>• The heating elements e.g. heater bands.</li> <li>• The plasticized material and / or vapors discharging from the vent opening, feed throat or hopper.</li> </ul>
<b>Parts Discharge Area</b> See Figure 3-1 area 8	<b>Mechanical Hazards</b> Accessible Through the Discharge Area Crushing, shearing and / or impact hazards caused by: <ul style="list-style-type: none"> <li>• Closing movement of the platen.</li> <li>• Movements of cores and ejectors and their drive mechanisms.</li> </ul> <b>Thermal Hazards</b> Accessible Through the Discharge Area Burns and or scalds due to operating temperature of: <ul style="list-style-type: none"> <li>• The mold.</li> <li>• Heating elements of the mold.</li> <li>• Plasticized material released from/through the mold.</li> </ul>
<b>Hoses</b> See Figure 3-1 area 9	<ul style="list-style-type: none"> <li>• Whipping action caused by hose assembly failure</li> <li>• Possible release of fluid under pressure that can cause injury.</li> <li>• Thermal hazards associated with hot fluid.</li> </ul>
<b>Area Inside the Guards and Outside the Mold Area</b> See Figure 3-1 area 10	Crushing and / or shearing and/or impact hazards caused by: <ul style="list-style-type: none"> <li>• Movement of the platen.</li> <li>• Movement of the drive mechanism of the platen.</li> <li>• Movement of the core and ejector drive mechanism.</li> <li>• Clamp opening movement.</li> </ul>
<b>Electrical Hazards</b>	<ul style="list-style-type: none"> <li>• Electric shock or burns due to contact with live conductive parts.</li> <li>• Electrical or electromagnetic disturbance generated by the motor control unit.</li> <li>• Electrical or electromagnetic disturbance that can cause failures in the machine control systems and adjacent machine controls.</li> <li>• Electrical or electromagnetic disturbance generated by the motor control unit.</li> </ul>
<b>Hydraulic Accumulators</b>	High pressure discharge.
<b>Power Operated Gate</b>	Crush or impact hazards caused by the movement of the power operated gates.
<b>Vapors and Gases</b>	Certain processing conditions and / or resins can cause hazardous fumes or vapors.

## 3.2 Operational Hazards



### WARNINGS

- Refer to all machine manuals and local regulations and codes for safety information.
- The equipment supplied is subjected to high injection pressures and high temperatures. Ensure that extreme caution is observed in the operation and maintenance of the injection molding machines.
- Only fully trained personnel should operate or maintain equipment.
- Do not operate the equipment with unconfined long hair, loose clothing or jewelry, including name badges, neckties, etc. These may get caught in the equipment and can cause death or serious injury.
- Never disable or bypass a safety device.
- Ensure that the protective guards are placed around the nozzle to prevent the material from splashing or drooling.
- A burn hazard exists from material during routine purging. Wear heat-resistant personal protective equipment (PPE) to prevent burns from contact with hot surfaces or splatter of hot material and gases.
- Material purged from machine may be extremely hot. Ensure protective guards are in place around the nozzle to prevent material from splashing. Use proper personal protective equipment.
- All operators should wear personal protective equipment, such as face shields and use heat resistant gloves when working around the feed inlet, purging the machine or cleaning the gates of the mold.
- Remove purged material from the machine immediately.
- Decomposing or burning material could result in noxious gases being emitted from the purged material, feed inlet or mold.
- Ensure proper ventilation and exhaust systems are in place to help prevent inhalation of harmful gases and vapors.
- Consult manufacturer's Material Safety Data Sheets (MSDS).
- Hoses fitted to the mold will contain high or low temperature fluids or air under high pressure. The operator must shut down and lockout these systems as well as relieving any pressure before performing any work with these hoses. Regularly inspect and replace all flexible hoses and restraints.
- Water and / or hydraulics on the mold may be in close proximity to electrical connections and equipment. Water leakage may cause an electrical short circuit. Hydraulic fluid leakage may cause a fire hazard. Always keep water and / or hydraulic hoses and fittings in good condition to avoid leaks.
- Never perform any work on the mold machine unless the hydraulic pump has been stopped.
- Check frequently for possible oil leaks / water leaks. Stop the machine and make repairs.





**WARNING**

- Make sure that the cables are connected to the correct motors. Cables and motors are clearly labeled. Reversing the cables can result in unexpected and uncontrolled motion causing a safety risk or damage to the machine.
- A crushing hazard exists between the nozzle and mold melt inlet during carriage forward motion.
- A possible shearing hazard exists between the edge of the injection guard and the injection housing during injection.
- The open feed port could present a hazard to a finger or a hand inserted during operation of the machine.
- The electric servo motors could overheat presenting a hot surface which could cause burns to someone touching it.
- The barrel, barrel head, nozzle, heater bands and mold components are hot surfaces which could result in burns.
- Keep flammable liquids or dust away from the hot surfaces as they could ignite.
- Follow good housekeeping procedures and keep floors clean to prevent slips, trips and falls due to spilled material on the work floor.
- Apply engineering controls or hearing conservation programs as necessary to control noise.
- When doing any work on the machine that requires moving and lifting the machine, ensure that lifting equipment (eyebolts, fork lift truck, cranes, etc.) will have sufficient capacity to handle mold, auxiliary injection unit or Hot Runner weight.
- Connect all lifting devices and support the machine using a crane of adequate capacity before commencing work. Failure to support the machine can result in severe injury or death.
- Mold cable from the controller to the mold must be removed before servicing the mold.

### 3.3 General Safety Symbols

Table 3-2 Typical Safety Symbols	
Symbol	General Description
	<b>General – Warning</b> Indicates an immediate or potentially hazardous situation, which if not avoided, could result in a serious injury or death, and / or damage to equipment.
	<b>Warning – Barrel Cover Grounding Strap</b> Lockout / tagout procedures must be followed before removing the barrel cover. Barrel cover can become energized upon removal of grounding straps and contact can result in death or serious injury. Grounding straps must be reconnected before reconnecting power to machine.
	<b>Warning – Crushing and / or Impact Points</b> Contact with moving parts can cause serious crushing injury. Always keep guards in place.
	<b>Warning – Crush Hazard Closing Mold</b>
	<b>Warning – Hazardous Voltage</b> Contact with hazardous voltages will cause death or serious injury. Turn off power and review electrical schematics before servicing equipment. May contain more than one live circuit. Test all circuits before handling to make sure circuits have been de-energized.
	<b>Warning – High Pressure</b> Overheated fluids may cause severe burns. Discharge pressure before disconnecting water lines.
	<b>Warning – High Pressure Accumulator</b> Sudden release of high pressure gas or oil can cause death or serious injury. Discharge all gas and hydraulic pressure before disconnecting or disassembling accumulator.
	<b>Warning – Hot Surfaces</b> Contact with exposed hot surfaces will cause serious burn injury. Wear protective gloves when working near these areas.
	<b>Mandatory – Lockout / Tagout</b> Ensure that all energies are properly locked out, and remain locked out until the service work is completed. Servicing equipment without disabling all internal and external power sources can cause death or serious injury. De-energize all internal and external power sources (electrical, hydraulic, pneumatic, kinetic, potential, and thermal).
	<b>Warning – Material Splashing Hazard</b> Material or high pressure gas can cause death or severe burns. Wear personal protective equipment while servicing the feed throat, nozzle, mold areas, and when purging the injection unit.
	<b>Warning – Read Manual Before Operation</b> Personnel should read and understand all instructions in the manuals before working on equipment. Only properly trained personnel should operate the equipment.
	<b>Warning – Slip, Trip or Fall Hazard</b> Do not climb on equipment surfaces. Serious slip, trip or fall injuries can result from personnel climbing on equipment surfaces.

Table 3-2 Typical Safety Symbols	
Symbol	General Description
	<b>Caution</b> Failure to follow instructions may damage equipment.
	<b>Important</b> Indicates additional information or used as a reminder.

### 3.4 Wiring Check



#### CAUTION

System Mains Supply Wiring:

- Before connecting the system to a power supply, it is important to check that the wiring between the system and the power supply has been done correctly.
- Particular attention must be given to the current rating of the power supply. For example, if a controller is rated at 63A, then the power supply must also be rated at 63A.
- Check that the phases of power supply are wired correctly.

Controller to Mold Wiring:

- For separate power and thermocouple connections, ensure that the power cables are never connected to the thermocouple connectors and vice-versa.
- For mixed power and thermocouple connections, ensure that the power and thermocouple connections have not been wired incorrectly.

Communications Interface and Control Sequence:

- It is the customer's responsibility to verify functionality of any custom machine interface at safe speeds, prior to operating equipment in the production environment at full speed in automatic mode.
- It is the customer's responsibility to verify all required motion sequences are correct, prior to operating equipment in the production environment at full speed in automatic mode.
- Switching the machinery into Auto mode without having verified the control interlocks and motion sequence are correct, may cause damage to machinery and / or equipment.

Failure to do wiring or connections properly will result in equipment failure.

The use of *Mold-Masters* standard connections can help to eliminate the potential for wiring errors.

*Mold-Masters Ltd.* cannot be responsible for damage caused by customer wiring and / or connection errors.



### 3.5 Lockout Safety

#### **WARNING**

DO NOT enter the cabinet without first ISOLATING the supplies.

High voltage and amperage cables are connected to the controller and the mold.

Electrical power must be shut off and lockout / tagout procedures followed prior to installing or removing any cables.

Use lockout / tagout to prevent operation during maintenance.

All maintenance should be performed by properly trained personnel based on local laws and regulation. Electrical products may not be grounded when removed from the assembled or normal operating condition.

Ensure proper grounding of all electrical components before performing any maintenance to avoid potential risk of electrical shock.

Often power sources are inadvertently turned on or valves are opened mistakenly before maintenance work is completed, resulting in serious injuries and fatalities. Therefore, it is important to ensure that all energies are properly locked out and that they remain locked out until the work is completed.

If a lockout is not performed, uncontrolled energies could cause:

- Electrocution from contact with live circuits
- Cuts, bruises, crushing, amputations or death, resulting from entanglement with belts, chains, conveyors, rollers, shafts, impellers
- Burns from contact with hot parts, materials or equipment such as furnaces
- Fires and explosions
- Chemical exposures from gases or liquids released from pipelines

### 3.5.1 Electrical Lockout



#### **WARNING - READ MANUAL**

Refer to all machine manuals and local regulations and codes.



#### **NOTE**

In some instances, there may be more than one power source feeding equipment and steps must be taken to ensure that all sources are effectively locked out.

Employers must provide an effective lockout / tagout program.

1. Shut down machine using normal operational shutdown procedure and controls. This should be done by, or in consultation with the machine operator.
2. After ensuring that the machinery has been completely shut down, and all controls in the “off” position, open the main disconnect switch located in the field.
3. Using your own personal padlock, or one assigned by your supervisor, lock the disconnect switch in the off position. Do not lock only the box. Remove the key and retain. Complete a lockout tag and affix to the disconnect switch. Each person working on the equipment must follow this step. The lock of the person doing the work or in charge must be installed first, remain throughout and be removed last. Test the main disconnect switch and make sure it cannot be moved to the “on” position.
4. Try to start the machine using the normal operation controls and point of operation switches to make sure that the power has been disconnected.
5. Other sources of energy that could create a hazard while working on the equipment must also be de-energized and appropriately “locked-out”. This can include gravity, compressed air, hydraulics, steam and other pressurized or hazardous liquids and gases. See Table 3-3.
6. When the work is completed, prior to removing the last lock, make sure the operational controls are in the “off” position so that the main disconnect switching is done under “no load”. Ensure all blocks, tools and other foreign materials are removed from machine. Also ensure that all personnel that may be affected are informed that the lock(s) will be removed.
7. Remove lock and tag, and close the main disconnect switch if permission has been given.
8. When the work has not been completed on the first shift, the next operator should install a personal lock and tag before the first operator removes the original lock and tag. If the next operator is delayed, a lock and tag could be installed by the next supervisor. Lockout procedures should indicate how the transfer is to be conducted.
9. It is important that, for their personal protection, each worker and/or fore person working in or on a machine places his/her own safety lock on the disconnect switch. Use tags to spotlight work in progress and give details of work being done. Only when the work is completed and the work permit signed off, may each worker remove his/her lock. The last lock to be removed should be that of the person supervising the lockout and this responsibility should not be delegated.

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### 3.5.2 Energy Forms and Lockout Guidelines

Table 3-3 Energy Forms, Energy Sources and General Lockout Guidelines		
Energy Form	Energy Source	Lockout Guidelines
<b>Electrical Energy</b>	<ul style="list-style-type: none"> <li>• Power transmission lines</li> <li>• Machine power cords</li> <li>• Motors</li> <li>• Solenoids</li> <li>• Capacitors (stored electrical energy)</li> </ul>	<ul style="list-style-type: none"> <li>• Turn off power at machine first (i.e., at point of operation switch), and then at the main disconnect switch for the machine.</li> <li>• Lock and tag the main disconnect switch.</li> <li>• Fully discharge all capacitive systems (e.g., cycle machine to drain power from capacitors) according to the manufacturer's instructions.</li> </ul>
<b>Hydraulic Energy</b>	<ul style="list-style-type: none"> <li>• Hydraulic systems (e.g., hydraulic presses, rams, cylinders, hammers)</li> </ul>	<ul style="list-style-type: none"> <li>• Shut off, lock (with chains, built-in lockout devices, or lockout attachments) and tag valves.</li> <li>• Bleed off and blank lines as necessary.</li> </ul>
<b>Pneumatic Energy</b>	<ul style="list-style-type: none"> <li>• Pneumatic systems (e.g., lines, pressure reservoirs, accumulators, air surge tanks, rams, cylinders)</li> </ul>	<ul style="list-style-type: none"> <li>• Shut off, lock (with chains, built-in lockout devices, or lockout attachments) and tag valves.</li> <li>• Bleed off excess air.</li> <li>• If pressure cannot be relieved, block any possible movement of machinery.</li> </ul>
<b>Kinetic Energy</b> (Energy of a moving object or materials. Moving object may be powered or coasting)	<ul style="list-style-type: none"> <li>• Blades</li> <li>• Flywheels</li> <li>• Materials in supply lines</li> </ul>	<ul style="list-style-type: none"> <li>• Stop and block machine parts (e.g. stop flywheels and ensure that they do not recycle). Review entire cycle of mechanical motion and ensure that all motions are stopped.</li> <li>• Block material from moving into area of work.</li> <li>• Blank as required.</li> </ul>
<b>Potential Energy</b> (Stored energy that an object has the potential to release due to its position)	<ul style="list-style-type: none"> <li>• Springs (e.g., in air brake cylinders)</li> <li>• Actuators</li> <li>• Counterweights</li> <li>• Raised loads</li> <li>• Top or movable part of a press or lifting device</li> </ul>	<ul style="list-style-type: none"> <li>• If possible, lower all suspended parts and loads to the lowest (rest) position.</li> <li>• Block parts that might be moved by gravity.</li> <li>• Release or block spring energy.</li> </ul>
<b>Thermal Energy</b>	<ul style="list-style-type: none"> <li>• Supply lines</li> <li>• Storage tanks and vessels</li> </ul>	<ul style="list-style-type: none"> <li>• Shut off, lock (with chains, built-in lockout devices, or lockout attachments) and tag valves.</li> <li>• Bleed off excess liquids or gases.</li> <li>• Blank lines as necessary.</li> </ul>

## 3.6 Disposal



### **WARNING**

*Mold-Masters* declines any responsibility for personal injury or personal damage arising from reuse of the individual components, if these parts are used other than for the original and proper intended purpose.

1. Hot Runner and system components must be disconnected from the power supply fully and properly before disposal (electricity, hydraulics, pneumatics and cooling).
2. Ensure that the system to be disposed of is free from fluids. In the case of hydraulic needle valve systems, drain the oil from the lines and cylinders and dispose it in an environmentally responsible manner.
3. The electrical components are to be dismantled, separating them accordingly environmental friendly and disposed as hazardous waste if necessary.
4. Remove the wiring. The electronic components are to be disposed in accordance with the national electric scrap ordinance.
5. The metal parts are to be returned for metal recycling (waste metal and scrap trade). The instructions of the corresponding waste disposal company are to be observed in this case.

Recycling of the materials occupies a forefront position during the disposal process.

### 3.7 Hot Runner Safety Hazards



#### WARNING

- The equipment supplied is subjected to high injection pressures and high temperatures.
- Ensure that extreme caution is observed in the operation and maintenance of the Hot Runner system and the injection molding machines.
- Do not operate the equipment with unconfined long hair, loose clothing or jewelry, including name badges, neckties, etc. These may get caught by the moving belt mechanism and can cause death or serious injury.
- Never disable or bypass a safety device.
- All operators should wear personal protective equipment, such as face shields, and use heat resistant gloves when working around the feed throat, purging the machine or cleaning the gates of the mold.
- Check frequently for possible oil or water leaks. Stop the machine and make repairs.
- Do not look directly into the feed throat of a hopper. Unexpected release of resin may cause serious burns. Use a mirror. Failure to do so may cause serious injury.
- Remove purgings from the machine immediately. Never directly handle plastic purgings or drool until they have completely cooled. Purgings may appear solid but may still be hot and cause serious injury.
- Some plastics develop gases that may be dangerous to personal health. Follow the plastics supplier's recommendations. Review their material safety data sheet. Ensure the molding area is well ventilated.
- Never touch or inspect the timing belt when power is on and motor and controller are connected. Unplug the controller before any maintenance.
- Always cover E-Drive belt area / molding machine drop out area / bench top with a proper protective cover before any bench test or in-mold testing.
- High voltage and amperage cables are connected to the controller (220 VAC). There is also a high voltage cable connection between the servo motor and controller.
- Always unplug the controller before performing any maintenance work.
- Hoses fitted to the mold will contain high or low temperature fluids or air under high pressure. The operator must shut down and lockout these systems as well as relieving any pressure before performing any work with these hoses.
- Never perform any work on the mold unless the hydraulic pump has been stopped.
- High voltage and amperage cables are connected to the mold. Electric power must be shut off prior to installing or removing any cables.



**WARNING**

- Water and / or hydraulics on the mold may be in close proximity to electrical connections and equipment. Water leakage may cause an electrical short circuit. Hydraulic fluid leakage may cause a fire hazard. Always keep water and / or hydraulic hoses and fittings in good condition to avoid leaks.
- Make sure the lifting eyebolt, lifting chain and crane are rated to adequately support the weight of the plate(s). Failure to do so can cause a serious injury.
- All maintenance on *Mold-Masters* products should be performed by properly trained personnel based on local law or regulation requirements.
- Ensure proper grounding of all electrical products before performing any maintenance to avoid potential risk of electrical shock.
- Make sure the machine has been locked out and tagged out in accordance to the machine's documented procedures. Failure to do so may lead to serious injury or death.
- Check that all coolant, hydraulic and air lines as well as electrical cables will not interfere with the moving parts of the mold, machine or robot. The lines must be of sufficient length so that they will not strain or pinch when the mold halves separate.
- For water cooling nozzle jacket, coolant must be maintained with the proper mixture to prevent corrosion and circuit blockage.
- Care must be taken to ensure the nozzle terminal ends do not come in contact with the hydraulic fluid. The nozzles may short out or become damaged.
- Do not mix electrical power cables with thermocouple extension cables. They are not designed to carry the power load or list accurate temperature readings in each other's application.

**CAUTION**

All *Mold-Masters* heated components are manufactured to standards that ensure safe and reliable operation provided that the following precautions are met:

- To maximize heater element and component life, the temperature must be controlled and maintained within safe operating limits. *Mold-Masters* strongly recommends individual control of each heated component, including heater plates, with a reliable temperature controller that includes soft-start protection.
- Always operate the system using correctly installed “J” type thermocouples connected to a reliable temperature controller with soft-start protection.
- Avoid running the system for long periods on manual control.
- Use caution when applying power in manual mode. Use minimum heat required for the process to avoid overheating and possible damage to components.
- Always replace pinched or damaged thermocouples.
- When grouping heated components together and controlling more than one load from a single thermocouple, make sure that the components are of similar material, wattage, size and are exposed to the same thermal conditions.
- When replacing heater plates or other heated components always replace with *Mold-Masters* components of the same type and install as originally specified on *Mold-Masters* General Assembly drawings.

# Section 4 - Preparation



## WARNING

Ensure that you have fully read “Section 3 - Safety” before unpacking, cleaning or assembling parts of the Hot Runner system.

The following section is a step-by-step guide to prepare your *Mold-Masters* system for use.

## 4.1 Tools Required

Depending on the size and complexity of your Hot Runner system, you will require most of the tools and materials listed below.

- Allen keys: Depending on system, set of metric or imperial size keys to use 4, 5, 6, 8 and 10 mm (0.16, 0.20, 0.24, 0.31 and 0.39 in.) on cap screws
- Nickel based anti-seize compound: to prevent oxidation of screw threads that could cause screws to seize with high temperatures
- Solvents (denatured alcohol): for removal of rust inhibitors
- Calibrated torque wrench: for consistent screw pressure throughout the system
- Pliers: for general assembly work
- Circlip pliers: to remove and install circlip in valve systems
- Micrometer: 0-150 mm (0-5.9 in.) to check system part and plate thickness
- Depth micrometer: to check bore depths
- Slot head screw driver: used in installing thermocouples and ground wires
- Slot head screw driver (small): used in fastening electrical wires to connectors
- Crimping tool: for fastening connector pins when necessary
- Wire strippers: for preparing wires
- Utility knife: for cutting tape, wires etc.
- Glass tape: for grouping wires into zones
- Dye spotting blue compound: for checking face contact
- Sockets
- Lapping compound for valve gate systems
- Plastic face hammer
- Proper actuator installation / extraction tools



Figure 4-1 Toolkit required

## 4.2 Screw Lengths



### WARNING

Be aware of warnings placed on the assembly drawings. When the manifold is heated the metal expands stretching the mounting screws, if screw lengths are shortened there is a possibility of shearing.

The expansion factor is calculated into the length of each screw size.



### CAUTION

The use of an incorrect size, length and grade screw could cause the screw to shear, fatigue or stretch beyond its yield point, resulting in expensive downtime of the Hot Runner.

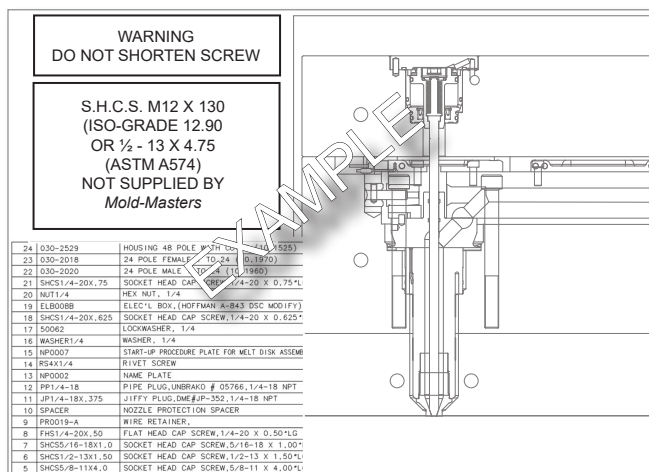


Figure 4-2 Screw length

### 4.3 Unpacking

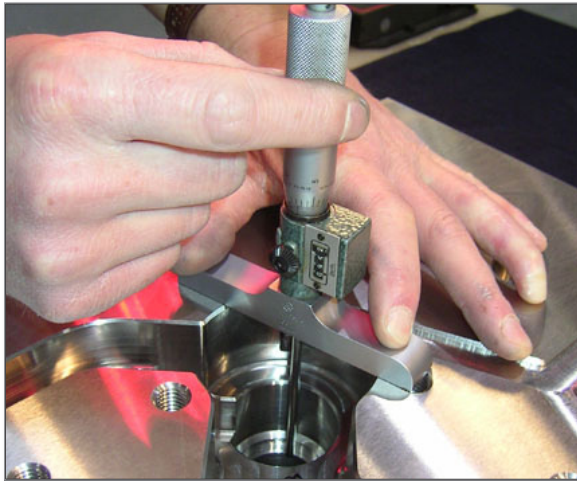


**WARNING**

Make sure the lifting eyebolt, lifting chain and crane are rated to adequately support the weight. Failure to do so can cause a serious injury.

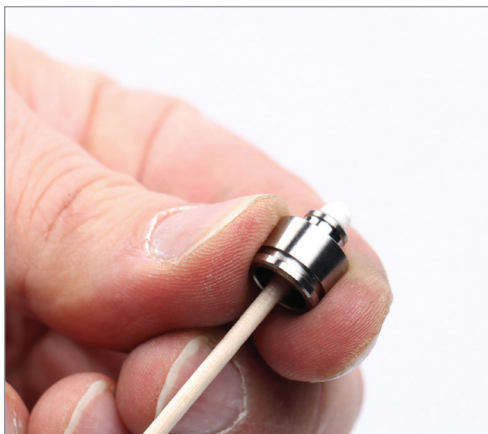
Make sure the machine has been locked out and tagged out in accordance to the machines documented procedures. Failure to do so may lead to serious injury or death.

1. Carefully remove all components from the shipping box and check that all components listed on the packing slip were supplied.
2. Check that all mold base dimensions are correct and correspond to *Mold-Masters* General Assembly drawings.



### 4.4 Cleaning

1. All nozzles, manifolds and Hot Runner components must be free of the rust inhibitor applied at the factory.
2. Disassemble the system.
3. Wipe down the nozzle body.
4. Remove the part and wipe clean.
5. If necessary, use a cotton swab to clean narrow interior surfaces or screw threads. For large surfaces such as mold plates, use thinner in spray form to clean channels and recesses.



## 4.5 Establish Your System Type

The following pages are to be used as a general guide to assist in identifying components. Refer to your General Assembly drawings for specific component lists. If your system does not match these systems, please refer to other speciality systems mentioned within the manual for additional information.

Remove the cavity plate to determine which type of Sprint system you have.

If wires are visible you have a front-mount thermocouple system.

If wires not visible you have a rear-mount thermocouple system.

### 4.5.1 System with ThinPAK-Series Nozzle

#### IMPORTANT

Figure 4-3 highlights the components within a thermal gate cast-in system.

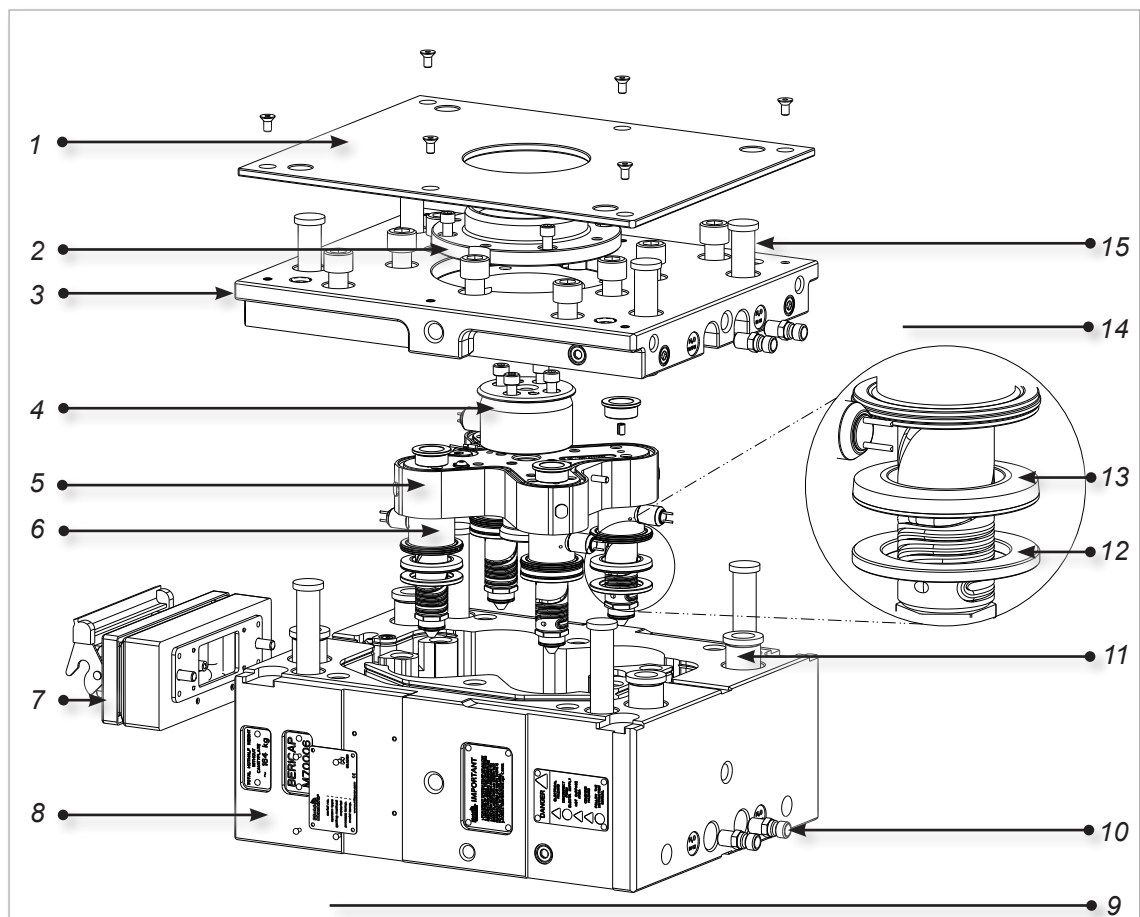


Figure 4-3 System with ThinPAK-Series nozzle and thermal gating

- |                     |                     |
|---------------------|---------------------|
| 1. Insulation board | 9. Name plate       |
| 2. Locating ring    | 10. Jiffy plugs     |
| 3. Top clamp plate  | 11. Leader bushing  |
| 4. Center heater    | 12. Hardened washer |
| 5. Manifold         | 13. Disc spring     |
| 6. Nozzle           | 14. Support pad     |
| 7. Electrical box   | 15. Leader pins     |
| 8. Manifold plate   |                     |

Figure 4-3 illustrates a pneumatic/hydraulic system with ThinPAK components.

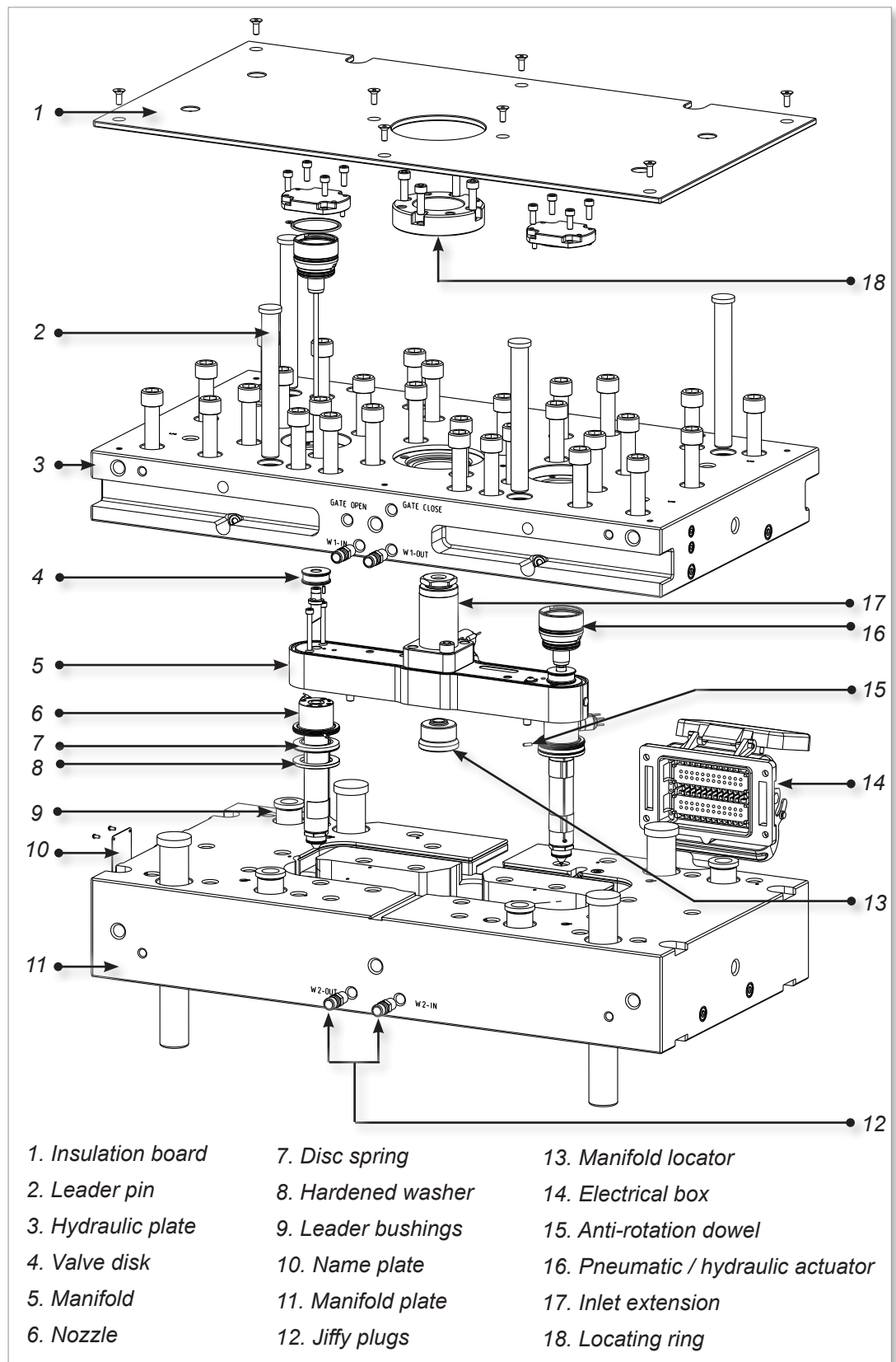


Figure 4-4 Pneumatic / hydraulic system with ThinPAK components

# Section 5 - Assembly



**WARNING**

Ensure that you have fully read “Section 3 - Safety” before assembling parts of the Hot Runner system.

This section is a step-by-step guide to assembling your *Mold-Masters* Hot Runner system.

## 5.1 Cutaway of a Sprint System

This illustration of a typical *Mold-Masters* ThinPAK cast-in system is divided into two halves: the valve side and the non-valve side. The terminology associated with the various components and features are listed below.

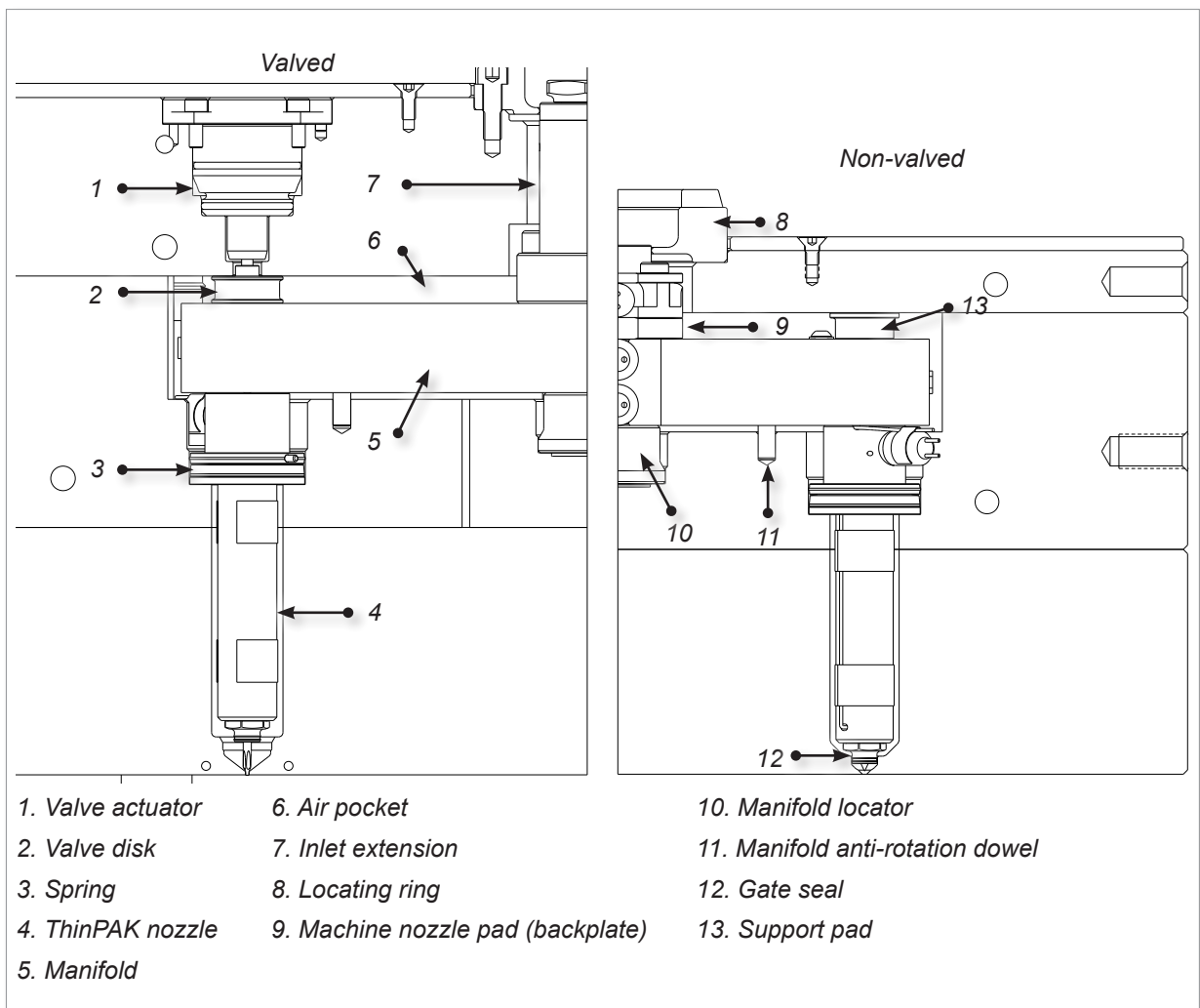


Figure 5-1 Cutaway of a ThinPAK cast-in system



## 5.2 Gate Seal Finishing

5.3 Most nozzles are supplied with the gate seal installed except when the seal requires final machining by a toolmaker, such as the hot valve or hot sprue.



### NOTE

The gate seals supplied with your system may need to be adjusted to tolerances based on the material grade and cooling in the cavity. Refer to your *Mold-Masters* General Assembly Gate Detail drawing to determine if gate seal finishing is required. Refer to the General Assembly drawing to determine which gating method applies.

## 5.4 Nozzle Insertion



### CAUTION

Systems with gate seals that are not accessible when fully assembled require the gate seals to be torqued hot prior to installation.

The mold plate needs to be in horizontal position when inserting nozzles. Care must be taken when handling the nozzles.

For liner systems, damage to the tip of a nozzle can result in gate vestige. Special care must be take with F-type, Hot Sprue and Hot Valve gating styles, where the transfer seal goes up into the part cavity. In these cases care is needed to prevent damage to the sharp edge of the gate seal and gate seal receiving bore.



### NOTE

Prior to commencing assembly verify manifold and nozzle cutouts in mold plates are to specification to ensure proper clearance to Hot Runner. Improper clearance will affect system performance.

### 5.4.1 Nozzle Insertion

Refer to Figure 5-2 for visual identification of the components.

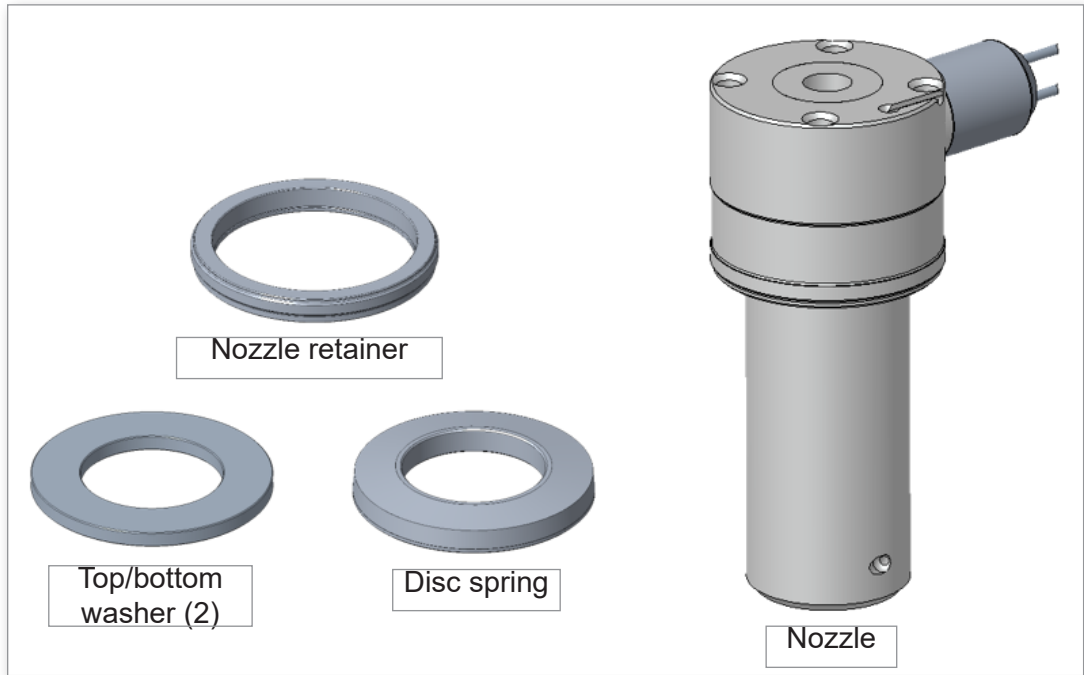
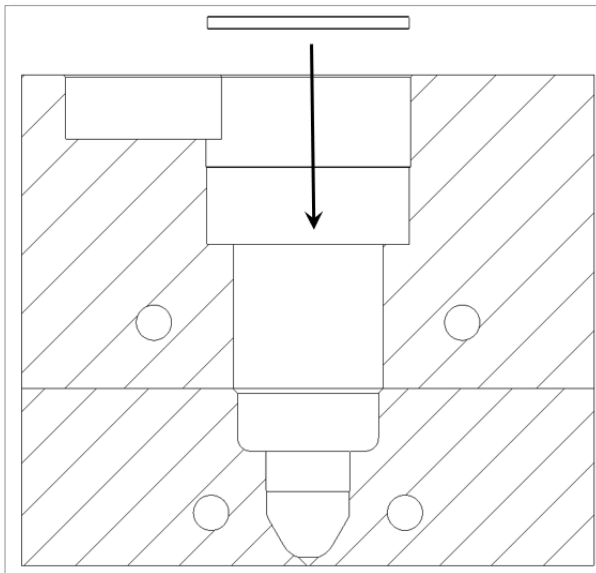


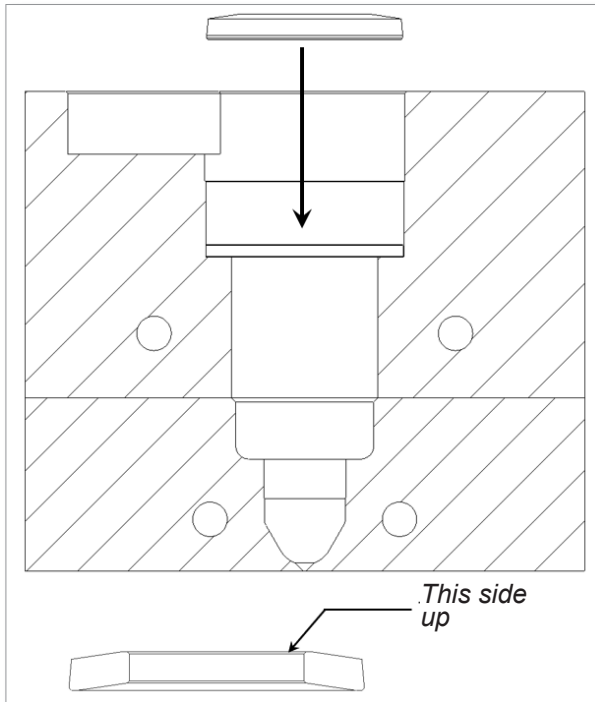
Figure 5-2 Sprint nozzle and components

1. Clean the seating bore of the nozzle well.
2. Install the bottom washer.

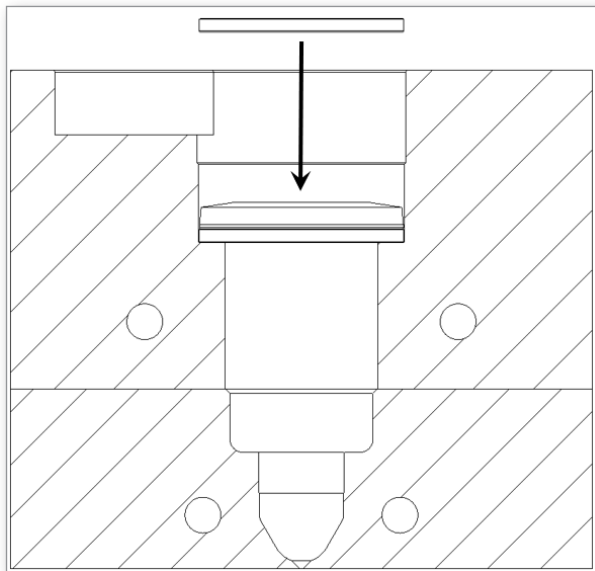


3. Apply high temperature grease to the disc spring.

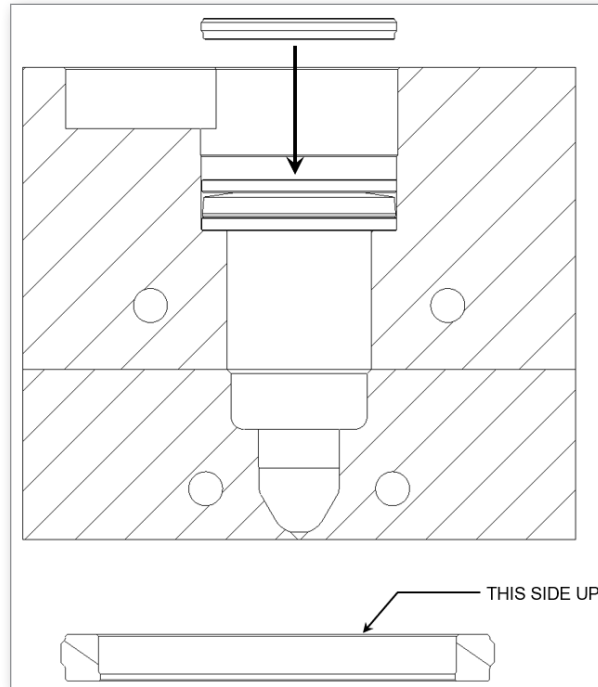
4. Install the disc spring in the correct orientation.



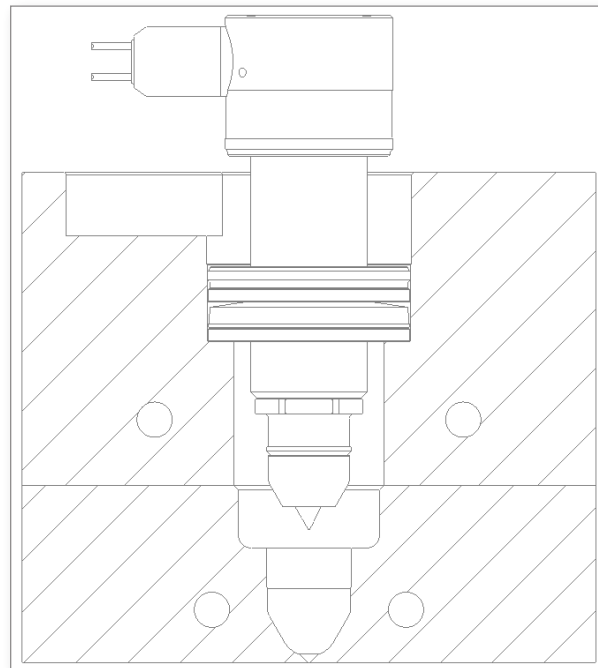
5. Install the top washer.



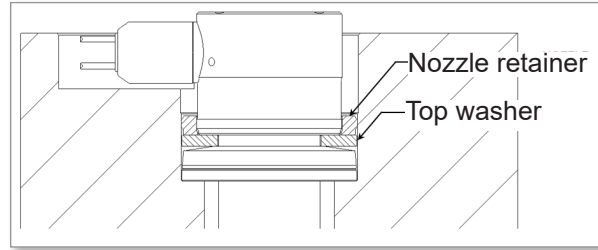
6. Install the nozzle retainer in the correct orientation. Note the protruding lip on the ID and bottom of the retainer ring.



7. Install the nozzle.



8. Make sure that the nozzle sits squarely in the nozzle well bore and flat against the top washer.



## 5.5 Nozzle Wire Layout

### 5.5.1 Front Mounted Thermocouples

1. Place a zone number on each wire and thermocouple.
2. Try to organize and tape wires by zone and plug.
3. Install the wires into the wire channels and secure with wire retainers.
4. Feed the wires back through the wire channel in the mold base to the mold plug. Do not cut the wires too short. Leave sufficient wire for future maintenance and ease of access.

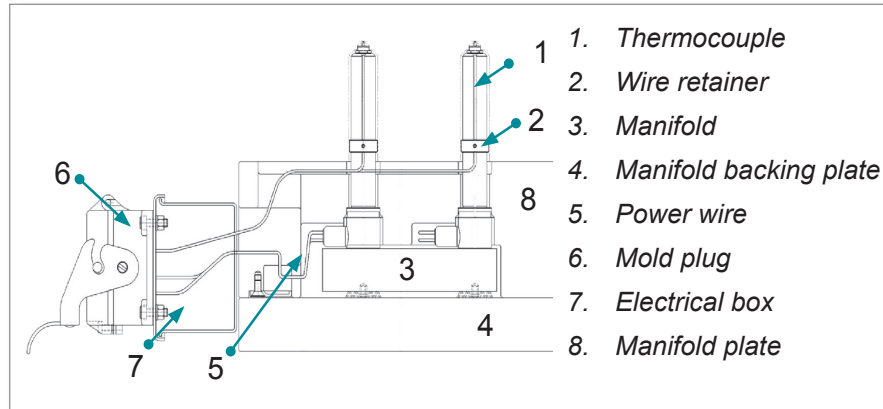


Figure 5-3 Thermocouple layout - side view

## 5.6 Emergency Heater Sleeve

### 5.6.1 Installation of Emergency Heater Sleeve

The emergency heater sleeve is intended for use as a temporary substitute heat source if the brazed-in heater element of a Sprint nozzle fails. The emergency heater sleeve is designed so that it can be installed over the nozzle (and uninstalled) while the mold is still in the press.



**NOTE**

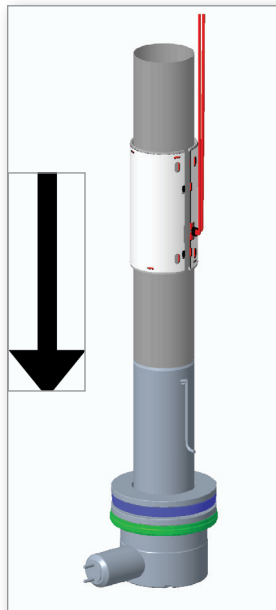
The use of the sleeve requires a different cutout and a revised nozzle design (-B or -C) than was implemented from November 2019 onward. The cutout needs to be requested when ordering so that it can be machined into the hot half during manufacturing.

The sleeve is shipped installed over an assembly tube. This sleeve and tube assembly are shown in Figure 5-5. Figure 5-4 shows the various emergency heater sleeve lengths available. The heater element exit is always located 19 mm from the end closest to the nozzle flange. The following assembly instructions apply whether sleeve installation is done with the tool in the press or on the bench.



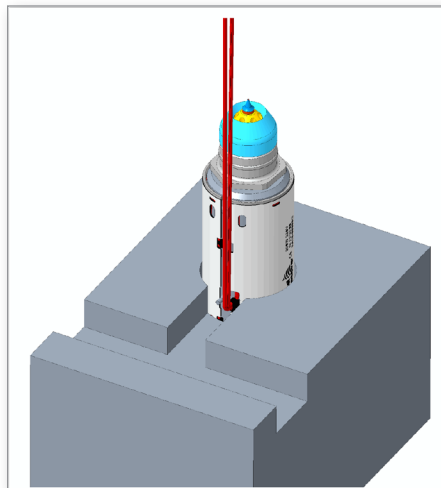
Figure 5-4 Emergency heater sleeves

1. Align the assembly tube with the end of the nozzle, and slide the emergency heater sleeve over the nozzle body. Make sure that the heater element is pointing away from the nozzle.



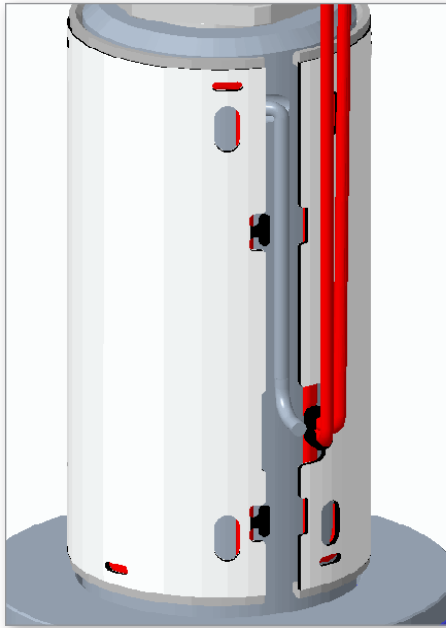
*Figure 5-5 Installed heater sleeve and tube assembly*

2. Make sure that the nozzle is positioned within its cutout so that the heater element exit is aligned with the cutout in the plate.

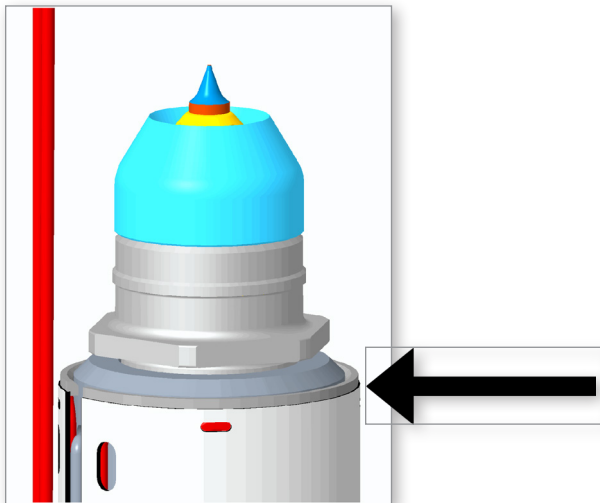




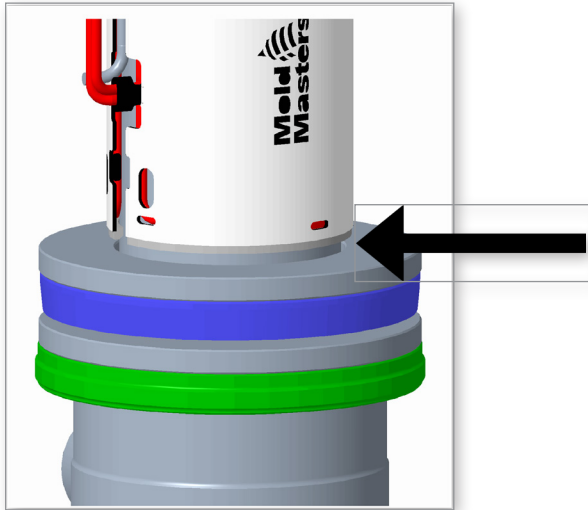
3. Make sure that the nozzle thermocouple travels through the gap in the heater sleeve. You may have to disassemble and re-assemble the nozzle.



4. Make sure that the emergency heater is aligned with the end of the chamfer on the nozzle body.



5. Make sure that the emergency heater sleeve does not contact the bottom washer.



6. Bend and route the heater element wires alongside the thermocouple wires through the front-mounted wire channels. See section 5.5.1.

### 5.6.2 Removal of Emergency Heater Sleeve

Equipment that can be used to do this procedure: snap ring pliers.

1. Open the emergency heater sleeve.
2. Use the slots on the emergency heater sleeve to pull the emergency heater sleeve off the nozzle. See Figure 5-6.

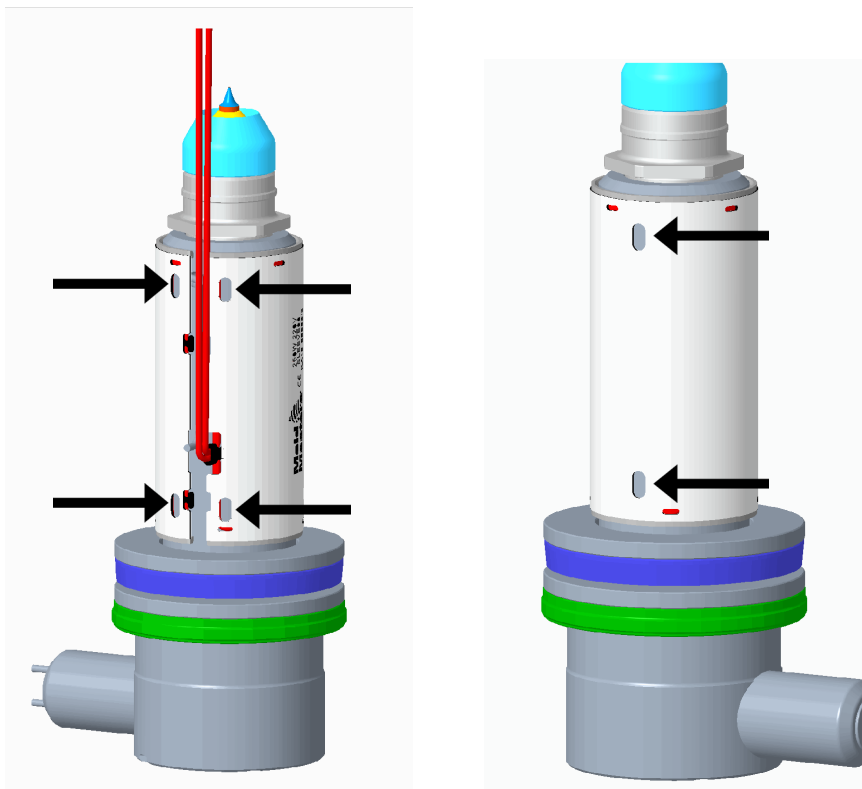


Figure 5-6 Slots on the emergency heater sleeve

## 5.7 Mount the Manifold

### Introduction

There are three methods used to locate the manifold:

1. Manifold locator
2. Manifold locating dowel pin
3. Manifold and slot locator

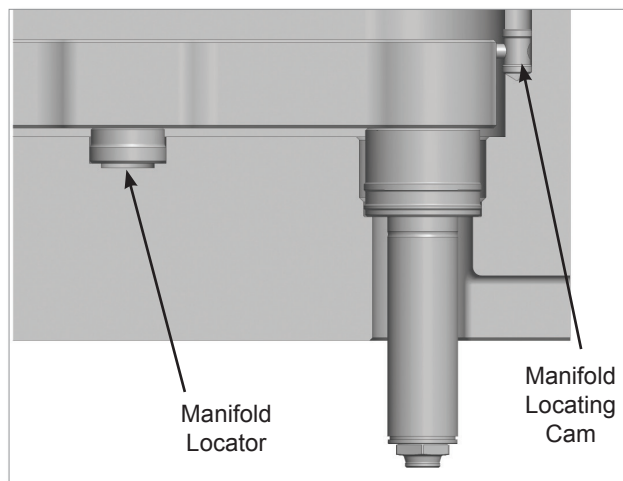


Figure 5-7 Manifold with a locator

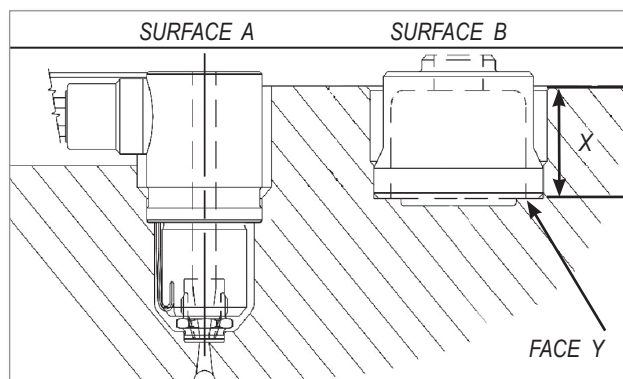


Figure 5-8 Locator surface

### 5.7.1 Manifold Locator

**WARNING**

Make sure the lifting eyebolt, chain and crane can support the weight of the manifold. Failure to do so may cause serious injury.

Depending on your system, the manifold locator may require final grinding.

**NOTE**

Refer to the General Assembly drawing for details of your particular system.

**Final Grinding Required**

For some systems, manifold locators are supplied oversize (X) and must be ground to the same level as the top of the nozzles. In this case remove the material from the bottom face of the locator (FACE Y). This will allow SURFACE (A) and SURFACE (B) to be at the same level in the cold condition, or as specified on the General Assembly drawing.

**Final Grinding Not Required**

In other systems the manifold locator does not require grinding and the height is determined by the cutout depth. In this case SURFACE (A) and SURFACE (B) will be at the same level in the hot condition.

1. Apply die spotting blue compound to the manifold locator into the bore to ensure proper seating.
2. Install the manifold locating cam onto its dowel pin.
3. If required, attach a crane of sufficient lifting capacity to the manifold.
4. Check for correct seating and height.
5. Check that there are no pinched wires.

### 5.7.2 Manifold Locating Dowel Pin

1. Install the dowel pin into the mold.
2. Check that the manifold locating dowel pin does not touch the top of the manifold.
3. Install the manifold locating cam onto its dowel pin.
4. Place manifold on top of nozzles and locating dowel.

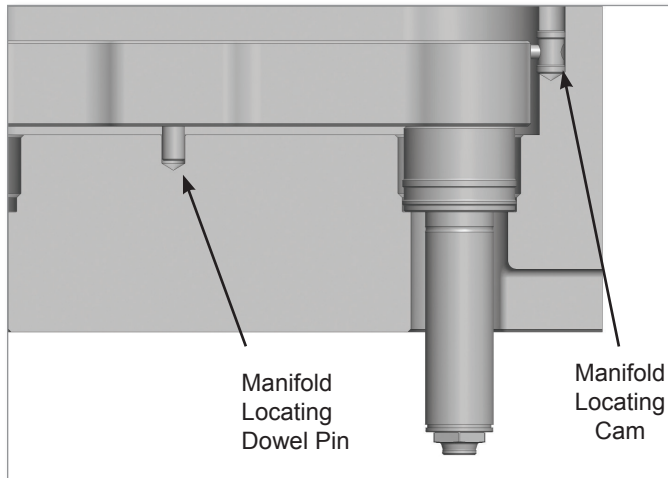


Figure 5-9 Manifold Locating with a dowel pin

5. Check for correct seating and height.
6. Check that there are no pinched wires.

### 5.7.3 Manifold and Slot Locator

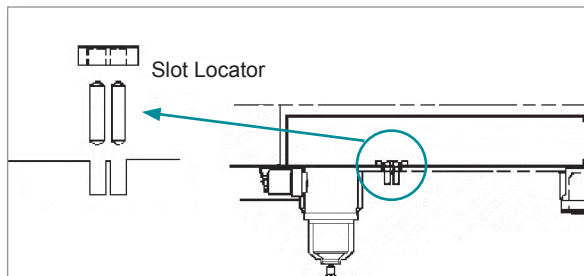
1. Apply die spotting blue compound to the manifold locator into the bore to ensure proper seating.
2. Install the slot locator into the mold.



#### **IMPORTANT**

Ensure sufficient gap between the slot locator and the manifold slot top surface. Under no circumstances should they touch.

3. If required, attach a crane of sufficient lifting capacity to the manifold. Place the manifold on top of the nozzles and manifold locator.



4. Check for correct seating and height.
5. Check that there are no pinched wires.

## 5.8 Manifold Thermocouple Installation

This procedure only applies to integrated systems.

1. Although not necessary, a thermal compound may be applied to the thermocouple tip to ensure a good contact.
2. Clean the thermocouple bore. Suggestion for 1.5 mm (0.06 in.) thermocouples is to use a 1/16 inch drill in a pin vise.
3. Insert the thermocouple into the bore. Check that the thermocouple is touching the bottom of the hole.
4. Press down on the thermocouple and gently bend the thermocouple sheath through 90°.
5. Check that the thermocouple sits in the manifold cutout.
6. Install the thermocouple washer and screw.
7. Install a zone number on each wire and thermocouple.
8. Tape wires for each zone together.
9. Install the wires into wire channels and secure with wire retainers.
10. Feed the wires back through the wire channel in the mold base to the electrical box.

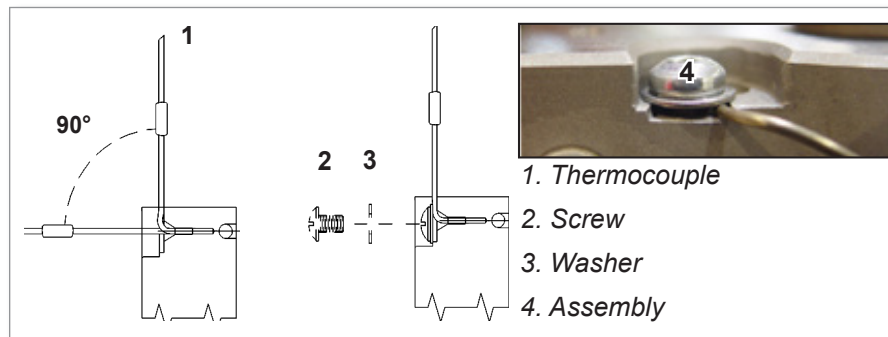


Figure 5-10 Thermocouple installation

## 5.9 Main Manifolds

Manifolds distribute melt from the inlet component to one or more submanifolds. If you have a submanifold configuration, follow these instructions. This system will have one of two configurations for inlet seals.

Refer to the General Assembly drawing to determine which applies.

- Inlet seal without step
- Inlet seal with step

### 5.9.1 Inlet Seal Installation - Without Step

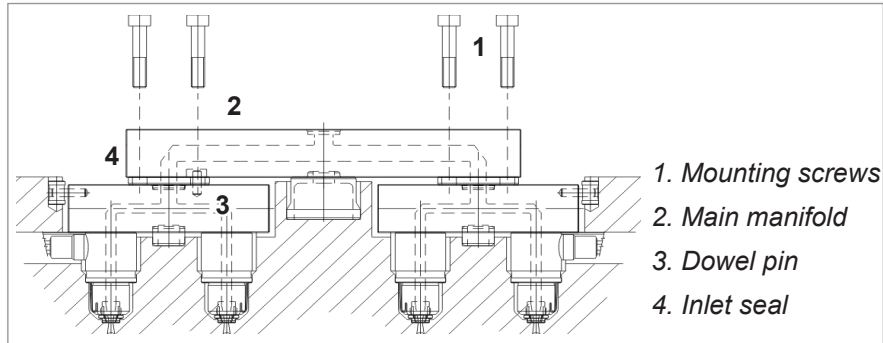


Figure 5-11 Install main manifold

Manifolds that use a seal without a step:

1. Place the inlet seal into all submanifold inlets.
2. Check that the inlet seal orientation is chamfer down.
3. Check that all inlet seal heights are at the same level.
4. Install the manifold locators. Refer to “Mounting the Manifold”.
5. Check that all components are free of debris.

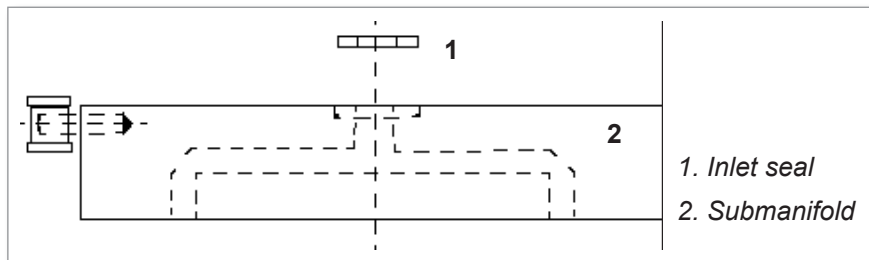


Figure 5-12 Inlet seal without step

### 5.9.2 Inlet Seal Installation - With Step

Manifolds that use inlet seals with a step:

1. Install the step inlet seal to the manifold.
2. Install the dowel pin into the seal and manifold.
3. Lower the main manifold into position.
4. Install manifold mounting screws and torque to required settings.  
Refer to your General Assembly drawing for specifications.
5. Install the manifold thermocouples. Refer to “5.8 Manifold Thermocouple Installation”.



**NOTE**

On bridge manifold systems, mounting screws should be torqued 1/3 higher than specified on General Assembly drawings.

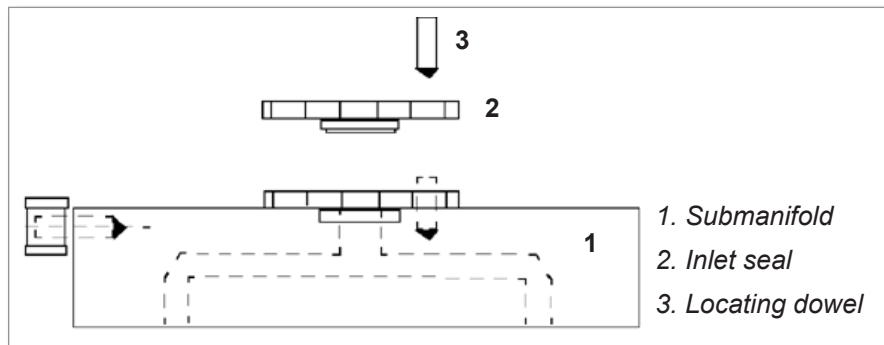


Figure 5-13 Inlet seal with step





## 5.10 Pressure Disk Installation

### NOTE

Pressure disks are not used within ThinPAK-Series systems. Please see “Support Bushing Installation” on page 5-20.

Review your parts list and General Assembly drawing to determine the feature installed in your system.

- **Pressure Disk** - is compressed by thermal expansive forces to form part of the plastic sealing mechanism. This also helps to reduce thermal transfer to a minimum. These may or may not require grinding.

For additional information please refer to “4.5 Establish Your System Type”.

### 5.10.1 Pressure Disk: Final Grinding Not Required

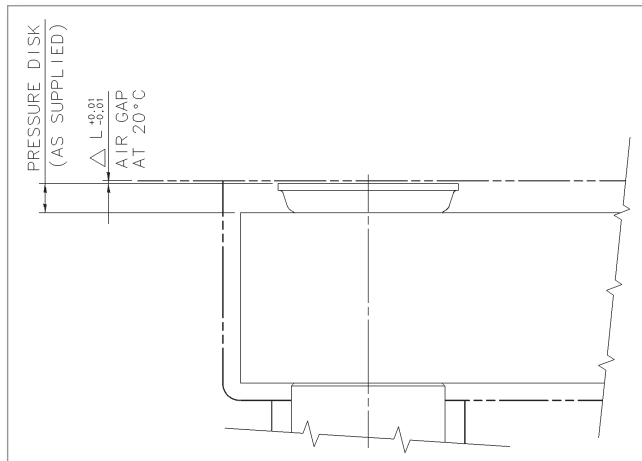


Figure 5-14 Optional pressure disk mounting detail

Alternate Method - Air gap adjustment from top clamp or hydraulic plate.

1. Calculate and machine the nozzle bore seat with additional air gap value. (Example: Flange height + Manifold height + Pressure disk height + Air gap value)
2. Install the nozzle into the manifold plate.
3. Install the manifold to the nozzle.
4. Refer to the General Assembly drawing for pressure disk locations.
5. Measure the gap between the top of the manifold plate and the top of the pressure disk. Ensure that it matches the air gap value on the General Assembly drawing.

### 5.10.2 EcoDisk Installation

EcoDisks are present on all Sprint systems and optional on others. They are installed directly onto the clamp plate and will align with the pressure disks when assembled.

1. Lay the clamp plate on a work bench with the bottom face up.
2. Locate the EcoDisk on the clamp plate as indicated on the General Assembly drawing. Ensure the ceramic disk is facing upwards and will contact the pressure disk when assembled.
3. Secure the EcoDisk with an M5 flat head screw uniformly, following the plate assembly specification.
4. Repeat for all EcoDisks.

There is no change to pressure disk assembly when using the EcoDisk.

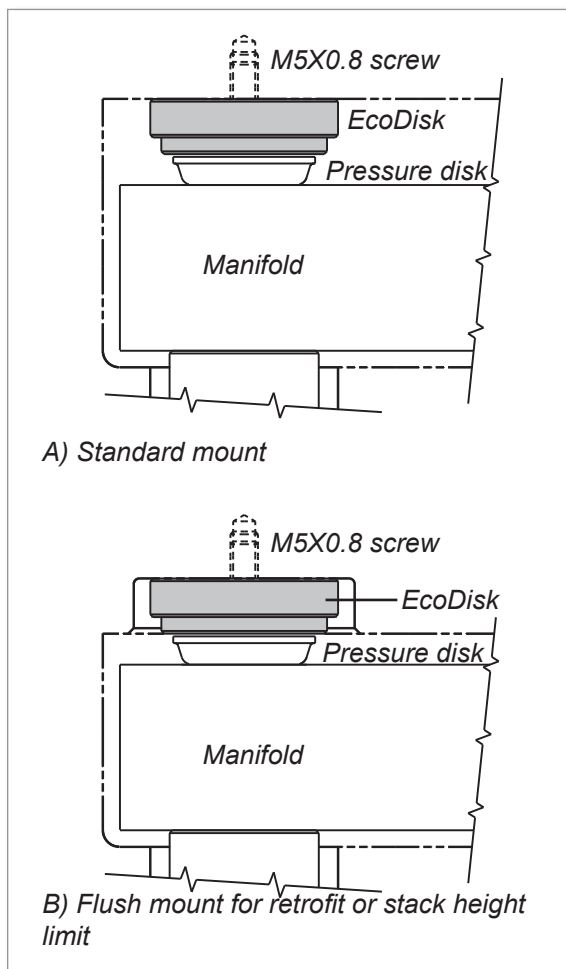


Figure 5-15 EcoDisk mounting configurations

## 5.11 Support Bushing Installation



### WARNING

Make sure the lifting eyebolt, chain and crane can support the weight of the manifold. Failure to do so may cause serious injury.

Support bushings are used for non-valved systems.

See Figure 5-16.

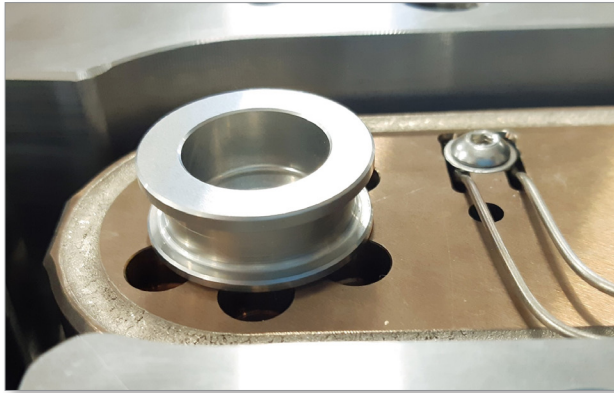


Figure 5-16 Support bushing



### IMPORTANT

Support bushings are supplied to final dimensions. No final grinding is required. Refer to the General Assembly drawing for more information.

1. Install the manifold into the plate and ensure that it sits on the nozzles.
2. Use the General Assembly drawings to locate the positions for the support bushings.
3. Use a dowel pin to install all of the support bushings into the manifold. See Figure 5-17.

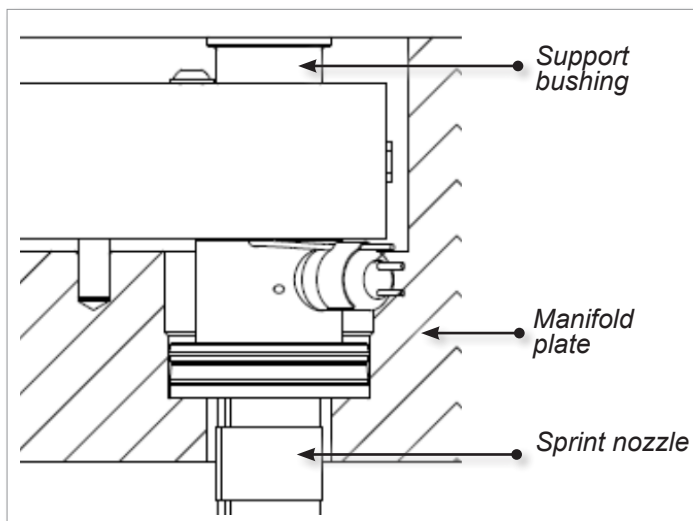


Figure 5-17 Location of support bushing

## 5.12 Inlet Components Installation



### CAUTION

For all inlet components it is important that the mold locating ring is touching the inlet component just enough for sealing the area. This should be double checked with the system drawings.

The following procedures refer to different system configurations. Refer to your parts list and General Assembly drawings to determine your system type.

### 5.12.1 Back Plate Installation

1. Check the machine nozzle radius.
2. Check the seating on the bottom face of the back plate and manifold.
3. Install the back plate onto the manifold.
4. Install M8 mounting screws through the back plate to the manifold using anti-seize compound on threads.
5. Torque screws to value indicated on the General Assembly drawing in a cross pattern, in 7 Nm (5 lbf-ft) increments.



### NOTE

The machine nozzle bore should be no less than 1.0 mm (0.040 in.) smaller than the back plate bore and no larger than the back plate bore.

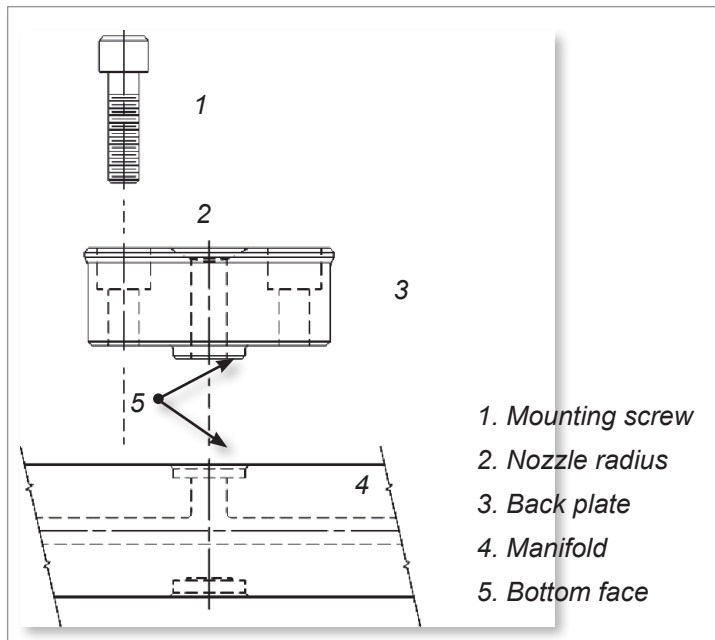


Figure 5-18 Back plate installation

### 5.12.2 Center Heater Installation

The center heater may require the machine nozzle radius to be added.

1. Place the center heater on the manifold.
2. Rotate the center heater to align with the tapped holes in the manifold and align terminals with cut out.
3. Install mounting screws through the center heater into the tapped holes of the manifold. Use anti-seize compound on the screws.
4. Torque screws to values indicated on the General Assembly drawing.
5. Place zone number on each wire and thermocouple.
6. Tape wires for each zone together.
7. Install the wires into the wire channels and secure with wire retainers.
8. Feed wires back through the wire channel in the mold base to the electrical box.

### 5.12.3 Three-Piece Center-Heater Installation

1. Install the back plate on the manifold.
2. Mount the center heater on back plate.
3. Although not necessary, a thermal compound may be applied to the thermocouple tip to ensure a good contact.
4. Install the thermocouple.
5. Install the cover plate.
6. Install M8 mounting screws through the cover plate into the tapped holes of the manifold. Use anti-seize compound on screws.
7. Torque screws to values indicated on the General Assembly drawing.

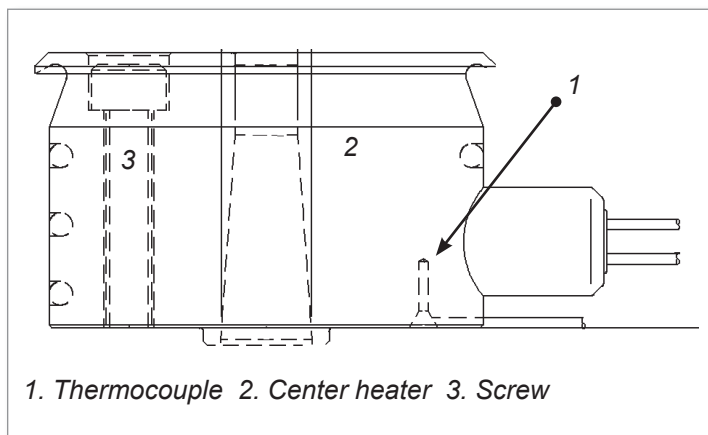


Figure 5-19 Center heater assembly

### 5.13 Thermocouple Installation

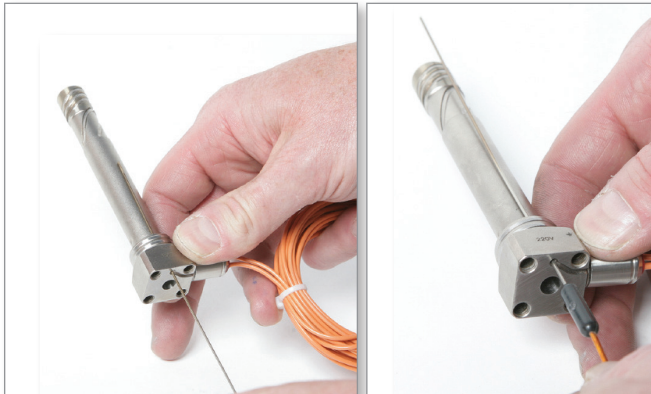
This section is applicable to some older Sprint systems. You may have a system with front mounted thermocouples. Please see “4.5 Establish Your System Type” on page 4-4 to determine your system type.

1. Clean the nozzle thermocouple bore.
  - For 1 mm (0.04 in.) thermocouples use a #58 drill in a pin vise.
  - For 1.5 mm (0.06 in.) thermocouples use a 1/16 inch drill in a pin vise.

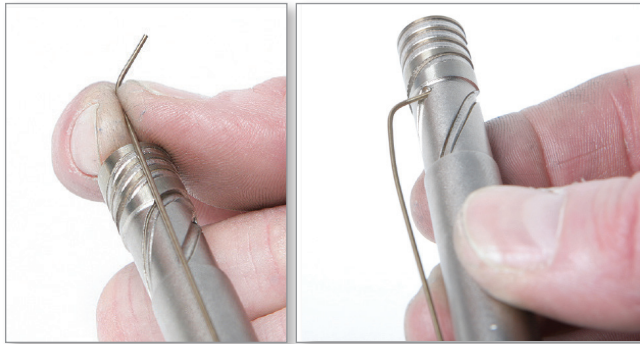
**NOTE**

For front-mounted thermocouples, skip step 2 and go to step 3.

2. Insert the thermocouple through the flange bore.



3. Manually bend the thermocouple tip against your thumb to approximately a 90° angle, ensuring bend length sufficient to reach the bottom of the thermocouple bore.

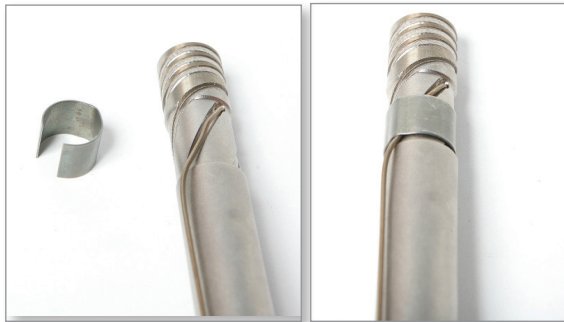


4. Dress thermocouple carefully alongside nozzle body and install retaining clip(s). Check parts list for recommended number of clips for the nozzle type. Check that the thermocouple fits into the recess of the clip.



**IMPORTANT**

It is important that one retainer clip is at the top of the nozzle to keep the thermocouple inside the bore. This is especially important when thermocouples are assembled from the front.



5. Install the terminal end retaining clip. Make sure that the thermocouple fits into the recess of the clip.



**IMPORTANT**

Make sure that the terminal end of the thermocouple stays fully engaged in the slot.

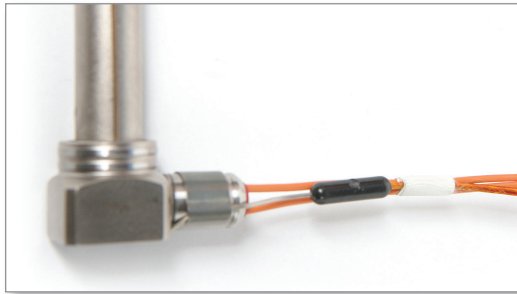
6. Bend the thermocouple at the nozzle flange area.



7. Install the clip over the terminal end.



8. Use heat resistant tape to secure the nozzle wires and thermocouple wires just above or below the insulator pod.



## 5.14 Thermocouple Removal For Non-Front Mounted Thermocouples



### CAUTION

Removing thermocouples will damage them and is not recommended unless replacing a damaged thermocouple with a replacement one.

1. Remove the thermocouple from the electrical box and wire channels.
2. Remove the nozzle from the manifold plate.
3. Remove the thermocouple retaining clips.
4. Remove the thermocouple.



# Section 6 - Electrical Testing



## WARNING

Ensure that you have fully read “Section 3 - Safety” before beginning electrical testing.

This section contains guidelines for electrical testing of your *Mold-Masters* Hot Runner system. The testing is based on the following European and North American standards:

- EN 60204-1 / DIN EN 60204-1 (IEC 60204-1, modified) Safety of machinery - electrical equipment of machines
- NFPA 79 Electrical Standard for Industrial Machinery

The standards themselves are the final authority for testing requirements (also any additional testing requirements from any national standards where the Hot Runner is in use).

## 6.1 Safety



### WARNING

The user is responsible to ensure protection against shock by indirect contact, by protective earth conductors and automatic disconnection of supply. *Mold-Masters* components and systems are either equipped with a protective earth conductor or there is a connector for this purpose.

Before you carry out electrical work, make sure that the Hot Runner system is securely grounded. Turn the temperature control off and disconnect all electric wires coming from the mold. Failure to follow any of these steps may lead to serious injury or death.

Ensure that all wiring and connection work is performed by a qualified electrician according to DIN EN 60204-1 / NFPA79.

If performing work on a disassembled nozzle, it should only be connected to an electrical supply when the nozzle has been grounded or a safety isolating transformer is used.

Contact with a disassembled, heated, nozzle would cause serious burns. Use a sign in a visible location indicating “Danger: Do Not Touch”. Wear protective heat-resistant gloves and a full face shield over safety glasses.

## 6.2 Electrical Wiring Check



### WARNING

The electricity mains should only be connected to the injection mold when all electrical connections are grounded and the mold is closed.

1. Check that each wire and thermocouple has a zone number.
2. Check that wires are organized and taped together by zone and plug.
3. Check all wires are secured in wire channels.
4. Connect all power leads and thermocouple wires to mold plugs.

## 6.3 Electrical Safety Testing

Electrical safety tests shall be performed according to DIN EN 60204-1, paragraph 18, and NFPA79. Testing guidelines are given below, however, the standards identified earlier in the introduction are the final authority.

### 6.3.1 Verify Equipment to its Technical Documentation

First, verify that the electrical equipment complies with its technical documentation.

### 6.3.2 Insulation Resistance Test

Measure the insulation resistance between each pin of the *Mold-Masters* power connector, in particular the heating circuit and ground.

The insulation resistance is measured at 500 V<sub>DC</sub>. The insulation resistance must not be less than 1 MΩ.

If this value is not reached when heating, the cause is often moisture inside the heating element, which should be removed using a control unit equipped with this function.

Where a mold has not been in use for several weeks or months, it should be retested.

### 6.3.3 Verification of Conditions for Protection by Automatic Disconnection of Supply



#### WARNING

The user is responsible to take protective measures against shock by indirect contact, while performing the tests.

The conditions for automatic shutdown of the supply is set at *Mold-Masters* and is usually set such that the protective conductor resistance between the grounding conductor connection and all of the protective earth conductor connected parts, is Maximum 0.3  $\Omega$ .

In TN systems the following two checks must be made:

### 6.3.4 Verification of Continuity of Protective Bonding Circuit

Verifies the continuity of the protective bonding circuit. The purpose of this test is to check whether all relevant touchable conductive parts are properly grounded. See the relevant requirements of the standard DIN EN 60204-1 / NPFPA79.

The protective conductor resistance is measured with a special instrument with a current between at least 0.2 A and approximately 10 A derived from an electrically separated supply source (for example SELV, see 413.1 of IEC 60364-4-41) having a maximum no-load voltage of 24 V AC or DC. The resistance must be within the expected range.

### 6.3.5 Verification of Fault Loop Impedance

Fault loop impedance verification and suitability of the associated overcurrent protective device.

The power supply connections and incoming external grounding connections to the Hot Runner system must be verified by inspection (usually through a temperature control device).

The conditions for protection by automatic disconnection of supply must be checked by both:

- Checking the impedance of the fault loop by calculation or measurement.
- Confirming that the setting and characteristics of the associated overcurrent protective device are in accordance with the requirements of the standard.

For more information, see the text of the EN 60204-1/ NFPA79 standards must be verified by inspection.

### 6.3.6 Thermocouple Continuity Test

1. Measure the resistance between each pair of thermocouple wires on the mold's thermocouple connector. See Figure 6-1.



**NOTE**

The resistance should be between 2.5 Ω and 25 Ω.

2. To verify alignment of thermocouple in the heating element, turn on one zone after the other and check that the temperature responds accordingly if the set temperature is adjusted.

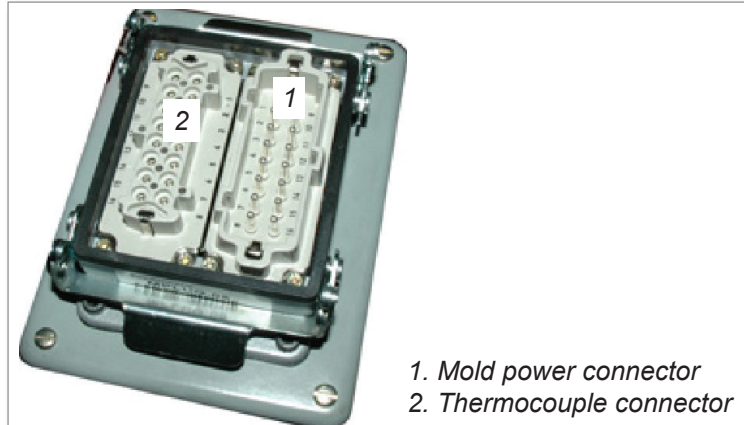


Figure 6-1 Mold plug

**6.3.7 Pinch Point Test**

1. If there is a suspected pinch point on the thermocouple, remove the thermocouple from the Hot Runner.
2. Connect a temperature control device to read the temperature.
3. Immerse the sheath of the thermocouple in boiling water to the point where the thermocouple reads the temperature.

A good thermocouple will show a temperature rise as soon as the tip of the thermocouple is immersed in water.

If there is a pinch point in the thermocouple there will be no change in the reading until the pinch point on the thermocouple is immersed in water.

**6.3.8 Heating Element Check**

Measure the resistance between each pair of heater power wires at the mold power connector.

Compare your reading with your General Assembly drawing.

Where:

$$R = \frac{V^2}{P}$$

**R** = resistance   **V** = voltage   **P** = power

### 6.3.9 Ungrounded Thermocouple Continuity Test

With an ungrounded thermocouple, there is no circuit or Ohms reading to ground, unless the thermocouple is damaged or pinched. This allows for an Ohms resistance (non-voltage) check prior to and after installation. To do this test, do these steps:

1. Set up a multimeter to read Ohms resistance.
2. Connect one lead to the red thermocouple wire.
3. Connect the other lead to the mold plate that the hot runner system is installed in.
4. If you see an Ohms resistance, replace the thermocouple (faulty thermocouple).
5. Repeat steps 2–4 for the white thermocouple wire.

Do this test on all thermocouples.

### 6.4 Thermocouple Wiring Guidelines

#### CAUTION

Exceeding controller zone amperage will cause controller fuses to blow.

- Thermocouples are Type “J” ungrounded and color coded to ASA standards. (White “+”/Red “-”).
- The tip must not be truncated or squeezed and must touch the bottom of the bore in order to measure the correct temperature.
- Each heat source should have its own closed loop temperature control in order to achieve accurate control.
- If there are not enough control zones, heat sources that have the same wattage and affect the same environment, may be grouped together.

### 6.5 Functional Test with a Temperature Controller

#### CAUTION

Never start the heating with more than 40% of power.

The functions of the electrical equipment must be checked. This test is carried out with an appropriate temperature control device.

- Monitor the initial heating of the system to minimize risk.
- Stay a minimum of 5 minutes at 100°C (212°F) before increasing heat.

### 6.6 Re-testing

Where a portion of the electrical equipment is changed or modified, that portion must be reverified and retested, as appropriate.





# Section 7 - Hot Half Assembly



**WARNING**

Ensure you have fully read “Section 3 - Safety” before assembling the Hot Half.

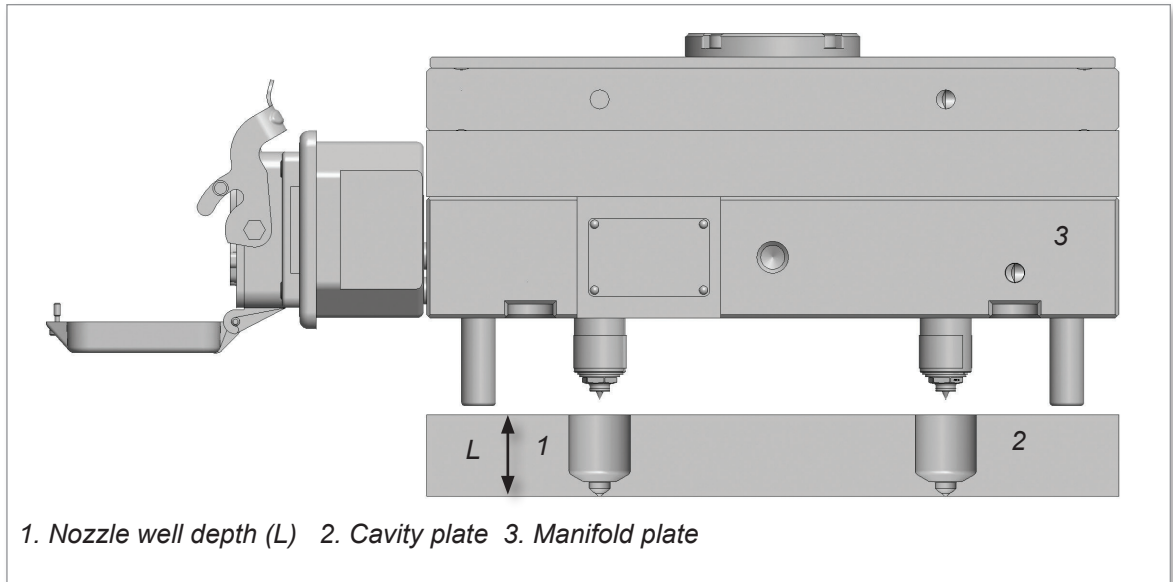


Figure 7-1 Nozzle depth

## 7.1 Hot Half Assembly



**WARNING**

Ensure the lifting eyebolt, lifting chain and crane are rated to support the weight of the plate.

When required, lockout and tagout the machine according to the documented procedures. Failure to do so may result in serious injury or death.



**CAUTION**

Install the cavity plate before nozzle temperatures become more than 55°C (130°F) hotter than the cavity plate. Otherwise the nozzles will have expanded too much and may be damaged during insertion.

Check that the nozzle well depth (L) in the cavity plate is to *Mold-Masters* specifications. See Figure 7-1.

1. Attach a crane that is rated to support the weight of the cavity plate.
2. Check that all wires are in the retainer grooves.
3. Be careful to not damage the gates seals when installing the cavity plate to the manifold plate.
4. Leave the Hot Half in a horizontal position.

5. Ensure the cavity plate is clean and undamaged before assembly.
6. Heat the manifolds to 180°C (365°F).

**IMPORTANT**

Heating the manifolds expands the system slightly to eliminate the cold clearance and ensures the nozzles are perpendicular to the manifold.

Do not install the cavity plate on a cold manifold.

7. When the manifolds reach 180°C (365°F), install the cavity plate on the manifold plate. If the plate does not assemble easily, remove the cavity plate and check for interference. Be careful to not damage the gate seals.
8. Install the mounting screws and torque to the required specifications. See the “Table 10-4 Torque Chart for Plate Assembly Screws” on page 10-16.
9. Attach a crane that is rated to support the weight of the mold (Cold Half).
10. Lock out and tag out the machine according to the documented procedures.
11. Latch the Hot Half to the Cold Half.
12. Install the mold into the molding machine. Refer to the machine manufacturer’s documentation for procedures.
13. Torque the mold mounting screws to required specifications. Refer to machine manufacturer’s documentation for torque values.
14. Connect wire lines, hydraulic, pneumatic and electrical components, as required.
15. Remove latches.



# Section 8 - System Startup and Shutdown



## WARNING

Ensure that you have fully read “Section 3 - Safety” before starting up or shutting down the Hot Runner.

## 8.1 Pre-Startup



## WARNING

Take appropriate safety precautions by assuming the system is pressurized and hot at all times.



## CAUTION

Water must be turned on for Hot Runner actuation before turning on temperature controls.

When running thermally sensitive materials, use a thermally stable material as recommended by the material supplier for the initial startup.

Do not exceed 100°C above the Mold-Masters-defined process temperature detailed on the system GA/mold tag.

1. Install the mold into the molding machine.



## NOTE

Ensure that the machine nozzle opening is the same size, or is **not more** than 1.0 mm (0.040 in.) smaller, than the back plate bore.

2. Connect all water lines and test to ensure there are no leaks and that the required flow is achieved in all water circuits.
3. Connect all electrical components and monitor to ensure that all zones are receiving heat and all thermocouples are reacting appropriately.

## 8.2 Startup



### WARNING

When the mold is open never inject material through Hot Runner system under high pressure. Failure to do so can result in serious injury or death.



### CAUTION

Failure to follow this procedure may result in leakage / damage occurring in the Hot Runner.



### IMPORTANT

When running thermally sensitive materials, use a thermally stable material as recommended by the material supplier for the initial startup.

1. Turn on the machine barrel and mold cooling system.
2. Prior to start up, ensure the:
  - a) Machine barrel is up to processing temperature.
  - b) Mold cooling is on and at cooling temperature.
3. Heat up all Hot Runner manifolds and / or bridges and inlets (excluding the nozzles) to processing temperature.
4. Begin nozzle heating when the manifolds and / or bridges have come within 50°C of processing temperature.



### IMPORTANT

Wait until ALL heating zones have reached processing temperature for 5 minutes before continuing.

For Hot Runner systems using heater plates, allow 10 minutes of soak time after the system reaches processing temperature.

5. Startup the system.
  - a) For empty systems or where there is no material in the gate detail, extrude material through the Hot Runner system using 34.4 bar (500 PSI) of back pressure. The purpose is to fill the Visco-Seal at low pressure. This prevents any possibility of leakage past the nozzle seal.
  - b) For systems filled with material, purge intended shot size twice from the barrel prior to bringing the machine barrel forward to the Hot Runner interface.
6. Set injection time and pressure according to part size, gate size and material.

## 8.3 Shutdown



### CAUTION

Failure to follow this procedure may result in leakage / damage occurring in the Hot Runner.



### IMPORTANT

Thermally sensitive materials should be purged from the Hot Runner system prior to shutdown using a thermally stable material with a similar processing temperature.

1. Turn off all heat to the system.
2. Leave the mold cooling system turned on until the Hot Runner system temperature is within 55°C (130°F) of the mold temperature.

# Section 9 - Color Change



## WARNING

Ensure that you have fully read “Section 3 - Safety” before purging the Hot Runner system.

Although it is not possible to make a generic color change procedure that will give the best performance in all circumstances because the flow characteristics of the plastic polymers in use can influence color changes, there are specific procedures which work to enhance color changes.

## 9.1 General Tips

- Always process a natural / clear color for the first shot on an empty Hot Runner system to coat the melt channel walls and gate bubbles with a neutral color.
- Ensure the hopper and conveying system are free of all contamination from the previous production color. Many times the previous color will hang up in the hopper or conveying system and be slowly released into the mold resulting in contaminated parts. Also, make sure there is no contamination in the resin being used in production.
- Schedule color changes from light to progressively darker.
- Understand the economics of your color change to decide if it is economically better to take the time to latch over the cavity plate and clean out the gate bubbles or just run scrap parts slightly longer to clean out the gate bubble area.
- Use purge compounds for color change in the machine barrel and Hot Runner.

## 9.2 Procedure A: Simple and Effective



## WARNING

To avoid serious burns when purging, wear safety clothing consisting of a protective heat-resistant coat, heat-resistant gloves and a full face shield over safety glasses.

Use adequate ventilation for fumes. Some plastics develop gases that may be dangerous to personal health. Follow the plastics supplier’s recommendations.

Do not look directly into the feed throat of a hopper - use a mirror. Unexpected release of resin may cause serious burns.

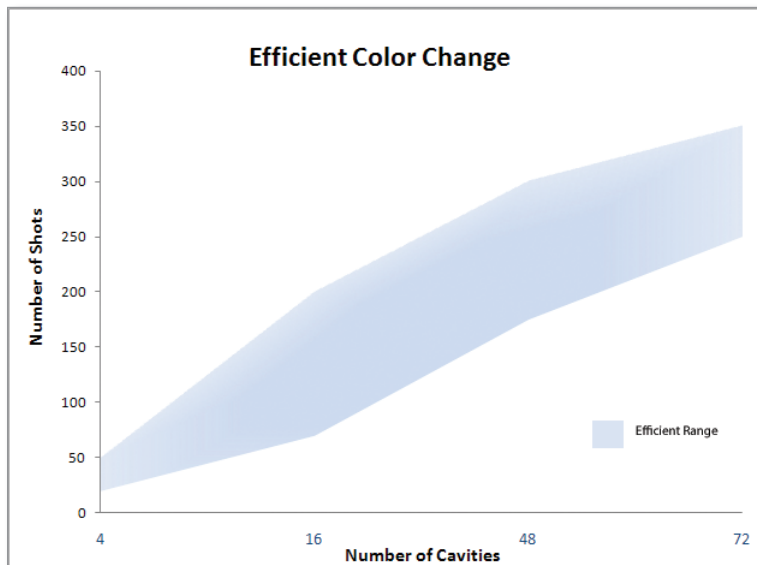
Never handle plastic purgings or drool until they have completely cooled. Purgings may appear solid but may still be hot and cause serious injury.

1. Empty hopper of existing color and clean thoroughly.
2. Increase Hot Runner system temperature on all zones 20°C (68°F) above processing temperatures. On *Mold-Masters* controllers, simply push the boost button on the controller to increase temperatures for a pre-determined time and temperature.
3. Back off the machine barrel, introduce the appropriate purge compound and purge until previous material is cleaned, then introduce new color. Increase barrel / extruder heats to help flush previous color (see machine maker recommendations).
4. Increase injection speed to help flush previous material.

5. Use Hot Runner purging compound (e.g. ASACLEAN™, Dyna-Purge®) at recommended temperatures to further reduce color change time.
6. Run parts until color has completely flushed through.
7. Continue processing while resetting Hot Runner system temperatures and injection speed back to normal.
8. Return all settings to normal and confirm acceptable part quality.

### 9.3 Procedure B: More Comprehensive

1. Empty hopper of existing color and clean thoroughly.
2. Increase Hot Runner system temperature on all zones 20°C (68°F) above processing temperatures. On *Mold-Masters* controllers, simply push the boost button to increase temperatures for a pre-determined time and temperature.
3. Back off the machine barrel, introduce the appropriate purge compound and purge until previous material is cleaned, then introduce new color. Increase barrel / extruder heats to help flush previous color (see machine maker recommendations).
4. Increase injection speed to help flush previous material.
5. Use Hot Runner purging compound (e.g. ASACLEAN™, Dyna-Purge®) at recommended temperatures to further reduce color change time.
6. Run 10 - 15 shots with natural material.
7. Back off the injection unit and switch off all heat on the Hot Runner.
8. Allow the Hot Runner system to cool down.
9. Latch over cavity plate.
10. Remove and clean gate bubbles.
11. Latch back cavity plate.
12. Turn on the Hot Runner system and heat to processing temperature.



13. Bring machine barrel back in.
14. Fill the Hot Runner with natural color resin to coat the melt channels with a neutral color (1-2 shots).
15. Introduce the new color.
16. Leave mold in open position and set the shot size to maximum possible.
17. Purge the entire shot through the Hot Runner and out the gates into the exposed cavity at the highest injection rate possible. Repeat this several times.

**NOTE**

It may be advisable to put a protective shield over the core side to prevent plastic from injecting and cooling on the core side.

18. Set the shot size back to normal levels and begin processing parts with increased injection speeds and mold temperature.
19. Continue processing while resetting Hot Runner system temperatures and injection speed back to normal.
20. Return all settings to normal and confirm acceptable part quality.

## Section 10 - Maintenance



### WARNING

Ensure that you have fully read “Section 3 - Safety” before doing maintenance procedures on the Hot Runner system.

This chapter is a guide to maintaining selective components. Repairs that should be performed by *Mold-Masters* personnel are not included. If you need an item repaired that is not included in this section, please call *Mold-Masters* support. The phone number and system identifier is located on the mold.



### WARNING

All maintenance on *Mold-Masters* products should be performed by properly trained personnel based on local law or regulation requirements. Electrical products may not be grounded when removed from the assembled or normal operating condition. Assure proper grounding of all electrical products before performing any maintenance to avoid potential risk of electrical shock.

To avoid serious burns wear safety clothing consisting of a protective heat resistant coat and heat-resistant gloves. Use adequate ventilation for fumes. Failure to do so can result in serious injury.



### CAUTION

Check that the manifold is secure.

For cast-in systems secure the manifold with clamps to prevent movement.

Never heat up the system without first clamping the main manifold, especially if the nozzles are not secured with the Hot Half. This prevents resin from leaking between the nozzle and Hot Half.

## 10.1 Terminal End Removal and Installation

Although this procedure shows a nozzle terminal end, the process is the same for manifold terminal ends.

### 10.1.1 Terminal End Removal



#### CAUTION

Care must be taken when removing the element sleeve to avoid damage to the ceramic sleeve or terminal nut.

1. If the terminal end is covered with plastic, warm the terminal end prior to removing the element sleeve.

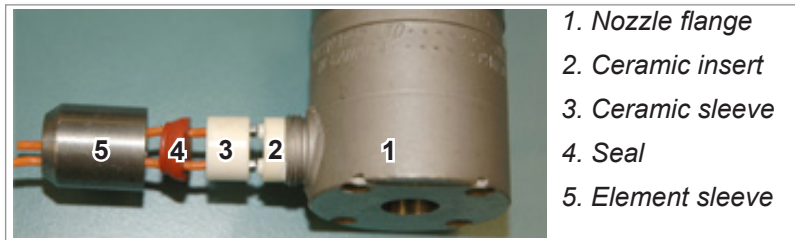


Figure 10-1 Nozzle terminal assembly

2. Grip the element sleeve at the threaded area and turn counter clockwise. If the wires rotate with the sleeve, damage may result.
3. Remove the seal.
4. Remove the set screw from the ceramic sleeve.
5. Remove the power leads.

### 10.1.2 Terminal Installation

Although this procedure shows a manifold, the process is the same for nozzle terminal ends.



#### NOTE

Please contact *Mold-Masters* Spare Parts Department to ensure you have the correct repair kit and crimping tool. The tools, along with the lead wire replacement kit, are available through the *Mold-Masters* Spare Parts Department.

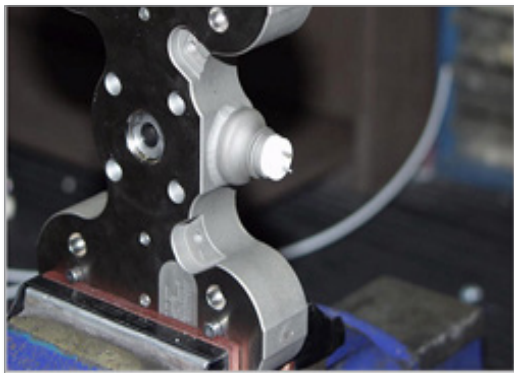


### 10.1.3 Terminal Assembly

1. Assemble the repair kit components.



2. Ensure the terminal end is clean.



3. Slide the element sleeve, silicon seal and ceramic insulator onto the wires.



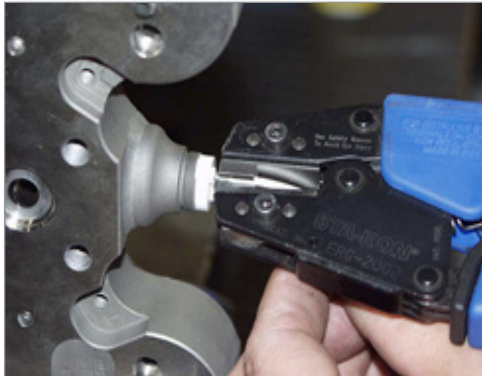
4. Slide crimps onto leads. Stranded wire should extend beyond the crimp.



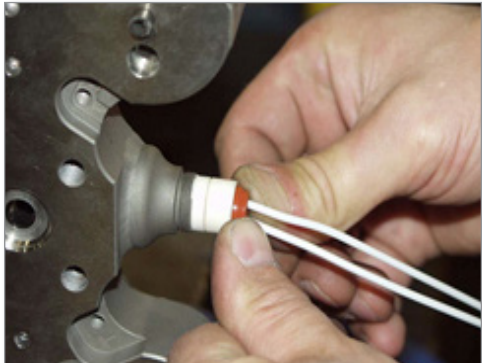
5. Spread the wire strands and insert the lead wire onto the terminal posts.



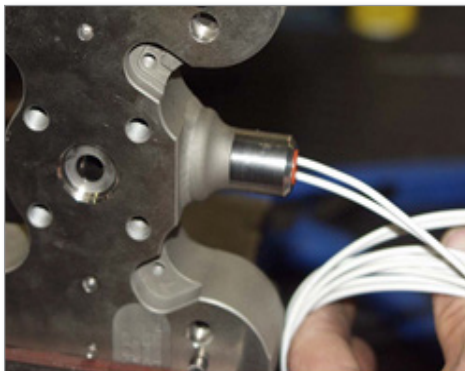
6. Grasp the crimp with the crimping tool, slide the crimp into position over the terminal post and crimp the connection.



7. Slide the ceramic insulator and silicon seal into place.



8. Screw the element sleeve into the position. Make sure that the silicon sleeve does not rotate with the sleeve which may damage the wire.



<b>Table 10-1 Crimping Tool Chart</b>	
<b>Product Name</b>	<b>Description</b>
PUNCHHANDLE01	Ratchet tool for securing crimp to terminal end assemblies
CRIMPDIE01	4.0mm Heater Element (Mates with CRIMPPUNCH01)
CRIMPPUNCH01	4.0mm Heater Element (Mates with CRIMPDIE01)
CRIMPDIE02	2.5 - 3.0mm Heater Element (Mates with CRIMPPUNCH02)
CRIMPPUNCH02	2.5 - 3.0mm Heater Element (Mates with CRIMPDIE02)
CRIMPDIE03	1.8 - 2.0mm Heater Element (Mates with CRIMPPUNCH03)
CRIMPPUNCH03	1.8 - 2.0mm Heater Element (Mates with CRIMPDIE03)
CRIMPREMOVEB01	Bottom Crimp Removal Insert for shearing HE crimps (Mates with CRIMPREMOVET01)
CRIMPREMOVET01	Top Crimp Removal Insert for shearing HE crimps (Mates with CRIMPREMOVEB01)

## 10.2 Gate Seal Maintenance



### WARNING

Ensure nozzles have cooled to room temperature. Failure to do so may cause serious injury.

Wear safety clothing such as a heat-resistant coat and heat-resistant gloves. Failure to do so may cause serious injury.



### CAUTION

It is critical that the seal surface be perfectly clean. Failure to properly clean may result in nozzle and seal damage and leakage.

Any anti-seize compound that enters the internal runner must be removed to prevent contamination of the melt.

Failure to torque the gate seals at processing temperatures may result in leakage.



### CAUTION

Use the socket supplied in the tool kit to loosen the gate seal.

Reasons for gate seal maintenance

- Tip damage
- Obstruction to melt flow
- Gate seal damage
- Tip wear



Figure 10-2 Sprint gate seal components (TSM188Px package)

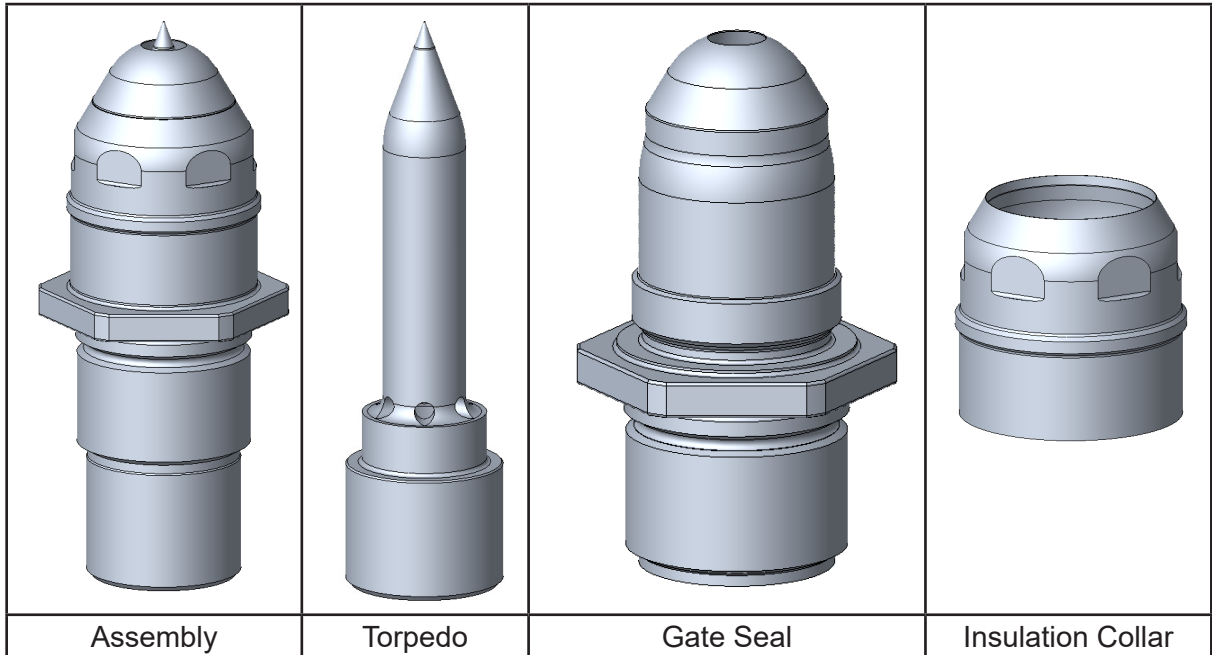


Figure 10-3 Sprint gate seal components (TSM325Px package)



Figure 10-4 Sprint gate seal tools

It is advisable to heat the nozzle to ensure the temperature condition is met to remove the gate seal.

### 10.2.1 Nozzle Tip Removal

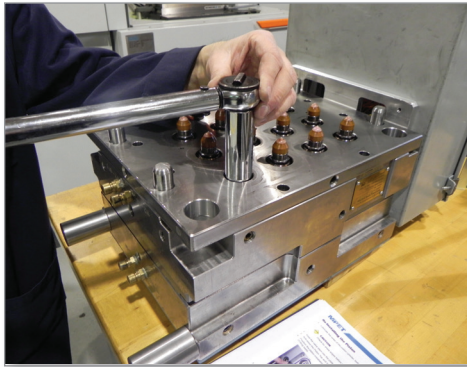


**CAUTION**

The Hot Runner system must be turned off and cooled to below 38 °C (100 °F) before cavity plate is removed. The cavity plate can then be removed to expose the nozzle tips.

1. After gate seals are exposed by removing the cavity plate, heat nozzles only until plastic softens in gate area (temperature will depend on resin used).

2. Apply loosening torque to the gate seal using 6 point socket provided (16 mm (0.6 in.) socket). If the seal initially loosens, but then starts to bind, apply some industrial lubricant to remove the gate seal more easily.



3. The gate seal, torpedo and insulator cap / insulation collar should come off the nozzle as an assembly. If the torpedo remains in the nozzle after the gate seal is removed, raise the nozzle temperature by 15 °C (59°F) or 5% power and remove the torpedo using soft jawed pliers.
4. If the gate seal package is a variant of TSM325Px, use an M17 6-point socket to unscrew the insulation collar from the gate seal.
5. Turn off heaters after gate seal removal.

### 10.3 Nozzle Tip Installation



#### WARNING

Failure to torque the gate seals at processing temperatures may result in leakage.

1. Clean all residual plastic from the nozzle threads and the torpedo / nozzle sealing surface.
2. Check the torpedo / nozzle sealing surface for damage. If damaged, lap the torpedo / nozzle sealing surface in a circular fashion with a hardened tool and 300 grit lapping compound.
3. After a smooth torpedo / nozzle contact surface is established, apply die spotting blue compound to the torpedo to the nozzle surface to ensure proper mating.



4. After ensuring good contact, clean die spotting blue compound off of both surfaces.

5. If the TSM325Px gate seal package is used, install the insulation collar onto the gate seal using an M17 6-point socket. Tighten the collar to a torque of 10 N·m (7 ft-lb) at room temperature.
6. Apply nickel-based anti-seize compound only to the gate seal threads at process temperature. If gate seal package TSM325Px is used, tighten the gate seal to a torque of 61–68 N·m (45–50 ft-lb) at process temperature.
7. Install the gate-seal/liner in the nozzle using the provided 6-point socket. Tighten the gate seal to a torque of 34–38 N·m (25–28 ft-lb) at process temperature.



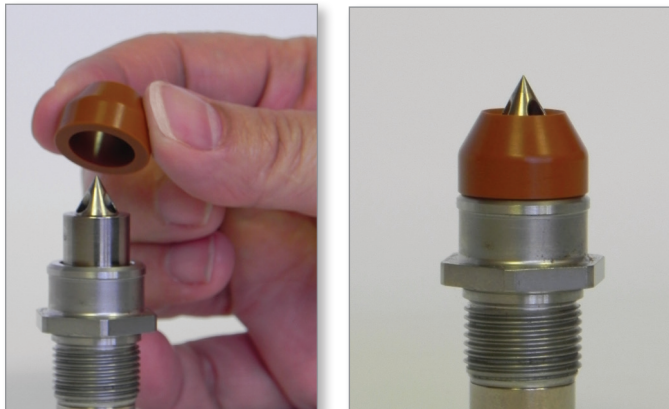
### 10.4 Clean the Nozzle Insulator Cap

1. Heat cap with heat gun.
2. Remove molten plastic and wipe the remainder from the insulator cap.



### 10.5 Install the Nozzle Insulator Cap

1. Press fit the insulator cap onto the torpedo by hand.



## 10.6 Check Nozzle Tip Height

1. Correct nozzle tip height and nozzle reference point is found on the gate detail of the General Assembly drawing.
2. Assemble spacer blocks to same value as correct nozzle tip height.
3. Zero indicator to spacer blocks.



4. Move indicator to correct reference point on nozzle tip (per drawing).
5. Check that nozzle height is within drawing specification.
6. Repeat for each nozzle.





## 10.7 Latches

There are two reasons latches are used in a mold:

1. To tie the mold halves together for transportation and handling.
2. To gain access between two mold plates which are screwed together during normal mold operation.

Latches are always used in pairs mounted on diagonally opposite sides of the mold to provide equal pull on the plates.

The latches are located on:

- The operator's side.
- Non-operator's side of the mold.
- Top and bottom of the mold.

Under no circumstances are plates to be pulled or handled with only one latch attached.

Latch locations are shown on the assembly drawings. During mold operation the latches must be removed from the mold and stored elsewhere.

## 10.8 Latch the Cavity Plate to the Core Half (Cold Half)



### WARNING

Make sure the machine has been locked out and tagged out in accordance to the machine's documented procedures.

Make sure the lifting eyebolt, lifting chain and crane are rated to adequately support the weight of the plate(s).

Install latches before removing the cavity plate mounting screws. Failure to do so could cause serious injury.



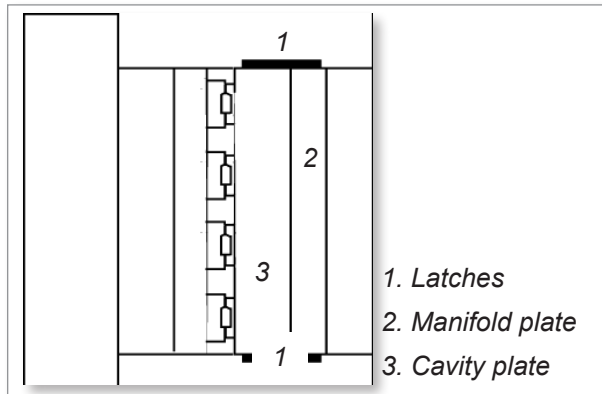
### CAUTION

The nozzles must be within 55°C (130°F) of mold temperature to prevent damage to Hot Runner and mold components. For cylindrical valve gated systems, valve pins should be in the open position prior to removal of the cavity plate to prevent damage.

Use this procedure for reference purposes only. For latch locations, refer to the assembly drawings.

For additional instructions on latching in the machine refer to the machine manufacturers manual.

1. Open the mold.
2. Ensure that the machine and Hot Runner controller has been locked out and tagged out.
3. Apply lockout / tagout to the machine power source and Hot Runner controller. Refer to the controller and machine manufacturer's documentation for procedures.
4. Allow the mold to cool to room temperature. Continue to circulate the mold cooling water in all plates to cool the mold more quickly.



5. If the mold has no leader pins, attach a crane that is rated to adequately support the weight of the cavity plate.
6. Latch the cavity plate to the manifold or manifold backing plate.
7. Check that the cavity plate hoses are long enough to allow the cavity plate to be latched over to the core half (Cold Half), without damaging the hoses.
8. Remove all cavity plate mounting screws.
9. Remove lockout / tagged out.
10. Place the machine in Mold Set mode.
11. Close the mold slowly.

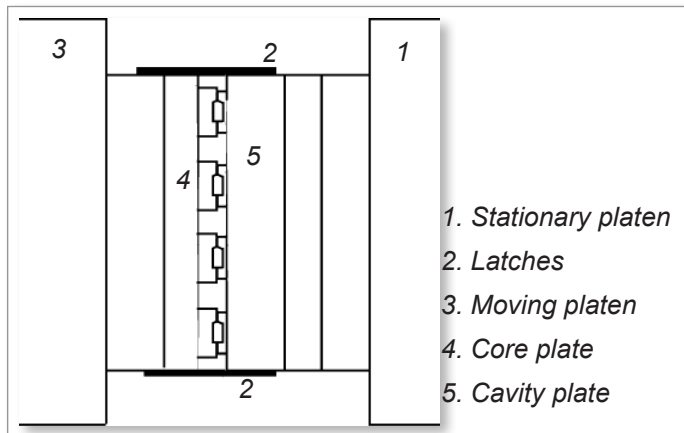


Figure 10-5 Cavity plate to core plate

12. Apply lockout / tagged out. Refer to machine manufacturer's documentation for procedures.
13. Remove the latches.
14. Latch the cavity plate to the core plate or Cold Half.
15. Remove lockout / tagged out.
16. Check the machine is in Mold Set mode.

- Open the mold moving the cavity plate away from the manifold plate.

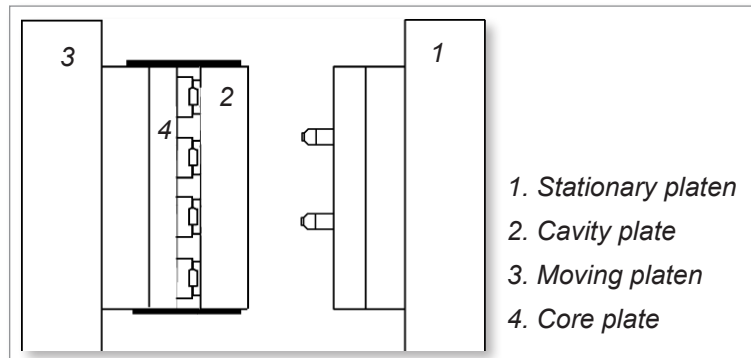


Figure 10-6 Latch cavity plate to core plate

- Apply lockout / tagout. Refer to the controller and machine manufacturer's documentation for procedures.

## 10.9 Latch the Cavity Plate to the Manifold Plate (Hot Half)



### WARNING

Make sure the machine has been locked out and tagged out in accordance to the machine's documented procedures. Failure to do so could lead to serious injury or death.

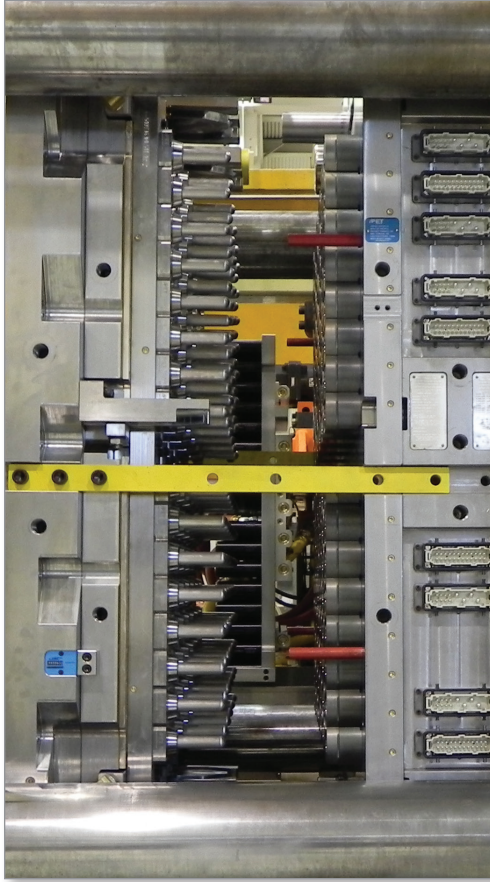


### CAUTION

The nozzles must be within 55°C (130°F) of mold temperature to prevent damage to Hot Runner and mold components. For cylindrical valve gated systems, valve pins should be in the open position prior to removal of the cavity plate to prevent damage.

- Check the machine is locked out / tagged out.
- Lubricate the guide pins on the Hot Half.
- Remove lockout / tagout.
- Check the machine is in Mold Set mode.
- Slowly close the mold.
- Check the machine has been locked out / tagged out. Refer to the controller and machine manufacturer's documentation for procedures.
- Remove the latches on both sides of the mold.
- Latch the cavity plate to manifold plate or manifold backing plate.
- Remove lockout / tagout.
- Open the mold.
- Check the machine has been locked out / tagged out. Refer to the controller and machine manufacturer's documentation for procedures.

12. Install and torque the cavity plate mounting screws. Torque to required specifications. Refer to assembly drawings for required torque settings.
13. Install hoses if required.
14. Remove latches from both sides of the mold.



## 10.10 Torque Settings

### 10.10.1 Torque Settings of Gate Seals



**CAUTION**

Gate seals are to be torqued at ambient (room) temperature and then re-torqued at processing temperature to the torque value specified. This is to prevent material leakage from the gate seal.



**NOTE**

Torque values in the chart should be referenced against the torque values on the General Assembly drawing for a specific system.

Table 10-2 Gate Seal Torque Settings												
Gating Method	Femto-Lite		Femto		Pico		Centi		Deci		Hecto	
	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb
E-Type Torpedo	8-9	6-7	8-9	6-7	16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Ext. E-Type Torpedo	8-9	6-7										
F-Type Torpedo	8-9	6-7	8-9	6-7	16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Hot Sprue			8-9	6-7	16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Extended Hot Sprue					16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Hot Valve			8-9	6-7	16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Bi-Metallic C-Sprue					16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Bi-Metallic Cylindrical Valve			8-9	6-7	16-18	12-13	27-30	20-22	34-38	25-28		
Bi-Metallic C-Valve					16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Spiral Hot Tip					16-18	12-13	27-30	20-22	34-38	25-28	47-54	35-40
Accu-Valve™			8-9	6-7	16-18	12-13	27-30	20-22	34-38	25-28		
TIT Edge					11-14	8-10	14-15	10-11	14-15	10-11		
Multi Tip - M7									8-9	6-7		
Multi Tip - M10							14-16	10-12	14-16	10-12		
Multi Tip - M12									25-28	18-21		
Horizontal Hot Tip							15-18	11-13	15-18	11-13		
C-Sprue	8-9	6-7	8-9	6-7								
C-Valve			8-9	6-7								

### 10.10.2 System and Plate Screw Torques



**CAUTION**

Bridge manifold mounting screws should be torqued 1/3 higher than specified on General Assembly drawings.

Quality and length of screws must be as specified on *Mold-Masters* General Assembly drawings.

Table 10-3 Torque Chart for System Assembly Screws			
Metric	Torque Setting	Imperial	Torque Setting
M5	7 Nm	#10-32	5 ft lbs
M6	14 Nm	1/4-20	10 ft lbs
M8	20 Nm	5/16-18	15 ft lbs
M10	40 Nm	3/8-16	30 ft lbs
M12	60 Nm	1/2-13	45 ft lbs
M16	145 Nm	5/8-11	107 ft lbs
M20	285 Nm	3/4-10	210 ft lbs

Table 10-4 Torque Chart for Plate Assembly Screws			
Metric	Torque Setting	Imperial	Torque Setting
M5	9 Nm / 6 ft lbs	#10-32	7 Nm / 5 ft lbs
M6	15 Nm / 11 ft lbs	1/4-20	16 Nm / 12 ft lbs
M8	36 Nm / 27 ft lbs	5/16-18	33 Nm / 24 ft lbs
M10	72 Nm / 53 ft lbs	3/8-16	59 Nm / 44 ft lbs
M12	125 Nm / 92 ft lbs	1/2-13	144 Nm / 106 ft lbs
M16	311 Nm / 229 ft lbs	5/8-11	287 Nm / 212 ft lbs
M20	606 Nm / 447 ft lbs	3/4-10	511 Nm / 377 ft lbs

### 10.10.3 Torque Settings of Sprint Gate Seals



**CAUTION**

Tighten the system screws from the center outwards to exert an even load across all screws during assembly. Tighten to the specified torque in a minimum of two steps.

Table 10-5 Torque Settings of Sprint Gate Seals				
Gating Method	Centi		Deci	
	N·m	ft-lb	N·m	ft-lb
3-Hole Design (Standard)	27–30	20–22	34–38	25–28
Color Change Tip	n.a.	n.a.	61–68	45–50

# Section 11 - Troubleshooting

**WARNING**

Ensure that you have fully read “Section 3 - Safety” before troubleshooting any issues with the Hot Runner system.

**WARNING - HOT SURFACES**

Extreme heat. Avoid contact with heated surfaces. To avoid serious burns wear safety clothing consisting of a protective heat resistant coat and heat-resistant gloves. Use adequate ventilation for fumes. Failure to do so can result in a serious injury.

**WARNING - LOCKOUT / TAGOUT**

Make sure the machine has been locked out and tagged out in accordance to the machines documented procedures. Failure to do so may lead to serious injury or death.

This troubleshooting information assumes that the Hot Runner has been operational.

Basic rules for troubleshooting are:

- Define the problem; what is seen is only a symptom of the underlying problem.
- Develop a method to isolate the problem.
- Test one item at a time to verify results.
- Monitor the final solution to verify that the problem has been solved. Repeat occurrences of the same symptom may indicate other problems.
- Document the solution so that a repeat occurrence can be solved quickly.
- Consult other resources to augment the troubleshooting information in this manual. One of the best resources may be your resin supplier.

## 11.1 Moisture Related Issues

Many common molding issues can be directly attributed to moisture contamination of the production resin. Generally, manufacturing resin is supplied from the manufacturer in ready to process pellets that are in sealed, airtight containers. Follow manufacturers storage instructions, keeping containers sealed until ready to use. Prior to using pellets, follow the drying instructions, as provided by the resin supplier and molding machine manufacturer, if applicable.

### 11.1.1 Resin Moisture Contamination

Moisture can be introduced into the resin in many ways:

- During transportation
- Environmental exposure (aging)
- Malfunctioning heater / dryer
- Extreme humidity in atmosphere
- Inadequate or malfunctioning facility HVAC

### **11.1.2 Resin Drying Issues**

During the drying stage of the resin (if applicable), ensure that:

- The resin pellets are not overpacked
- Adequate air circulation is present
- The drying system is properly sealed, according to manufacturers instructions

### **11.1.3 Importance of Pre-Drying Resin**

Thermoplastic resins can be hygroscopic, able to absorb moisture from the air. Under normal processing conditions, this can lead to degradation of the polymer during molding. Breakage of polymer chains changes the properties, resulting in possible blisters, streaks, splay or other defects described in this section.

Recycled resins can have higher hygroscopic properties due to greater surface area and should be dried separately from fresh resins.

If moisture issues are ruled out, continue with the troubleshooting tables in the following pages.

## **11.2 Pre-Molding Precautions**

Prior to commencing production, ensure that the following conditions have been met. This will greatly reduce any future need to troubleshoot defective production.

### **11.2.1 History**

- Review any documentation associated with your batch job regarding the recipe using the mold, molding machine, thermoplastic resin, environmental setting, etc.
- Review comments, notes, logbooks, blogs, and anything other resource material that pertains to the batch job.
- Verify that all settings such as all time, temperature, pressure, material, etc. are correct.

### **11.2.2 Material**

- Ensure that the thermoplastic resin to be used is the right grade, and has been stored and / or prepared/dried, etc, according to manufacturer's specifications.
- Verify that the pigment / dye to be used meets manufacturer's specifications, and is compatible with the resin / molding machine / mold.
- Verify the correct recycle ratio and adjust settings accordingly.

### **11.2.3 Hardware**

- Make sure the mold has been properly stored, and is dry, clean, free of rust, dirt, moisture, residual resin, pigment and any protective coating.
- Check that the temperature controller meets requirements, and is fully tested and operational.
- The injection molding machine has been properly maintained, cleaned, lubricated; tolerances and dimensions verified.
- Make sure that the nozzles, cylinders, valves, gates, and any other variable that is appropriate for the batch job has been chosen.



### 11.2.4 Settings

Ensure that all batch job parameters are correct:

- Temperatures
- Pressures
- Injection Speed
- Back Pressure

### 11.3 Establishing Root Cause

This section is to be used as a reference tool only.

When a system that has been set up according to specification and was functioning normally suddenly produces sub-standard parts, the data in the following pages may be used to determine the possible cause, but only should be used as a guide.

A correct set up procedure that has been proven in will produce parts that meet design tolerances and specifications. A sudden change in any parameter indicates a possible fault. Rather than modify other settings to compensate for this variation, it is advisable to determine which of the original settings has changed.

### 11.4 Fault Identification

The operator will need to evaluate all the possible conditions which may have caused the defect.

- Identify the problem
- Determine the frequency
- Is the problem random or in the same location
- Review past history logs for similar occurrences and resolutions.

Review the machine settings to ensure that there is no variation from the original set-up which was producing standard parts.

injection speed	melt heating
screw speed	locking
melt temperature	cushion
back pressure	mold heating

For a more thorough analysis of the defect, refer to the Troubleshooting Section in the following pages.

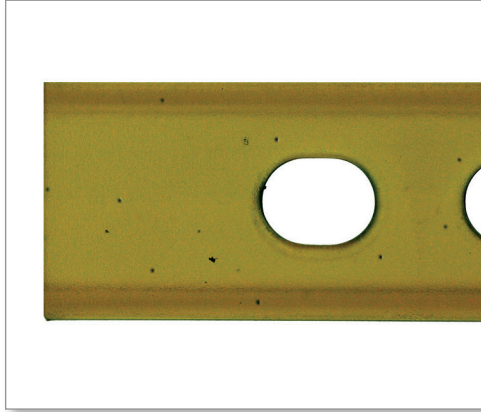
## 11.5 Defect Types, Causes, and Remedies

Dark Specks .....	19-5
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## 11.6 Troubleshooting Typical Problems

### 11.6.1 Dark Specks

The finished product contains dark specks. Usually occurs when transparent resins are used.



#### Probable Cause:

1. Molding Machine
  - Off-line for extended period
  - Barrel off-line for extended period
  - Barrel improperly purged
  - Contamination in plasticizer
  - Wrong nozzle
  - Use of wrong screw
2. Mold
  - Gate and / or runner has dead spots
3. Material
  - Physical contamination of raw material
  - Chemical contamination of raw material
  - Particulate contamination from machine barrel

#### Solution (in sequence):

1. Purge system with appropriate material
2. Trace source of contamination and repair, remove or discard
3. Adjust melt temperature if necessary
4. Inspect for dead spots: gates, runners, nozzle, back flow valve
5. Inspect feed screw for degradation

### 11.6.2 Blisters or Bubbles

The finished product contains small gas or air filled pockets or cooling voids.



#### Probable Cause:

1. Molding Machine
  - Low injection pressure
  - Back flow valve malfunctioning
  - Decompression cycle too long
  - Rapid plasticizing
  - Trapped air in feed
  - Feed error
2. Mold
  - Trapped or volatile gas
  - Low mold temperature
  - Poor thin/thick transition phase
  - Inadequate venting
3. Material
  - Overheating of resin

#### Solution (in sequence):

1. Verify control and / or holding pressure
2. Increase back pressure
3. Increase mold temperature
4. Inspect back flow valve
5. Ensure proper venting
6. Increase gate size
7. Decrease vent land length

### 11.6.3 Flow Marks

The finished product exhibits blush and flow marks, due to variations in material temperature from gradients between the machine nozzle and mold sprue bushing. Cold material in the nozzle tip section results in a halo around the direct sprue.



#### Probable Cause:

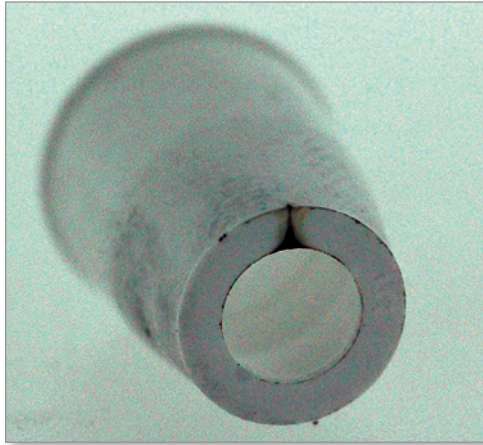
1. Molding Machine
  - Wrong injection speed
  - Wrong injection pressure
  - Hold pressure too long
2. Mold
  - Insufficient mold cooling
  - Temperature of mold too high around the gate
  - Temperature of mold too cool
  - Gate size is too small
  - Gate is in wrong location
  - Land length of gate is too long
  - Incorrect Hot Runner system
3. Material
  - Melt temperature is too low

#### Solution (in sequence):

1. Adjust injection speed
2. Add a large cold slug area
3. Add cold wells at the end of the runner system
4. Use hot sprue bushing
5. Identify and eliminate dead pockets / sections

### 11.6.4 Burn Marks

The finished product display brown streaks. This is from the material being overheated due to trapped air (diesel effect), which can lighten or darken the color.



#### Probable Cause:

1. Molding Machine
  - High injection speed
  - Backflow / check ring valve malfunctioning
  - High back pressure
2. Mold
  - Trapped or volatile gas
  - Burning due to friction
  - Incorrect sprue diameter
3. Material
  - Overheated / underheated melt, possible shear

#### Solution (in sequence):

1. Clear blocked vent channels
2. Lower injection speed
3. Lower injection pressure
4. Check heater functionality
5. Check thermocouple functionality
6. Reduce feed screw rotation
7. Reduce melt temperature
8. Increase mold cavity venting
9. Enlarge gate
10. Change gate position and / or size

### 11.6.5 Delaminating Parts

The finished product is separating into layers that can be peeled off; surface layers are flaking off. Insufficient layer bonding as a result of high shear stresses; non homogeneous material.



#### Probable Cause:

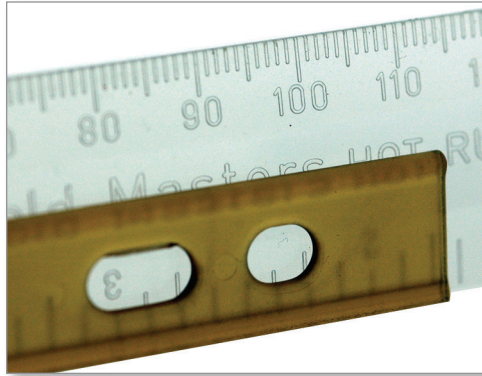
1. Molding Machine
  - High injection speed
2. Mold
  - Cold mold
  - Gate has sharp corners
  - Sharp corners causing shear heat
3. Material
  - Physical contamination of raw material
  - Chemical contamination of raw material
  - Melt too hot / poor melt
  - Incompatible color dye
  - High percentage of recycled material

#### Solution (in sequence):

1. Increase melt temperature
2. Increase mold temperature
3. Decrease injection speed
4. Eliminate contamination
5. Adjust regrind ratio
6. Adjust or change resin moisture content
7. Purge system
8. Reduce sharp corners at gate

### 11.6.6 Dimensional Irregularities

The finished product is of a different dimensional value than originally designed or previous production.



#### Probable Cause:

1. Molding Machine
  - Low injection pressure
  - Short hold pressure time
  - Damaged backflow / check ring valve
  - Short cycle time
  - Cylinder clearance too big
  - Nozzle heaters malfunctioning
2. Mold
  - Temperature setting too high
  - Small gate size resulting in wrong pressure
  - Incorrect gate location
  - Incorrect mold configuration / size
3. Material
  - Generally not a material related issue unless excessive regrind is used

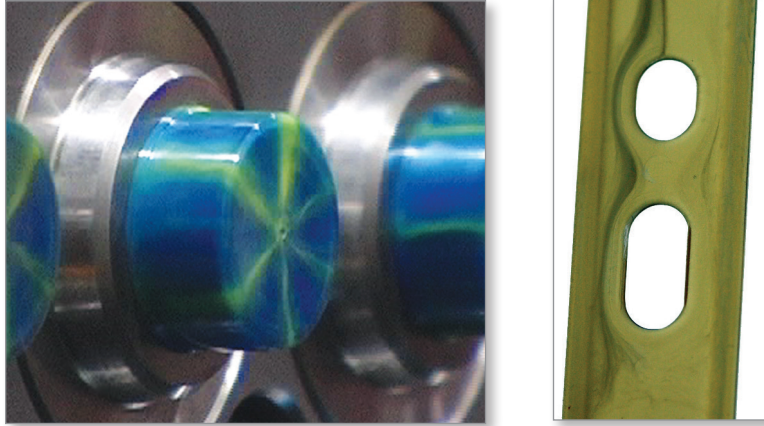
#### Solution (in sequence):

1. Increase injection pressure
2. Increase cooling time
3. Increase mold temperature
4. Ensure cycle time is consistent
5. Monitor molding machine for irregularities
6. Balance regrind ratio
7. Increase gate size
8. Decrease gate land length
9. Balance the runner and / or gate system
10. Decrease cavity quantity



### 11.6.7 Discolored Parts

The finished product varies in color on different surfaces.



#### Probable Cause:

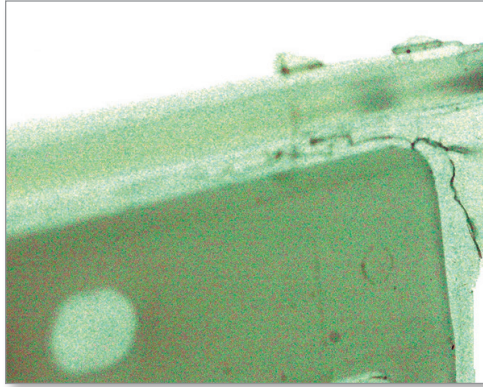
1. Molding Machine
  - Contamination
2. Mold
  - Incorrect sprue diameter
  - Inadequate venting
3. Material
  - Physical contamination of raw material
  - Chemical contamination of raw material
  - Melt too hot / poor melt
  - Incompatible color dye
  - Residence time too high

#### Solution (in sequence):

1. Purge heating cylinder
2. Lower resin temperature by:
  - reducing cylinder temperature
  - reducing screw speed
  - reducing back pressure
3. Decrease nozzle temperature
4. Adjust residence time
5. Adjust regrind ratio
6. Adjust cycle time
7. Check for external contamination sources
8. Ensure proper cooling in all areas
9. Increase mold venting

### 11.6.8 Flash

Also known as “fins” or “spew”. The finished product contains a thin film of material attached at the mold parting line.



#### Probable Cause:

1. Molding Machine
  - Low clamping pressure
  - High injection pressure
  - High injection speed
2. Mold
  - Inadequate mold supports
  - Low clamping force
  - Damaged mold
  - Projected area too large for machine capacity
3. Material
  - Low melt viscosity
  - High melt temperature

#### Solution (in sequence):

1. Reduce the injection speed
2. Reduce the injection pressure
3. Reduce the injection time
4. Increase clamping force
5. Inspect the mold for irregularities
6. Reduce the melt temperature
7. Inspect vent depth
8. Switch to higher tonnage clamping machine
9. Establish correct transfer position
10. Reduce hold pressure

### 11.6.9 Jetting

The finished product exhibits serpentine flow patterns on the surface as a result of the melt cooling prior to complete filling of the mold.



#### Probable Cause:

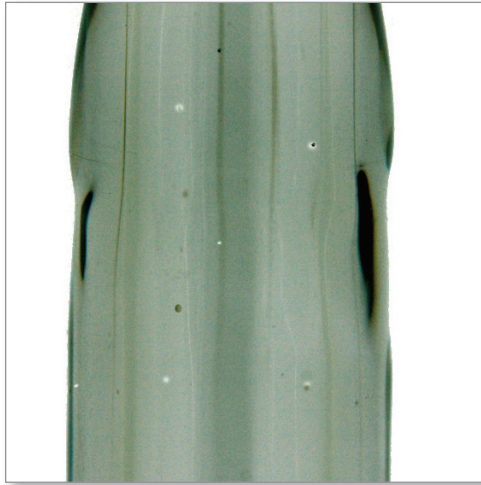
1. Molding Machine
  - High injection speed
2. Mold
  - Cold mold
  - Small gate
  - Wrong gate land length
  - Wrong gate location
3. Material
  - Cold melt

#### Solution (in sequence):

1. Decrease injection speed
2. Verify nozzle temperature
3. Increase mold temperature
4. Increase melt temperature
5. Increase gate size
6. Modify gate location

### 11.6.9 Pitted Parts

The finished product contains unmelted particles or small holes on the surface.



#### Probable Cause:

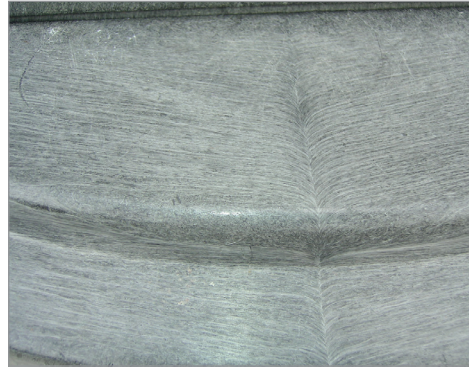
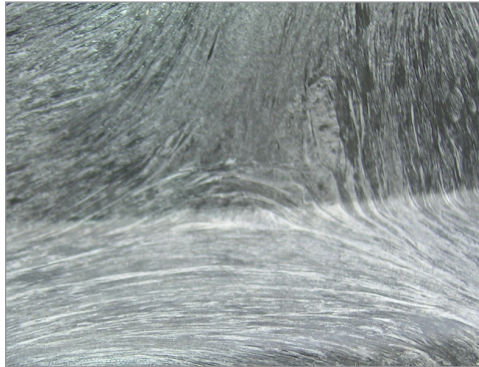
1. Molding Machine
  - Improper or worn out feed screw
  - Low melt temperature
  - Low injection speed
2. Mold
  - Gating shear
  - Sharp corners
3. Material
  - Resin used is not homogeneous
  - External contamination

#### Solution (in sequence):

1. Reduce shear
2. Reduce back pressure
3. Reduce injection speed
4. Modify temperature
5. Modify regrind ratio
6. Modify shot size
7. Inspect Hot Runner and nozzles

### 11.6.10 Rough Surface

The finished product exhibits patterns on the surface similar to grooves on a record, due to rapid cooling of the melt as it nears mold surface, followed over and over again by fresh melt



#### Probable Cause:

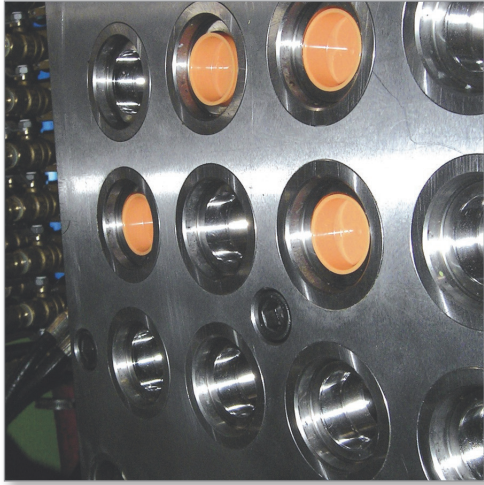
1. Molding Machine
  - Low injection speed
  - Low injection pressure
2. Mold
  - Cold mold
  - Irregularities in mold surface, defective polishing
3. Material
  - Cold melt

#### Solution (in sequence):

1. Increase injection speed
2. Increase injection pressure
3. Increase melt temperature
4. Increase mold temperature
5. Inspect mold surface

### 11.6.11 Parts Sticking to Cavity

The finished product does not properly release from the mold (female side).



#### Probable Cause:

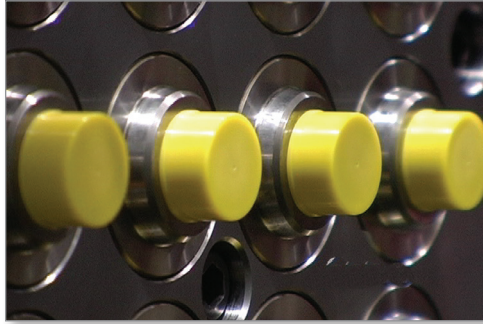
1. Molding Machine
  - High injection pressure
  - High injection speed
  - Long holding time
  - High material feed
2. Mold
  - Hot cavity
  - Cold mold
  - Defective mold surface
3. Material
  - Melt too hot

#### Solution (in sequence):

1. Confirm cycle time for cooling
2. Reduce injection pressure
3. Reduce injection hold time
4. Reduce injection speed
5. Reduce injection time
6. Adjust feed
7. Inspect mold finish
8. Increase mold opening cycle
9. Lower mold temperature
10. Adjust differential temperatures
11. Inspect for appropriate mold release

### 11.6.12 Parts Sticking to Core

The finished product does not properly release from the mold (male side).



#### Probable Cause:

1. Molding Machine
  - High injection pressure
2. Mold
  - Hot core
  - Bending of core
  - Presence of vacuum
3. Material
  - Generally not a material related issue

#### Solution (in sequence):

1. Confirm cycle time for cooling
2. Reduce injection pressure
3. Reduce injection hold time
4. Reduce injection time
5. Adjust feed
6. Reduce mold closed time
7. Increase core temperature
8. Decrease nozzle temperature
9. Inspect mold for undercuts and / or improper draft
10. Verify mold bending ratio

### 11.6.13 Short Parts

The finished product is not completely formed.



#### Probable Cause:

1. Molding Machine
  - Bad feed
  - Low injection pressure
  - Low injection speed
  - Short injection time
  - Back flow valve / check ring faulty
  - Improper venting
2. Mold
  - Insufficient venting
  - Cold mold
3. Material
  - Low melt temperature
  - Viscous material

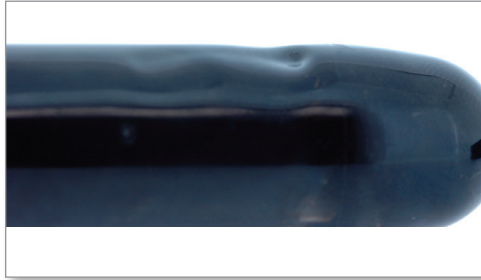
#### Solution (in sequence):

1. Increase feed
2. Increase injection pressure
3. Increase feed temperature by increasing cylinder temperature
4. Increase injection time
5. Increase mold temperature
6. Increase nozzle diameter
7. Inspect for restrictions
8. Increase gate size of sprue and runner system



### 11.6.14 Sinks or Voids

The finished product has hollows and pockets in areas that do not cool sufficiently, causing contraction.



#### Probable Cause:

1. Molding Machine
  - Low injection pressure
  - Short injection time
  - Insufficient material in cavity
  - High injection speed
  - Low back pressure
  - Damaged backflow valve / check ring
2. Mold
  - Mold not at required temperature
  - Small gate leading to early freezing
  - Gate land length too long
  - Incorrect rib / wall dimensions
  - Material flow incorrect
  - Thick wall part
3. Material
  - Hot material
  - Material wrong grade for application

#### Solution (in sequence):

1. Adjust injection speed
2. Increase injection hold time
3. Increase injection pressure
4. Adjust melt temperature
5. Adjust mold temperature
6. Inspect for hot spots
7. Enlarge and / or add vents to mold parting line
8. Increase sprue or runner size
9. Increase gate size / reduce gate land length
10. Relocate gate closer to heavy / thicker areas
11. If possible, core out heavy wall sections

### 11.6.15 Splay

The finished product display splay / splash marks and / or silver streaks.



#### Probable Cause:

1. Molding Machine
  - Resin degraded from overheating
  - Cylinder contains hot spots
  - Material trapped at nozzle tip
  - Wrong injection pressure
  - Wrong injection speed
  - Low back pressure
2. Mold
  - Friction related burning in gate, nozzle or Hot Runner
  - Trapped volatile compounds
3. Material
  - Hot melt
  - Contaminated resin (moisture, dirt, organics)
  - Degraded resin

#### Solution (in sequence):

1. Dry resin according to procedure; check drying equipment for functionality
2. Reduce nozzle temperature
3. Reduce material temperature:
  - lower cylinder temperature
  - reduce screw speed
  - reduce back pressure
4. Decrease injection speed
5. Increase mold temperature
6. Decrease or eliminate screw decompression
7. Reduce cycle time
8. Check for drooling
9. Check for contamination in mold cavity
10. Open gates
11. Try mold in smaller shot-size press

### 11.6.16 Streaks

The finished product has large, dull and laminate appearance areas on the surface.



#### Probable Cause:

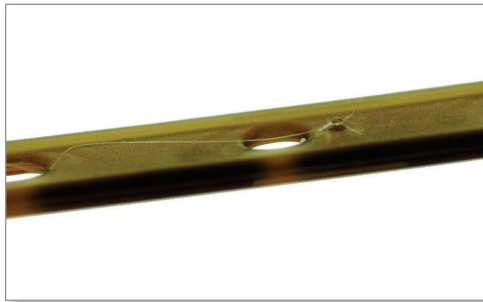
1. Molding Machine
  - Back flow valve ring damaged
2. Mold
  - Hot spots
  - Material trapped in certain areas
3. Material
  - Contamination of resin or machine
  - If pattern is identical, cause may be the machine
  - If pattern is erratic, cause may be the material or coloring
  - Degraded or unstable material

#### Solution (in sequence):

1. Check for contamination
2. Check barrel purging
3. Inspect back flow ring for wear or cracks
4. Inspect feed screw for wear and tear
5. Inspect screw / barrel for tolerances
6. Verify heater operation
7. Verify thermocouple operation

### 11.6.17 Stringing

The finished product has thin plastic strings attached to the sprue.



#### Probable Cause:

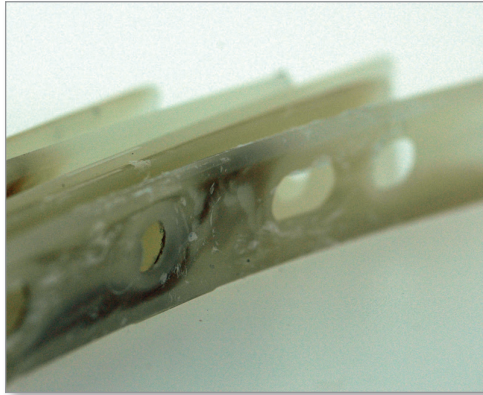
1. Molding Machine
  - High back pressure
  - High nozzle temperature
2. Mold
  - Incorrect sprue
3. Material
  - Melt strength inadequate

#### Solution (in sequence):

1. Reduce back pressure
2. Modify nozzle temperature
3. Modify temperature profile
4. Eliminate sprue breaks
5. Increase cooling time
6. Decrease mold temperature at the gate

### 11.6.18 Warped Parts

The finished product has pressure differences / stress on its surface, causing the part to be disfigured.



#### Probable Cause:

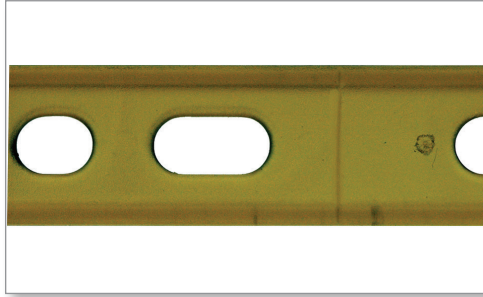
1. Molding Machine
  - Wrong cooling time
  - High injection pressure
2. Mold
  - Gate located in wrong area
  - Undercuts too big
  - Cavity too hot
  - Part is wrong design or too heavy
3. Material
  - Fillers have wrong orientation
  - Incorrect material

#### Solution (in sequence):

1. Ensure temperature in both mold halves is equal
2. Monitor part ejection from mold for uniformity
3. Monitor part handling following ejection
4. Verify part weight following ejection
5. Increase injection hold time
6. Increase cooling time
7. Adjust injection pressure
8. Adjust mold temperature; set sequential temperatures based on part geometry
9. Check gate dimensions, quantities and locations
10. Re-design part if necessary

### 11.6.19 Weld Lines

The finished product has lines where two flow fronts meet and have not fused, creating the possibility of weak areas and stress fractures.



#### Probable Cause:

1. Molding Machine
  - Low injection speed
  - Low injection pressure
  - Short injection time forward
2. Mold
  - Low mold temperature
  - Poor venting
  - Back flow valve / check ring malfunctioning
  - Gates too far apart
  - Redesign part
3. Material
  - Cold melt
  - Material wrong grade for application

#### Solution (in sequence):

1. Increase injection pressure
2. Increase injection holding time
3. Increase injection speed
4. Increase cylinder temperature
5. Increase mold temperature
6. Check for venting
7. Provide an overflow well adjacent to the weld area
8. Modify the gate location
9. Decrease gate land length

## Section 12 - Glossary of Terms

**Aspect Ratio:** Ratio of total flow length to average wall thickness.

**Back Pressure:** The pressure applied to the plastic during screw recovery. By increasing back pressure, mixing and plasticating are improved; however, screw recovery rates are reduced.

**Backplate:** Inlet component to the Hot Runner manifold.

**Barrel:** The part of the molding press where resin is melted.

**B-side:** The mold half that mounts to the moving side of the injection molding press. Sometimes referred to as the core side of the mold or the Cold Half, the B-side has ejector pins to push the part out of the open mold. An analysis of the part geometry determines the optimal part orientation to ensure that it will remain on the B-side when the mold is opened

**Clamp Force:** The force required to hold the mold shut so resin cannot escape during injection.

**Contoured Pins:** Ejector pins with the ends shaped to match a sloping surface on the part.

**Core:** A convex feature on either side of the mold that will enter an opposing cavity when the mold is closed. The void between the cavity and core is where the resin solidifies and forms the part. Often the B-side of a mold is referred to as the core side.

**Core-cavity:** The design of a mold where the A-side forms the outside of the part and the B-side forms the inside. The advantage to this approach is that the part will shrink onto the B-side so it can be ejected, and if the inside and outside are drafted with equal and opposite draft the wall thickness will be constant.

**Cycle Time:** The time it takes to make one part including the closing of the mold, the injection of the resin, the solidification of the part, the opening of the mold and the ejection of the part.

**Cavity:** The space inside a mold into which material is injected.

**Clamp:** The part of an injection molding machine incorporating the platens that provides the force necessary to hold the mold closed during injection of the molten resin and open the mold to eject the molded part.

**Clamping Plate:** A plate fitted to a mold and used to fasten the mold to a platen.

**Clamping Pressure:** The pressure applied to the mold to keep it closed during a cycle, usually expressed in tons.

**Closed-loop Control:** System for monitoring complete, injection molding- process conditions of temperature, pressure and time, and automatically making any changes required to keep part production within preset tolerances.

**Cooling Channels:** Channels located within the body of a mold through which a cooling medium is circulated to control the mold surface temperature.

**Cushion:** Extra material left in barrel during cycle to try and ensure that the part is packed out during the hold time.

**Cycle:** The complete sequence of operations in a process to complete one set of moldings. The cycle is taken at a point in the operation and ends when this point is again reached and moving platens of the clamp unit in the fully open position.

**Cycle Time:** The time required by an injection molding system to mold a part.

**Dwell:** A pause in the applied pressure to a mold during the injection cycle just before the mold is completely closed. This dwell allows any gases formed or present to escape from the molding material.

**Ejector Pins:** Pins that are pushed into a mold cavity from the rear as the mold opens to force the finished part out of the mold. Also called knockout pins.

**Ejector Return Pins:** Projections that push the ejector assembly back as the mold closes. Also called surface pins or return pins.

**Ejector Rod:** A bar that actuates the ejector assembly when the mold opens.

**Family Mold:** A multi-cavity mold where each of the cavities forms one of the component parts of an assembled finished part.

**Fill:** The packing of the cavity or cavities of the mold as required to give a complete part or parts that are free of flash.

**Flow:** A qualitative description of the fluidity of a plastic material during the process of molding. A measure of its moldability generally expressed as melt flow rate or melt index.

**Gate:** An orifice through which the melt enters the mold cavity.

**Hot Tip Gate:** An injection molding method that uses a heated gate on the A-side of the part to eliminate the creation of any runner or sprue. The gate vestige will be a small sharp bump that can be trimmed if necessary.

**Hot Runner Mold:** A mold in which the runners are insulated from the chilled cavities and are kept hot. Hot Runner molds make parts that have no scrap.

**Injection:** The process of forcing melted resin into a mold.

**Injection Pressure:** The pressure on the face of the injection screw or ram when injecting material into the mold, usually expressed in PSI or BAR.

**Knockout Pins:** A rod or device for knocking a finished part out of a mold.

**L/D Ratio:** A term used to help define an injection screw. This is the screw length-to-diameter ratio.

**Manifolds:** distribute melt from the inlet component to one or more submanifolds within a Hot Runner.

**Melt Flow Rate:** A measure of the molten viscosity of a polymer determined by the weight of polymer extruded through an orifice under specified conditions of pressure and temperature. Particular conditions are dependent upon the type of polymer being tested. MFR usually is reported in grams per 10 minutes. Melt flow rate defines the flow of a polypropylene resin. An extrusion weight of 2160 grams at 446°F (230°C) is used.

**Melt Flow Index:** Term that defines the melt flow rate of a polyethylene resin. An extrusion weight of 2160 grams at 310°F (190°C) is used.

**Mold:** A series of machined steel plates containing cavities into which plastic resin is injected to form a part.

**Mold Frame:** A series of steel plates which contain mold components, including cavities, cores, runner system, cooling system, ejection system, etc.

**Mold-Temperature-Control Unit:** Auxiliary equipment used to control Hot Runner temperature. Some units can both heat and cool the mold. Others, called chillers, only cool the mold.



**Moving Platen:** The platen of an injection molding machine that is moved by a hydraulic ram or mechanical toggle.

**Multi-Cavity Mold:** A mold having two or more impressions for forming finished items in one machine cycle.

**Multi-Material Molding:** The injection of two-or-more materials, in sequence, into a single mold during a single molding cycle. The injection molding machine is equipped with two-or-more plasticators. (See also co-injection)

**Nest Plate:** A retainer plate in the mold with a depressed area for cavity blocks.

**Non-Fill:** See short shot.

**Non-Return Valve:** Screw tip that allows for material to flow in one direction and then closes to prevent backflow during injection.

**Machine Nozzle:** The hollow-cored, metal nose screwed into the injection end of a plasticator. The nozzle matches the depression in the mold. This nozzle allows transfer of the melt from the plasticator to the runner system and cavities.

**Packing:** The filling of the mold cavity or cavities as full as possible without causing undue stress on the molds or causing flash to appear on the finished parts. Over- or under-packing results in less than optimum fill.

**PET:** Polyethylene Terephthalate, a type of polyester and a leading recyclable plastic material.

**Pinpoint Gate:** A restricted gate of 0.030 in. or less in diameter, this gate is common on Hot Runner molds.

**Platens:** The mounting plates of a press on which the mold halves are attached.

**Preform:** A plastic test tube shaped part produced by injection molding systems in the first step of a two-stage injection molding and blow molding process used to produce PET bottles or containers. The preform is subsequently re-heated and stretch blown through a blow molding process into the final container shape.

**Pressure Disk:** Manifold component designed to be compressed by thermal expansive forces to form part of the plastic sealing mechanism. Also helps to reduce thermal transfer to a minimum.

**Process:** The injection molding environment consisting of input variables such as temperature, pressure, injection rates and time that are controlled to fill the mold while optimizing the trade-offs between cosmetics and dimensional accuracy.

**Ram:** The forward motion of the screw in the barrel that forces the melt into the mold cavity.

**Recovery Time:** The length of time for the screw to rotate and create a shot.

**Retainer Plate:** The plate on which demountable pieces, such as mold cavities, ejector pins, guide pins and bushings are mounted during molding.

**Ring Gate:** Used on some cylindrical shapes. This gate encircles the core to permit the melt to first move around the core before filling the cavity.

**Runner:** The channel that connects the sprue with the gate for transferring the melt to the cavities.

**Runnerless Molding:** See Hot Runner mold.

**Screw Travel:** The distance the screw travels forward when filling the mold cavity.

**Shear:** The force between layers of resin as they slide against each other or the surface of the mold. The resulting friction causes some heating of the resin.

**Short Shot:** Failure to completely fill the part or cavities of the mold. Edges may appear melted.

**Shot:** The complete amount of melt injected during a molding cycle, including that which fills the runner system.

**Shot Capacity:** Generally based on polystyrene, this is the maximum weight of plastic that can be displaced or injected by a single injection stroke. Generally expressed as ounces of polystyrene.

**Single-Cavity Mold:** A mold having only one cavity and producing only one finished part per cycle.

**Sprue Bushing:** A hardened-steel insert in the mold that accepts the Screw nozzle and provides an opening for transferring the melt.

**Sprue Gate:** A passageway through which melt flows from the nozzle to the mold cavity.

**Sprue:** The feed opening provided in injection molding between the nozzle and cavity or runner system.

**Stationary Platen:** The large front plate of an injection molding press to which the front plate of the mold is secured. This platen does not move during normal operation.

**Thermoplastic:** A polymer which melts or flows when heated. Thermoplastic polymers are usually not highly cross-linked, and act much like molecular solids: low melting and boiling points, high ductile strength.

**Thermoset:** A polymer that does not melt when heated. Thermoset polymers “set” into a given shape when first made and afterwards do not flow or melt, but rather decompose upon heating. They are often highly cross-linked polymers, with properties similar to those of network covalent solids, i.e., hard and strong.

**Valve Disk:** Manifold component designed to be compressed by thermal expansive forces to form part of the plastic sealing mechanism. Its high tolerance bore allows the valve pin to shift through it without plastic leakage and part of it enters the melt stream and helps guide the plastic flow without stagnation.

**Valve Gating:** An injection molding method that uses a mechanical shut off to open and close the gate orifice.

**Vent:** A shallow channel or opening cut in the cavity to allow air or gases to escape as the melt fills the cavity.

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