



Dura[®]+ **PLUS**



Dura+ User Manual version 01

Original Instructions



Table of Contents

Section 1 - Introduction	1-1
1.1 OVERVIEW	1-1
1.2 INTENDED USE	1-1
1.3 OPERATOR TRAINING AND SAFETY	1-1
1.4 DOCUMENTATION	1-2
1.5 WARRANTY	1-2
1.6 RELEASE DETAILS	1-2
1.7 COPYRIGHT	1-2
1.8 TRADEMARKS AND PATENTS	1-3
 Section 2 - Global Support	 2-1
2.1 MANUFACTURING FACILITIES	2-1
2.2 REGIONAL OFFICES	2-1
2.3 INTERNATIONAL REPRESENTATIVES	2-2
 Section 3 - Safety	 3-1
3.1 SAFETY HAZARDS	3-2
3.2 SAFETY SYMBOLS TYPICAL TO INJECTION MOLDING MACHINES	3-5
3.3 DURA PLUS SAFETY HAZARDS	3-7
3.4 DISPOSAL	3-9
 Section 4 - Preparation	 4-1
4.1 TOOLS REQUIRED	4-1
4.2 SCREW LENGTHS	4-2
4.3 UNPACKING	4-2
4.4 CLEANING	4-3
 Section 5 - Assembly	 5-1
5.1 TYPICAL DURA PLUS SYSTEM	5-1
5.2 PRE-ASSEMBLY CHECKS OF GATE SEALS AND NOZZLE	5-2
5.3 ASSEMBLY OF GATE SEALS TO NOZZLE	5-3
5.4 THERMOCOUPLE INSTALLATION FOR 01 NOZZLE	5-4
5.4.1 NOZZLE FLANGE ASSEMBLY	5-6
5.5 SUB-MANIFOLD ASSEMBLY FOR DROP-IN SYSTEM	5-9
5.5.1 INSTALL VALVE DISK (VALVE DISK DESIGN)	5-9
5.5.2 PNEUMATIC SYSTEM INSTALLATION	5-12
5.5.3 HYDRAULIC SYSTEM INSTALLATION	5-15
5.6 ACTUATOR ASSEMBLY	5-20
5.6.1 INSTALL PNEUMATIC ACTUATOR ASSEMBLY	5-20
5.6.2 INSTALL HYDRAULIC ACTUATOR ASSEMBLY	5-24
5.7 INSTALL SUB-MANIFOLD HEATER PLATES (IF APPLICABLE)	5-29
5.8 INSTALL BRIDGE HEATER PLATES (IF APPLICABLE)	5-30
5.8.1 INSTALLING HEATER PLATE THERMOCOUPLE	5-30
5.8.2 INSTALL HEATER PLATES	5-30

5.9 TUBULAR HEATER INSTALLATION AND REPLACEMENT FOR BRIDGE	
FOR FIELD REPLACEMENT OF FLEXIBLE HEATERS ONLY	5-31
5.9.1 STORAGE	5-31
5.9.2 REMOVING A HEATER ELEMENT	5-32
5.9.3 INSTALLING A NEW HEATER ELEMENT	5-32
5.10 BRIDGE ASSEMBLY	5-35
5.10.1 INSTALLATION OF INLET COMPONENTS	5-35
5.10.2 HEATED BACK PLATE INSTALLATION	5-35
5.10.3 INLET EXTENSION WITH HEATER SLEEVES	5-37
5.10.4 WIRING CHANNEL	5-40
5.10.5 SUB-MANIFOLD WIRING	5-41
5.10.6 POWER WIRING	5-41
5.10.7 THERMOCOUPLE WIRING	5-42
5.10.8 PREPARING TO WIRE THE BRIDGE	5-42
5.10.9 WIRING CHANNEL INSTALLATION	5-43
5.10.10 ELECTRICAL BOX	5-45
5.10.11 SOLENOID VALVE WIRING	5-45

Section 6 - Electrical Testing.....6-1

6.1 WIRING CHECK	6-1
6.2 GROUND SHORTS TEST	6-2
6.3 THERMOCOUPLE CONTINUITY TEST	6-2
6.4 PINCH POINT TEST	6-3
6.5 HEATER CONTINUITY	6-3
6.6 THERMOCOUPLE WIRING GUIDELINES	6-3
6.7 HEATING TEST WITH A TEMPERATURE CONTROLLER	6-4
6.8 RETESTING	6-4

Section 7 - System Installation.....7-1

7.1 PRIOR TO ASSEMBLY	7-1
7.1.1 WATER COOLING NOZZLE JACKET ASSEMBLY	7-1
7.1.2 INSTALL SUB-MANIFOLD ASSEMBLY	7-2
7.1.3 INSTALL MANIFOLD LOCATOR AND ANTI-ROTATION DOWEL	7-2
7.1.4 INSTALL BRIDGE ASSEMBLY	7-3
7.1.5 FINAL INSTALLATION STEPS	7-4

Section 8 - System Startup and Shutdown 8-1

8.1 STARTUP	8-1
8.2 SHUTDOWN	8-2

Section 9 - Maintenance Procedures.....9-1

9.1 TERMINAL END REMOVAL	9-2
9.2 TERMINAL ASSEMBLY	9-3
9.3 HEATER PLATE POWER LEAD REPLACEMENT	9-6
9.3.1 REMOVAL	9-6
9.3.2 INSTALLATION	9-6
9.4 GATE SEAL MAINTENANCE	9-7
9.5 MULTI-CAVITY SYSTEMS	9-7

9.6 GATE SEAL REMOVAL.....	9-8
9.7 GATE SEAL REPLACEMENT	9-9
9.8 CHECKING NOZZLE TIP HEIGHT	9-11
9.9 NOZZLE THERMOCOUPLE REMOVAL.....	9-12
9.10 TORQUE SETTINGS	9-12
9.10.1 GATE SEAL TORQUE SETTINGS.....	9-12
9.10.2 SYSTEM AND PLATE SCREW TORQUES	9-13

Section 10 - Troubleshooting 10-1

10.1 MOISTURE RELATED ISSUES	10-1
10.1.1 RESIN MOISTURE CONTAMINATION	10-1
10.1.2 RESIN DRYING ISSUES.....	10-1
10.1.3 IMPORTANCE OF PRE-DRYING RESIN.....	10-2
10.2 PRE-MOLDING PRECAUTIONS	10-2
10.2.1 HISTORY	10-2
10.2.2 MATERIAL	10-2
10.2.3 HARDWARE	10-2
10.2.4 SETTINGS.....	10-3
10.3 ESTABLISHING ROOT CAUSE	10-3
10.4 FAULT IDENTIFICATION	10-3
10.5 TROUBLESHOOTING TYPICAL PROBLEMS.....	10-4
10.5.1 DARK SPECKS	10-4
10.5.2 BLISTERS OR BUBBLES	10-5
10.5.3 FLOW MARKS.....	10-6
10.5.4 BURN MARKS.....	10-7
10.5.5 DELAMINATING PARTS	10-8
10.5.6 DIMENSIONAL IRREGULARITIES	10-9
10.5.7 DISCOLORED PARTS	10-10
10.5.8 FLASH	10-11
10.5.9 JETTING.....	10-12
10.5.10 PITTED PARTS	10-13
10.5.11 ROUGH SURFACE.....	10-14
10.5.12 PARTS STICKING TO CAVITY.....	10-15
10.5.13 PARTS STICKING TO CORE.....	10-16
10.5.14 SHORT PARTS.....	10-17
10.5.15 SINKS OR VOIDS	10-18
10.5.16 SPLAY	10-19
10.5.17 STREAKS	10-20
10.5.18 STRINGING.....	10-21
10.5.19 WARPED PARTS	10-22
10.5.20 WELD LINES.....	10-23
10.5.21 VESTIGE OR TEMPERATURE MARKS AT GATE	10-24

Section 11 - Glossary of Terms 11-1

Index 11-7

List of Tables

TABLE 1-1 RELEASE DETAILS 1-2

TABLE 3-1 SAFETY HAZARDS 3-3

TABLE 3-2 TYPICAL SAFETY SYMBOLS 3-5

TABLE 9-1 CRIMPING TOOL CHART.....9-1

TABLE 9-2 GATE SEAL TORQUE SETTINGS 9-12

TABLE 9-3 TORQUE CHART FOR SYSTEM ASSEMBLY SCREWS.....9-13

TABLE 9-4 TORQUE CHART FOR PLATE ASSEMBLY SCREWS 9-13

List of Figures

FIGURE 3-1 INJECTION MOLDING MACHINE HAZARD AREAS.....	3-2
FIGURE 4-1 TOOLKIT REQUIRED.....	4-1
FIGURE 4-2 SCREW LENGTH.....	4-2
FIGURE 5-1 TYPICAL DURA PLUS SYSTEM.....	5-1
FIGURE 5-2 PNEUMATIC CYLINDER COMPONENTS.....	5-20
FIGURE 5-3 HYDRAULIC CYLINDER ASSEMBLY COMPONENTS.....	5-24
FIGURE 5-4 BACK PLATE (HEATED).....	5-36
FIGURE 5-5 WIRING CHANNEL.....	5-40
FIGURE 6-1 MOLD PLUG.....	6-2
FIGURE 7-1 LOCATOR SURFACE.....	7-2
FIGURE 9-1 NOZZLE TERMINAL ASSEMBLY.....	9-2
FIGURE 9-2 NOZZLE TERMINAL ASSEMBLY.....	9-5
FIGURE 9-3 TERMINAL END ASSEMBLY.....	9-6
FIGURE 9-4 CLEANING LOCATIONS.....	9-9

Section 1 - Introduction

We would like to take this opportunity to thank you for purchasing a *Mold-Masters* Dura Plus hot runner. The purpose of this manual is to assist users in the integration, operation and maintenance of *Mold-Masters* systems. 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 Overview

With standard components and drop-in features, the Dura Plus system is a clear choice for automotive lens and housing applications. The Dura Plus system ensures faster delivery time, easy installation, quick startups and user-friendly maintenance.

1.2 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.

1.3 Operator Training and Safety

Before unpacking, moving, integrating or using the equipment, please read the manual, especially “Section 3 - Safety”, for important information. Please also 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 also the obligation of the employer to properly train and instruct its personnel in the safe operation of equipment, including maintenance and the use of all the safety devices. In addition, the employer must provide its personnel with all necessary protective clothing, including a face shield and heat resistant gloves.



1.4 Documentation

NOTE

This manual should also be used in conjunction with any appropriate *Mold-Masters* Temperature Controller User Manual.

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 drawings used to integrate your hot runner system into the mold.
- Hot half drawing used to integrate hot half to cavity plate, if applicable.
- CE declaration of conformity and declaration of incorporation (EU only).

1.5 Warranty

Warranty details are provided with your order documentation. Please do not return any parts to *Mold-Masters* without preauthorization and a return authorization number supplied by *Mold-Masters* Limited.

1.6 Release Details

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

Table 1-1 Release Details		
Document #	Release Date	Version
DP-UM-EN-00-01	June 2017	01-1

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Section 2 - Global Support

2.1 Manufacturing Facilities

GLOBAL HEADQUARTERS

CANADA

Mold-Masters (2007) Limited
233 Armstrong Avenue
Georgetown, Ontario
Canada L7G 4X5
tel: +1 905 877 0185
fax: +1 905 873 2818
info@moldmasters.com

SOUTH AMERICAN HEADQUARTERS

BRAZIL

Mold-Masters do Brasil Ltda.
Estrada Municipal Mineko Ito, nº4305
Loteamento Industrial Vecon Zeta
Sumaré/ SP
Brazil
tel: +55 19 3518 0699
fax: +55 19 3518 0699
vendas@moldmasters.com.br

UNITED KINGDOM

Mold-Masters (UK) Ltd
Netherwood Road
Rotherwas Ind. Est.
Hereford, HR2 6JU
United Kingdom
tel: +44 1432 265768
fax: +44 1432 263782
uk@moldmasters.com

EUROPEAN HEADQUARTERS

GERMANY / SWITZERLAND

Mold-Masters Europa GmbH
Postfach/P.O. Box 19 01 45
76503 Baden-Baden, Germany
Neumattweg 1
76532 Baden-Baden, Germany
tel: +49 7221 50990
fax: +49 7221 53093
europe@moldmasters.com

INDIA

Mold-Masters Technologies
Private Limited
247, Alagesan Road,
Shiv Building, Saibaba Colony.
Coimbatore T. N.
India 641 011
tel: +91 422 423 4888
fax: +91 422 423 4800
mmtplinfo@moldmasters.com

U.S.A.

Mold-Masters Injectioneering LLC
29111 Stephenson Highway
Madison Heights, MI 48071, USA
tel: +1 800 450 2270 (USA only)
tel: +1 (248) 544-5710
fax: +1 (248) 544-5712
mmi-inq@moldmasters.com

ASIAN HEADQUARTERS

CHINA/HONG KONG/TAIWAN

Mold-Masters (KunShan) Co, Ltd
Zhao Tian Rd
Lu Jia Town, KunShan City
Jiang Su Province
People's Republic of China
tel: +86 512 86162882
fax: +86 512-86162883
mmc-sales@moldmasters.com

JAPAN

Mold-Masters K.K.
1-4-17 Kurikidai, Asaoku
Kawasaki, Kanagawa
Japan, 215-0032
tel: +81 44 986 2101
fax: +81 44 986 3145
info@mmkk.co.jp

2.2 Regional Offices

AUSTRIA / East and South East Europe

Mold-Masters Handelsges.m.b.H.
Pyhrnstrasse 16
A-4553 Schlierbach
Austria
tel: +43 7582 51877
fax: +43 7582 51877 18
at@moldmasters.com

KOREA

Mold-Masters Korea Ltd
708 Byucksan Digital Valley 5 Cha,
60-73 Gasan-dong, Geumcheon-gu,
Seoul, 153-788, South Korea
tel: +82 2 2082 4755
fax: +82 2 2082 4756
mmkr-sales@moldmasters.com

CZECH REPUBLIC

Mold-Masters Europa GmbH
Hlavni 823
75654 Zubri
Czech Republic
tel: +420 571 619 017
fax: +420 571 619 018
cz@moldmasters.com

MEXICO

MM Hot Runner Injection México,
S.A. de C.V.
Av. San Carlos No. 4 – Nave 2
Parque Industrial Lerma
Lerma, Estado de México
52000, México
tel: +52 728 282 48 33
fax: +52 728 282 47 77
mexico@moldmasters.com

FRANCE

Mold-Masters France
ZI la Marinière,
2 Rue Bernard Palissy
91070 Bondoufle
tel: +33 (0) 1 78 05 40 20
fax: +33 (0) 1 78 05 40 30
fr@moldmasters.com

POLAND

Mold-Masters Europa GmbH
Skr. Pocztowa 59
00-908 Warszawa
Poland
tel: +48 (0) 66 91 80 888
fax: +48 (0) 66 91 80 208
pl@moldmasters.com

**Regional offices - continued****SINGAPORE / MALAYSIA****INDONESIA / THAILAND**

Mold-Masters Singapore PTE. Ltd.
No 48 Toh Guan Road East
#06-140 Enterprise Hub
Singapore 608586
Republic of Singapore
tel: +65 6261 7793
fax: +65 6261 8378
mmsinfo@moldmasters.com

SPAIN

Ferromatik Milacron /
Mold Masters Europa GmbH
C/. Enric Morera, 7
Polig. Ind. Foinvasa
08110 Montcada i Reixac
Barcelona, Spain
tel: +34 93 575 41 29
fax: +34 93 575 34 19
es@moldmasters.com

TURKEY

Mold-Masters Europa GmbH
Merkezi Almanya Türkiye İstanbul
Şubesi
Alanaldı Caddesi Bahçelerarası
Sokak No:31 D:1
İçerenköy-Ataşehir/İSTANBUL
tel: +90 216 577 32 44
fax: +90 216 577 32 45
turkey@moldmasters.com

2.3 International Representatives**Argentina**

Sollwert S.R.L.
La Pampa 2849 2^o B
C1428EAY Buenos Aires
Argentina
tel: +54 11 4786 5978
fax: +54 11 4786 5978 Ext. 35
sollwert@fibertel.com.ar

Australia

Comtec I P E
1084 South Road,
Edwardstown, South Australia 5039
PO Box 338, Magill,
South Australia 5072
tel: +61 8 8374 4633
fax: +61 8 8299 0892
jehmann@comteceipe.com
kwillner@comteceipe.com

Bulgaria

Mold-Trade OOD
62, Aleksandrovska St.
Ruse City
Bulgaria
tel: +359 82 821 054
fax: +359 82 821 054
contact@mold-trade.com

Denmark, Norway, Sweden

Englmayer A/S
Skenkelsovej 9,
DK - 3650 Oelstykke, Denmark
tel: +45 46 733847
fax: +45 46 733859
support@englmayer.dk

Finland

Oy Scalar Ltd.
Viertolantie 12
11120 Riihimäki, Finland
tel: +358 10 387 2955
fax: +358 10 387 2950
info@scalar.fi

Greece

Ionian Chemicals S.A.
21 Pentelis Ave.
15235 Vrilissia
Athens, Greece
tel: +30 210 6836918-9
fax: +30 210 6828881
m.pavlou@ionianchemicals.gr

Ireland

Bray Engineering Services
Mr. Liam Shortt
Unit F3
Network Enterprise Business Park
Kilcoole, Co. Wicklow, Ireland
tel: +353 1 201 5088
fax: +353 1 201 5099
info@BrayEngineeringServices.com

Israel

ASAF INDUSTRIES Ltd.
29 Habanai Street
PO Box 5598 Holon 58154
Israel
tel: +972 3 5581290
fax: +972 3 5581293
sales@asaf.com

Italy

Commerciale Isola SPA
Via G.B. Tiepolo 3
35010 Cadoneghe, (Padova)
Italy
tel: +39 49 706600
fax: +39 49 8874231
info@com-isola.it

Portugal

Gecim LDA
Rua Fonte Dos Ingleses, No 2
Engenho
2430-130 Marinha Grande,
Portugal
tel: +351 244 575600
fax: +351 244 575601
gecim@gecim.pt

Romania

Tehnic Mold Trade SRL
Str. W. A Mozart nr. 17
Sect. 2
020251 Bucharesti
Romania
tel: +4 021 230 60 51
fax: +4 021 231 05 86
contact@matritehightech.ro

Russia

PORTMOLD Company LC
Gefsimanskies prudy 4,
141307 Sergiev Posad
Russia
tel: +7 8 495 743 48 65
fax: +7 8 496 549 25 26
moldmasters@portmold.ru

South Africa

Mould & Die Solutions CC
98E Platinum Junction
School Road
Milnerton, Cape Town, 7441
P.O. Box 669
Edgemad, 7407
tel: +27 021 555 2701
fax: +27 021 555 2707
info@m-d-s.co.za

Vietnam

Mold-Masters Singapore PTE. Ltd.
No 48 Toh Guan Road East
#06-140 Enterprise Hub
Singapore 608586
Republic of Singapore
tel: +65 6261 7793
fax: +65 6261 8378
mmsinfo@moldmasters.com

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

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



WARNING

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

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

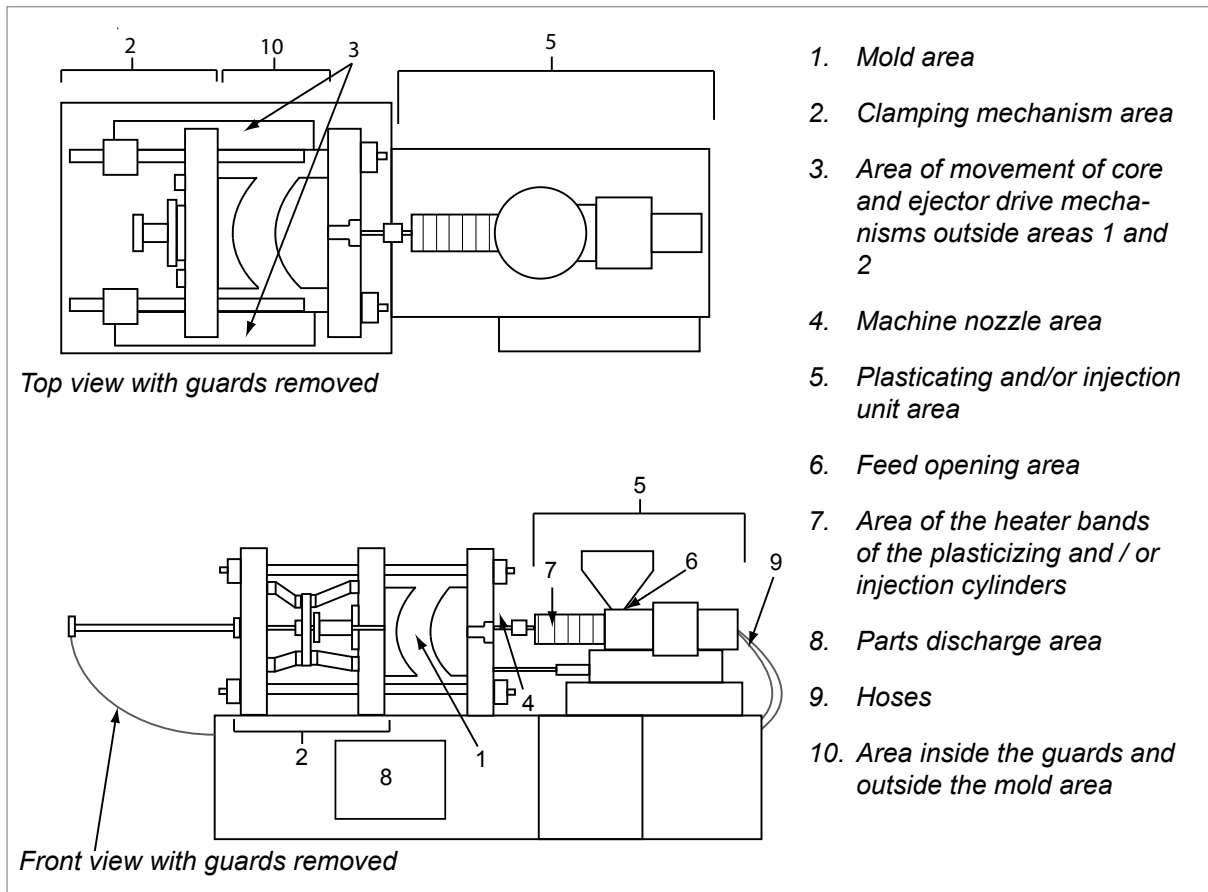


Figure 3-1 Injection molding machine hazard areas



Table 3-1 Safety Hazards

Hazard Area	Potential Hazards
Mold Area Area between the platens See Figure 3-1 area 1	Mechanical Hazards Crushing and / or shearing and / or impact hazards caused by: • Movement of the platen • Movements of the injection barrel(s) into the mold area • Movements of cores and ejectors and their drive mechanisms • Tie bar motion Thermal Hazards Burns and / or scalds due to operating temperature of: • The mold heating elements • Plasticized material released from / through the mold
Clamping Mechanism Area See Figure 3-1 area 2	Mechanical Hazards Crushing and / or shearing and/or impact hazards caused by: • Movement of the platen • Movement of the drive mechanism of the platen • Movement of the core and ejector drive mechanism
Movement of Drive Mechanisms Outside the Mold Area and Outside the Clamping Mechanism Area See Figure 3-1 area 3	Mechanical Hazards Mechanical hazards of crushing, shearing and / or impact caused by the movements of: • Core and ejector drive mechanisms
Nozzle Area The nozzle area is the area between the barrel and the sprue bushing. See Figure 3-1 area 4	Mechanical Hazards Crushing, shearing hazards, and / or impact hazards caused by: • Forward movement of the plasticizing and / or injection unit including nozzle • Movements of parts of the power operated nozzle shutoff and their drives • Over pressurization in the nozzle Thermal Hazards Burns and or scalds due to operating temperature of: • The nozzle • Plasticized material discharging from the nozzle
Plasticizing and / or Injection Unit Area 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	Mechanical Hazards Crushing, shearing and / or drawn-into hazards caused by: • Unintentional gravity movements e.g. for machines with plasticizing and/or injection unit positioned above the mold area • The movements of the screw and/or the injection plunger in the cylinder accessible through the feed opening • Movement of the carriage unit Thermal Hazards Burns and or scalds due to operating temperature of: • The plasticizing and / or injection unit • The heating elements e.g. heater bands • The plasticized material and / or vapors discharging from the vent opening, feed throat or hopper Mechanical and / or Thermal Hazard Hazards due to reduction in mechanical strength of the plasticizing and / or injection cylinder due to overheating



Table 3-1 Safety Hazards

Hazard Area	Potential Hazards
Feed Opening See Figure 3-1 area 6	Pinching and crushing between injection screw movement and housing.
Area of the Heater Bands of the Plasticizing and / or Injection Cylinders See Figure 3-1 area 7	Burns and / or scalds due to operating temperature of: • The plasticizing and / or injection unit • The heating elements e.g. heater bands • The plasticized material and / or vapors discharging from the vent opening, feed throat or hopper
Parts Discharge Area See Figure 3-1 area 8	Mechanical Hazards Accessible through the discharge area Crushing, shearing and / or impact hazards caused by: • Closing movement of the platen • Movements of cores and ejectors and their drive mechanisms Thermal Hazards Accessible through the discharge area Burns and or scalds due to operating temperature of: • The mold • Heating elements of the mold • Plasticized material released from / through the mold
Hoses See Figure 3-1 area 9	• Whipping action caused by hose assembly failure • Possible release of fluid under pressure that can cause injury • Thermal hazards associated with hot fluid
Area Inside the Guards and Outside the Mold Area See Figure 3-1 area 10	Crushing and / or shearing and / or impact hazards caused by: • Movement of the platen • Movement of the drive mechanism of the platen • Movement of the core and ejector drive mechanism • Clamp opening movement
Electrical Hazards	• Electrical or electromagnetic disturbance generated by the motor control unit • Electrical or electromagnetic disturbance that can cause failures in the machine control systems and adjacent machine controls • Electrical or electromagnetic disturbance generated by the motor control unit
Hydraulic Accumulators	High pressure discharge.
Power Operated Gate	Crush or impact hazards caused by the movement of the power operated gates
Vapors and Gases	Certain processing conditions and / or resins can cause hazardous fumes or vapors.

3.2 Safety Symbols Typical to Injection Molding Machines

Table 3-2 Typical Safety Symbols	
Symbol	General Description
	General – Warning Indicates an immediate or potentially hazardous situation, which if not avoided, could result in a serious injury or death, and / or damage to equipment.
	Warning – Barrel Cover Grounding Strap 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.
	Warning – Crushing and / or Impact Points Contact with moving parts can cause serious crushing injury. Always keep guards in place.
	Warning – Crush Hazard Closing Mold
	Warning – Hazardous Voltage 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.
	Warning – High Pressure Overheated fluids may cause severe burns. Discharge pressure before disconnecting water lines.
	Warning – High Pressure Accumulator 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.
	Warning – Hot Surfaces Contact with exposed hot surfaces will cause serious burn injury. Wear protective gloves when working near these areas.
	Mandatory – Lockout / Tagout 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).
	Warning – Material Splashing Hazard 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.
	Warning – Read Manual Before Operation Personnel should read and understand all instructions in the manuals before working on equipment. Only properly trained personnel should operate the equipment.
	Warning – Slip, Trip or Fall Hazard 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
	Caution Failure to follow instructions may damage equipment
	Important Indicates additional information or used as a reminder

3.3 Dura Plus 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.
- It is highly recommended that all operators wear 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.
- Remove purgings from the machine immediately.
- 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 belt area with proper protecting sheet 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.
- 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.
- 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.
- 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.



Dura Plus Safety Hazards - continued

CAUTION

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.

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.

3.4 Disposal

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

**WARNING**

Milacron *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, including 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 as environmentally friendly waste or 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.

Section 4 - Preparation

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 for use on cap screws (4, 5, 6, 8 and 10 mm or imperial equivalent)
- 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: (sizes 0-6" and 0-150 mm) 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
- Die spotting blue compound: for checking face contact
- Sockets
- Lapping compound for valve gate systems
- Plastic face hammer
- Proper actuator installation / extraction tools
- Retaining ring pliers for bore diameter bigger than 65 mm
- Removal tool for crimp contacts when necessary



Figure 4-1 Toolkit required

4.2 Screw Lengths



WARNING

Be aware of warnings placed on the General Assembly drawing. 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.

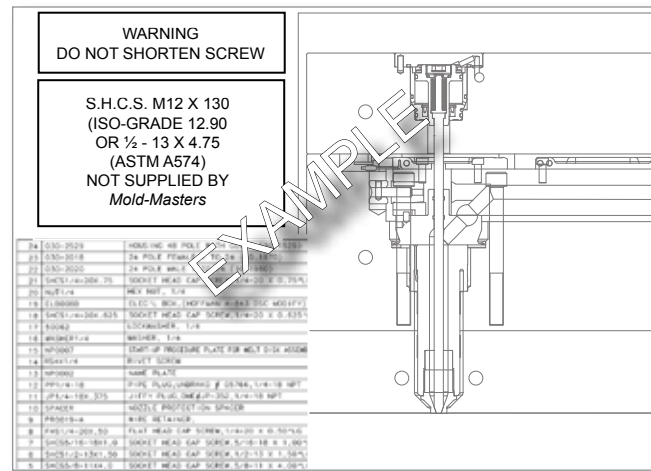


Figure 4-2 Screw Length

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 open the shipping crate and inspect contents. Secure loose items and check that the system is received in good condition and no damage occurred during shipment. Remove any documentation or spares packages and set aside.
2. After removing all restraints, attach the crane to the hoist and carefully remove the system from the shipping crate.
3. Check that all mold base dimensions are correct and correspond to *Mold-Masters* General Assembly drawing.

4.4 Cleaning

All nozzles, manifolds and hot runner components must be free of the rust inhibitor applied at the factory.

1. Remove protective covers from all gate seals.
2. Clean all surfaces and dowel holes, ensuring that no debris, burrs, shavings, dust, dirt or other foreign material which could interfere with measurements, exists. Ream holes out if necessary.
3. Remove tape from inlet and clean.

Section 5 - Assembly

Dura Plus systems are designed in modules for easy installation, quick startups and user friendly maintenance. However, depending on the type of system ordered, some systems may be supplied with certain additional components for “Plug & Play” function. Please refer to your General Assembly drawing for details on the system ordered.

The following detailed assembly instructions are largely for reference purposes. The wiring and plumbing instructions at the end of the section will be helpful for assembling the system.

See “Section 7 - System Installation” for instructions on installing your Dura Plus hot runner into an existing manifold plate system or spacer block system.

Optional Components / Features:

- Optional water cooling nozzle jacket

5.1 Typical Dura Plus System

An example Dura Plus system is provided below to illustrate the various components.

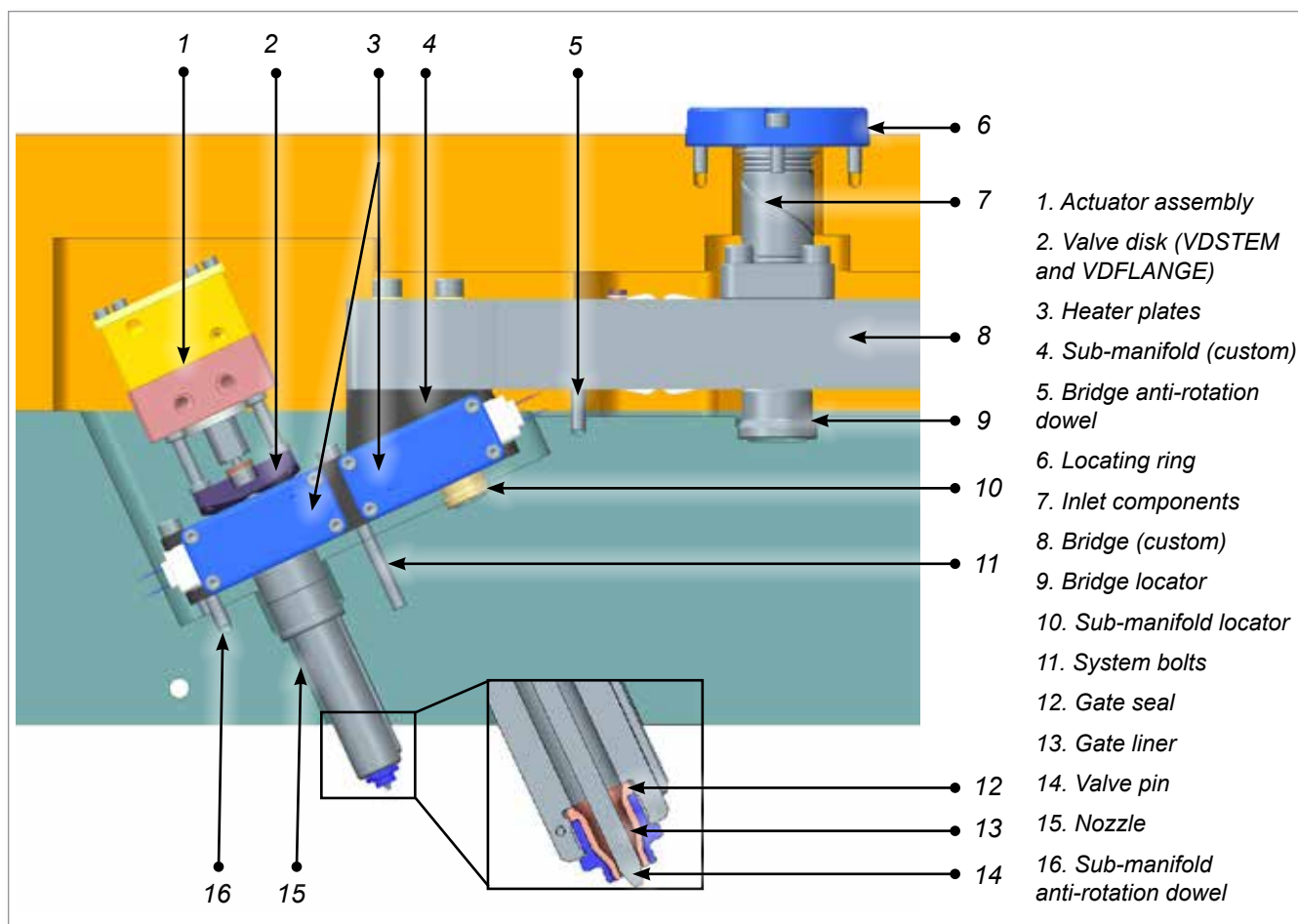


Figure 5-1 Typical Dura Plus system

5.2 Pre-assembly Checks of Gate Seals and Nozzle



CAUTION

Gate seals are torqued at ambient (room) temperature at *Mold-Masters*. Please torque each seal at processing temperature to the torque value specified to prevent material leakage from the gate seal.

1. Apply die spotting blue compound to the gate seal (and liner, if used) to ensure a proper contact on sealing surface.



2. Torque the gate seal to specified value. Refer to the General Assembly drawing for torque values.



3. Remove the gate seal and verify transfer of die spotting blue compound from gate to the liner and to nozzle. If not 100% blue on the face, contact your *Mold-Masters* representative.



4. Clean die spotting blue compound from components.

5.3 Assembly of Gate Seals to Nozzle

1. Apply anti-seize compound to all threaded interfaces.



2. Ensure all sealing surfaces are clean and dry.
3. Install gate seal and liner.



4. Torque to specified values. Refer to the General Assembly drawing for torque values.



5. Heat nozzle to processing temperature and re-torque seal.

5.4 Thermocouple Installation for 01 Nozzle



CAUTION

Ensure the terminal end of the thermocouple stays fully engaged in the slot while bending the thermocouple at the nozzle flange area.

1. Clean the thermocouple bore in the nozzle. For 2 mm thermocouples we suggest using a 2.1 mm drill in a pin vise.



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 is sufficient to reach the bottom of the thermocouple bore.

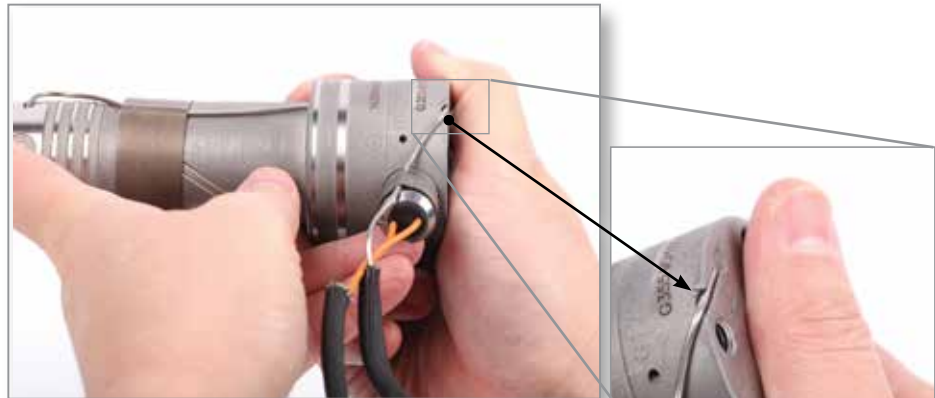


Thermocouple Installation for 01 Nozzle - continued

4. Press 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. 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. Check that the thermocouple is seated in the recess of the terminal end clip.



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



5.4.1 Nozzle Flange Assembly



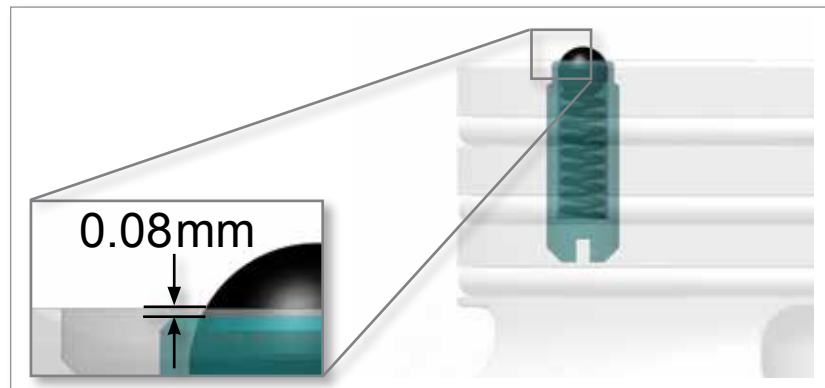
CAUTION

Nozzles should be torqued at ambient (room) temperature and then re-torqued at processing temperature to the torque value specified to prevent material leakage.

1. Apply anti-seize compound to the ball plunger threads.



2. Install the ball plunger into the flange with a 2.5 mm (0.10 in.) hex wrench. Make sure the ball plunger top surface is lower than the flange top surface by at least 0.08 mm (0.003 in.).



3. Apply die spotting blue compound to the thread to ensure a proper contact with the flange.

Nozzle Flange Assembly - continued

4. Apply anti-seize compound to the nozzle threads and then thread the nozzle into the flange. Torque nozzles to the following values:

For Hecto Nozzles: torque value is 135Nm (100 ft lb)

For Mega Nozzles: torque value is 183Nm (135 ftlb)

Remember to re-torque at process temperature when system assembly is complete.

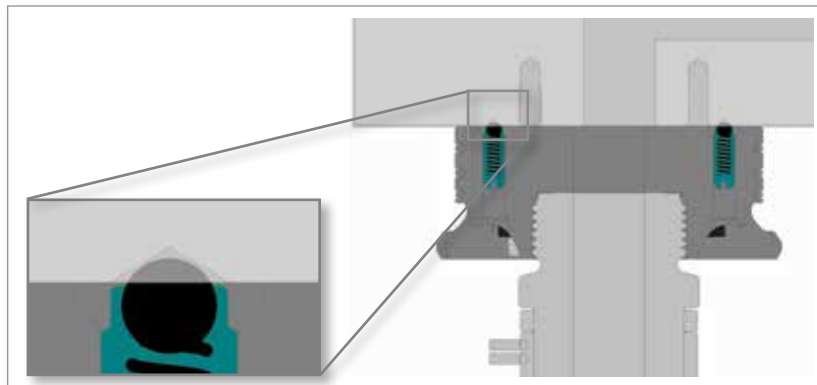


5. Insert five spring clips (SPRG15) into the M6 shoulder bolt (SHSSM6X25), and apply anti-seize compound to the thread.



Nozzle Flange Assembly - continued

6. Locate the nozzle assembly to the manifold by lining up the two ball plungers to the dimples on manifold bottom surface. Make sure the balls sit completely inside the dimple.



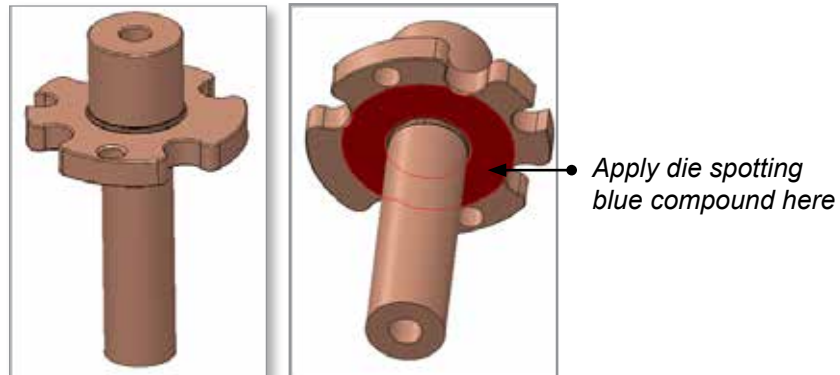
7. Torque the two M5 shoulder bolts to 9.5 Nm (84 lbf.in.).



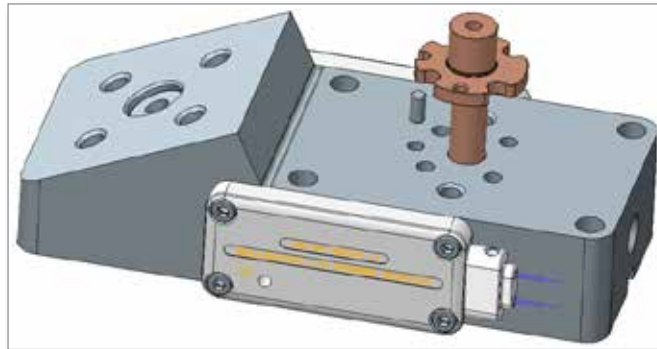
5.5 Sub-Manifold Assembly for Drop-In System

5.5.1 Install Valve Disk (Valve Disk Design)

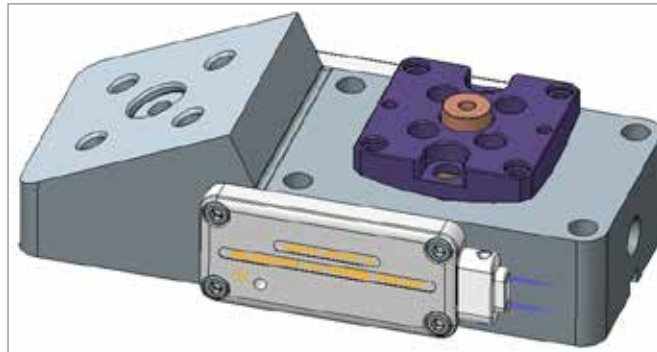
1. Apply die spotting blue compound to the valve disk stem.



2. Line up the valve disk stem into the manifold hole.

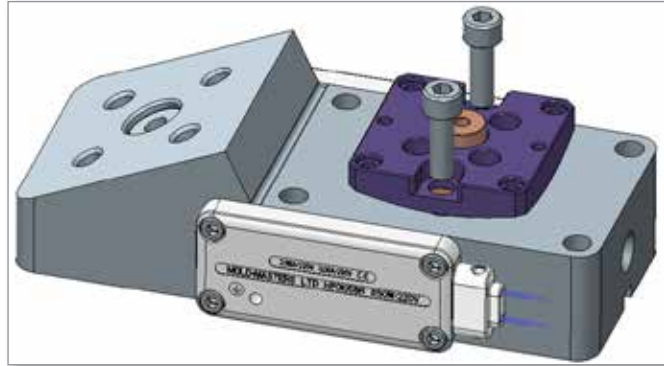


3. Install the valve disk flange on top of the valve disk stem.

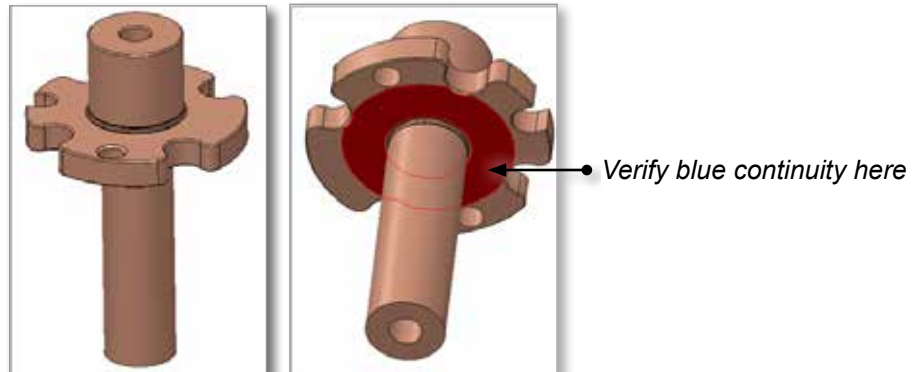


Install Valve Disk (Valve Disk Design) - continued

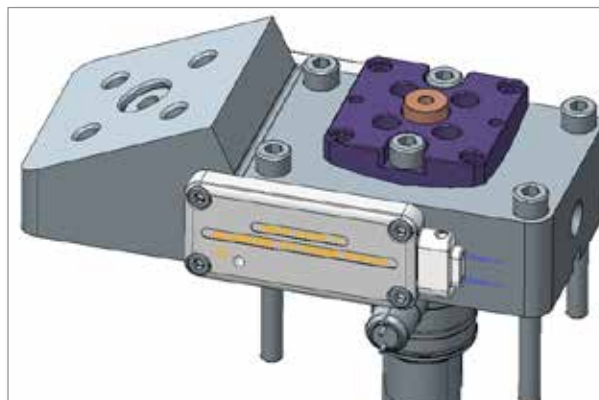
4. Install the screws and torque. Refer to the General Assembly drawing for torque values.



5. Remove valve disk stem and verify die spotting blue compound is continuous on valve disk stem or manifold contact surfaces.

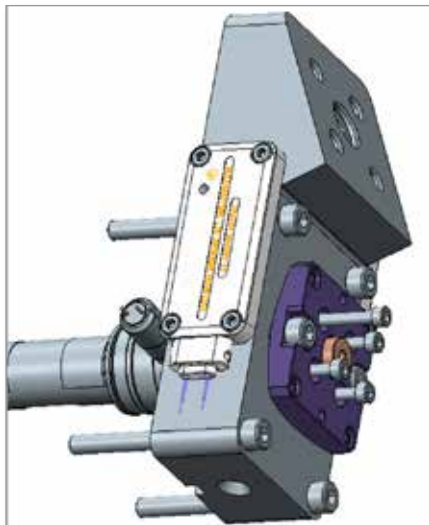


6. Clean die spotting blue compound from all components.
7. Apply anti-seize compound to screws, reinstall the valve disk stem and valve disk flange and torque in a crossing pattern. Refer to the General Assembly drawing for torque values.



Install Valve Disk (Valve Disk Design) - continued

8. Install the valve pin to verify fit.
9. Install screws in a crossing pattern to nozzle through the manifold.

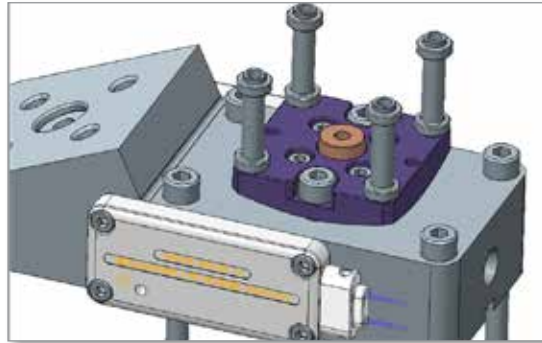
**NOTE**

Ensure nozzle terminal end is in the direction noted on the General Assembly drawing.

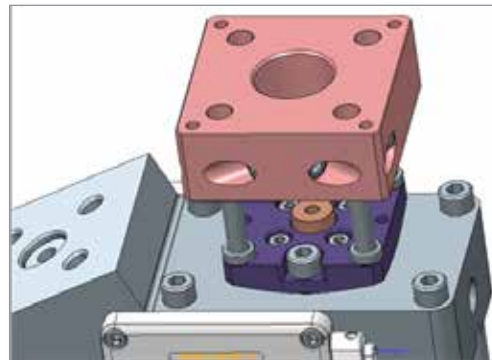


5.5.2 Pneumatic System Installation

1. Install the spacers on top of the manifold or valve disk flange.

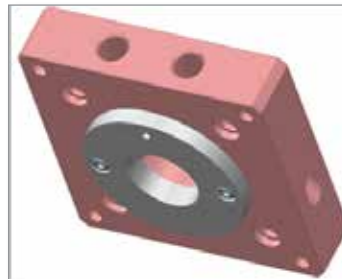


2. Locate the pneumatic cylinder cooling plate onto the spacers. Make sure to align the fitting ports in the appropriate direction.

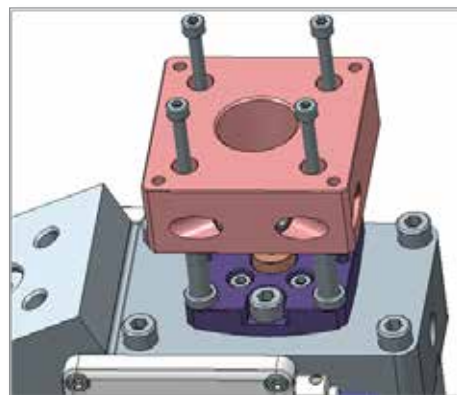


3. Apply anti-seize compound to screws.

Optional: Install anti-rotation collar to the bottom of cooling plate. Ensure proper alignment after reassembly.

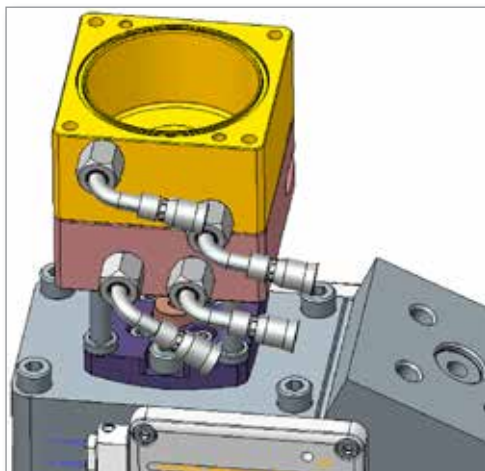


4. Torque screws in a crossing pattern gradually increasing torque to the specified value. Refer to the General Assembly drawing for torque values.



Pneumatic System Installation - continued

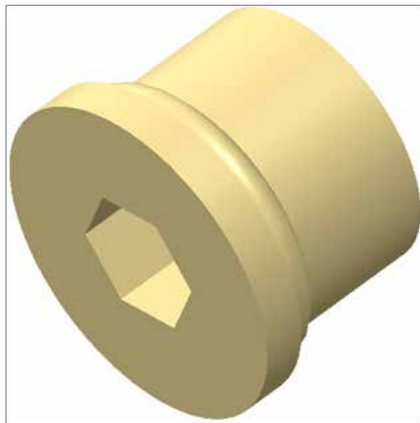
5. Place the cylinder housing onto the cylinder cooling plate.



6. Insert the valve pin into the piston.



7. Apply anti-seize compound to the piston top.



Pneumatic System Installation - continued

8. Install the piston top into the piston.

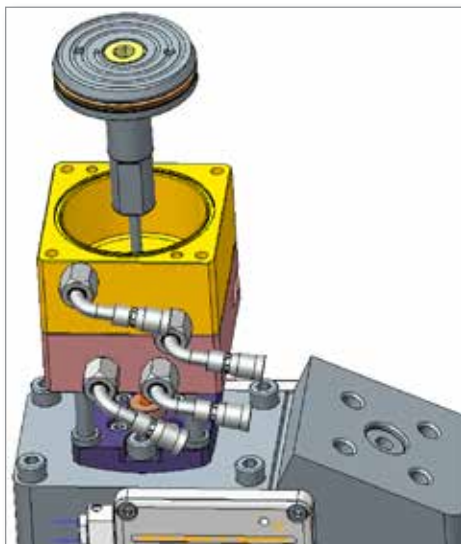


NOTE

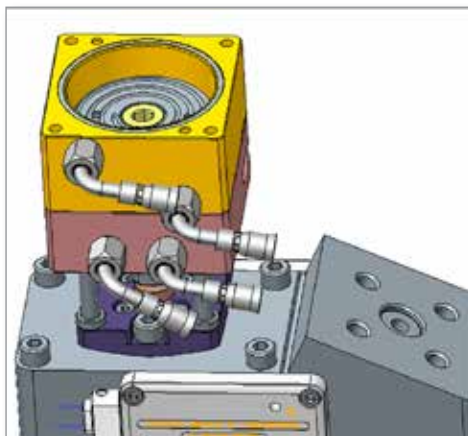
Use soft vise jaws with cutout for piston body to prevent damage to the part.



9. Install the piston into the cylinder housing.

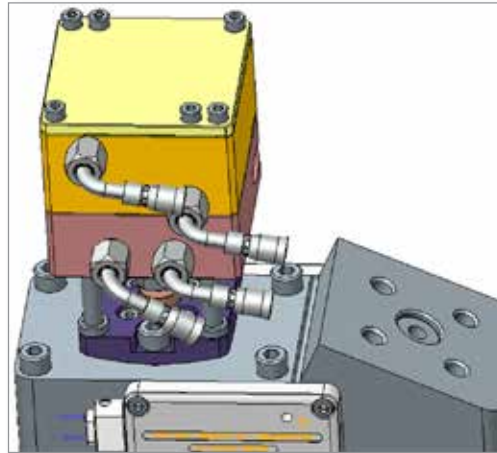


10. Install the cylinder top O-ring.



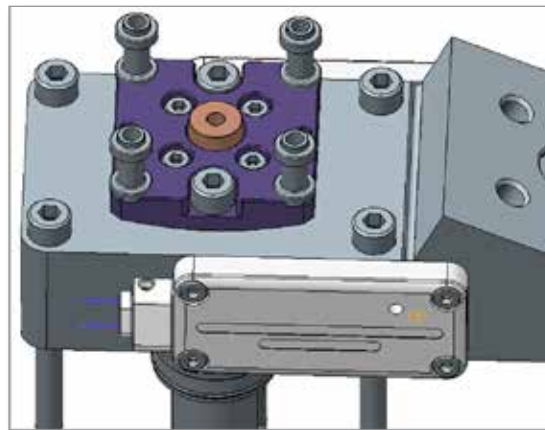
Pneumatic System Installation - continued

11. Install the cylinder top.
12. Apply anti-seize compound to the screws and torque the screws in a crossing pattern, gradually increasing torque to the specified value. Refer to the General Assembly drawing for torque values

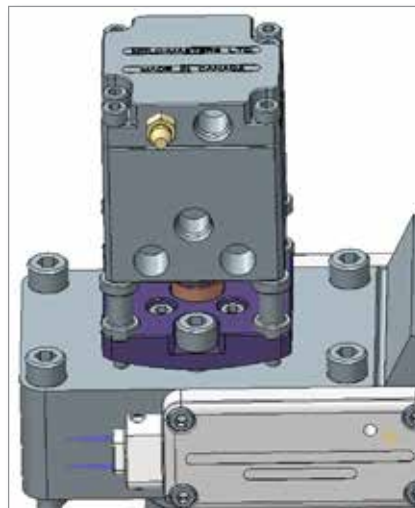


5.5.3 Hydraulic System Installation

1. Install the spacers on top of the manifold or valve disk flange.



2. Locate actuator on top of the spacers. Make sure to align the fitting ports in the appropriate direction.

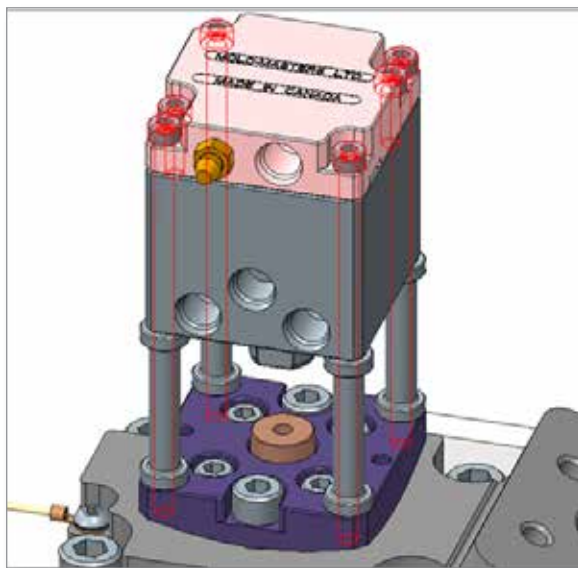


Hydraulic System Installation - continued

3. Apply anti-seize compound to the screws.



4. Torque screws in a crossing pattern, gradually increasing torque to the specified value. Refer to the General Assembly drawing for torque values.



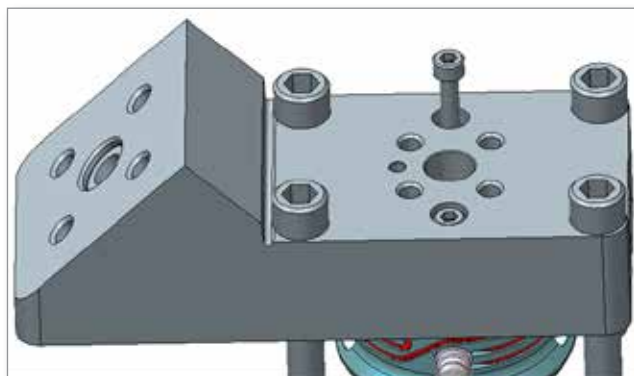
5.5.3.1 Install Valve Disk with Nozzle and Heater Sleeves

1. Place sub-manifold on nozzle with heater sleeves, install the screws and torque to the specified value. Refer to the General Assembly drawing for torque values.

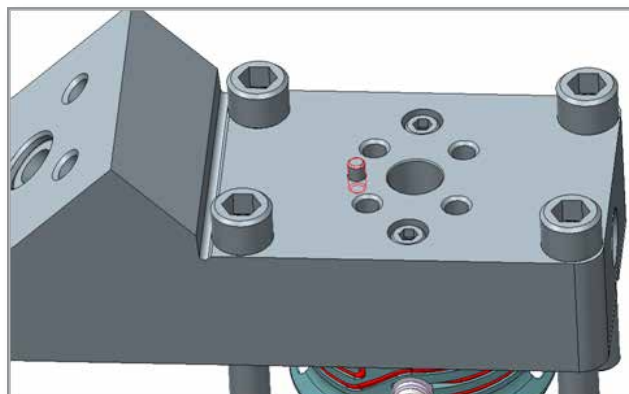


NOTE

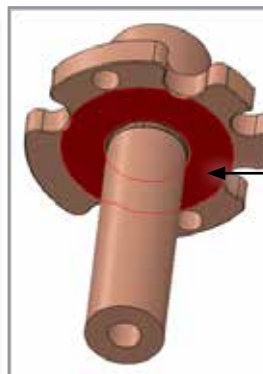
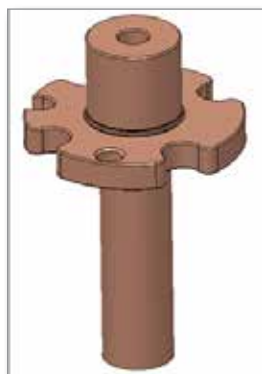
Heater plates are not shown in pictures below for clarity.



2. Install dowel pin.



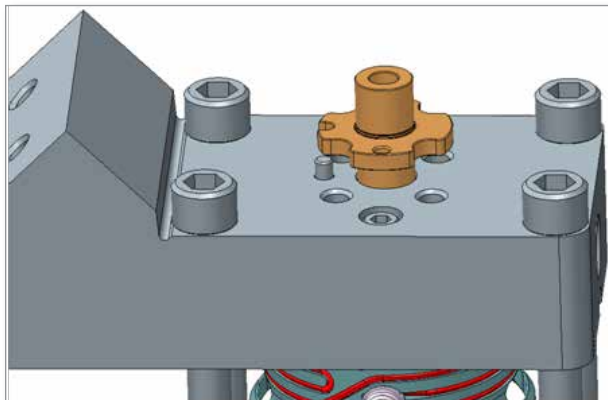
3. Apply die spotting blue compound valve disk stem.



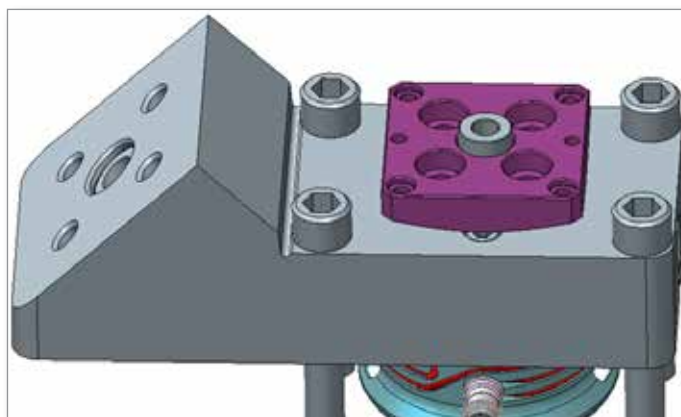
*Apply die spotting
blue compound here*

Install Valve Disk with Nozzle with Heater Sleeves - cont.

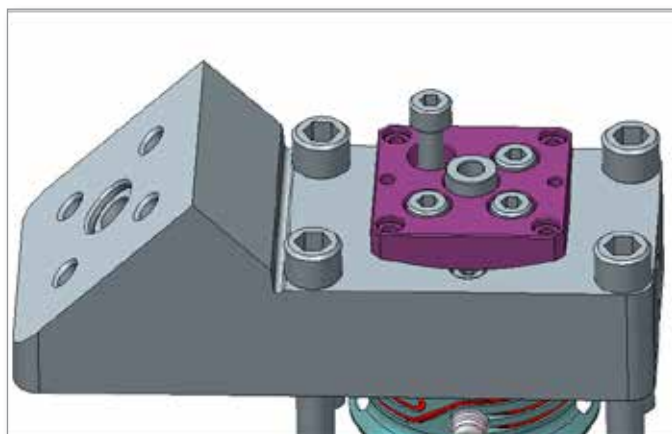
4. Line up the valve disk stem into the manifold hole. Install and confirm sealing contact.



5. Install valve disk flange on top of valve disk stem.

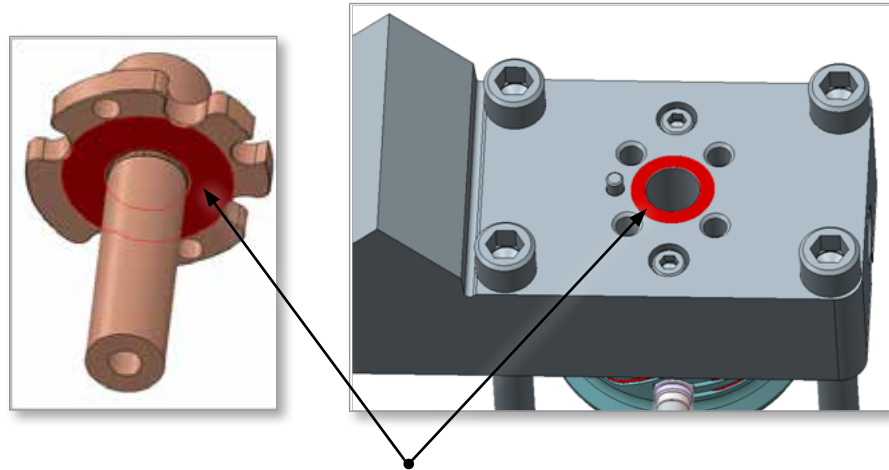


6. Install the screws and torque to the specific value. Refer to the General Assembly drawing for torque values.



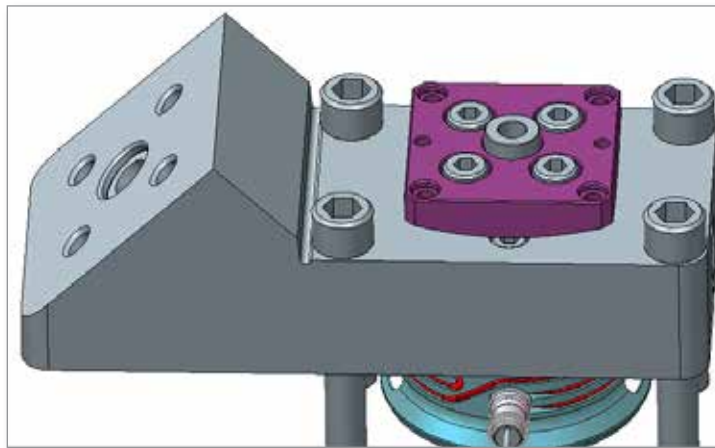
Install Valve Disk with Nozzle with Heater Sleeves - cont.

7. Remove valve disk stem and verify die spotting blue compound is continuous on valve disk stem / manifold contact surfaces.



Verify die spotting blue continuity

8. Clean die spotting blue compound from all components.
9. Apply anti-seize compound to the screws and reinstall the valve disk stem and valve disk flange, torquing in a crossing pattern to the specified value. Refer to the General Assembly drawing for torque values.



5.6 Actuator Assembly

5.6.1 Install Pneumatic Actuator Assembly

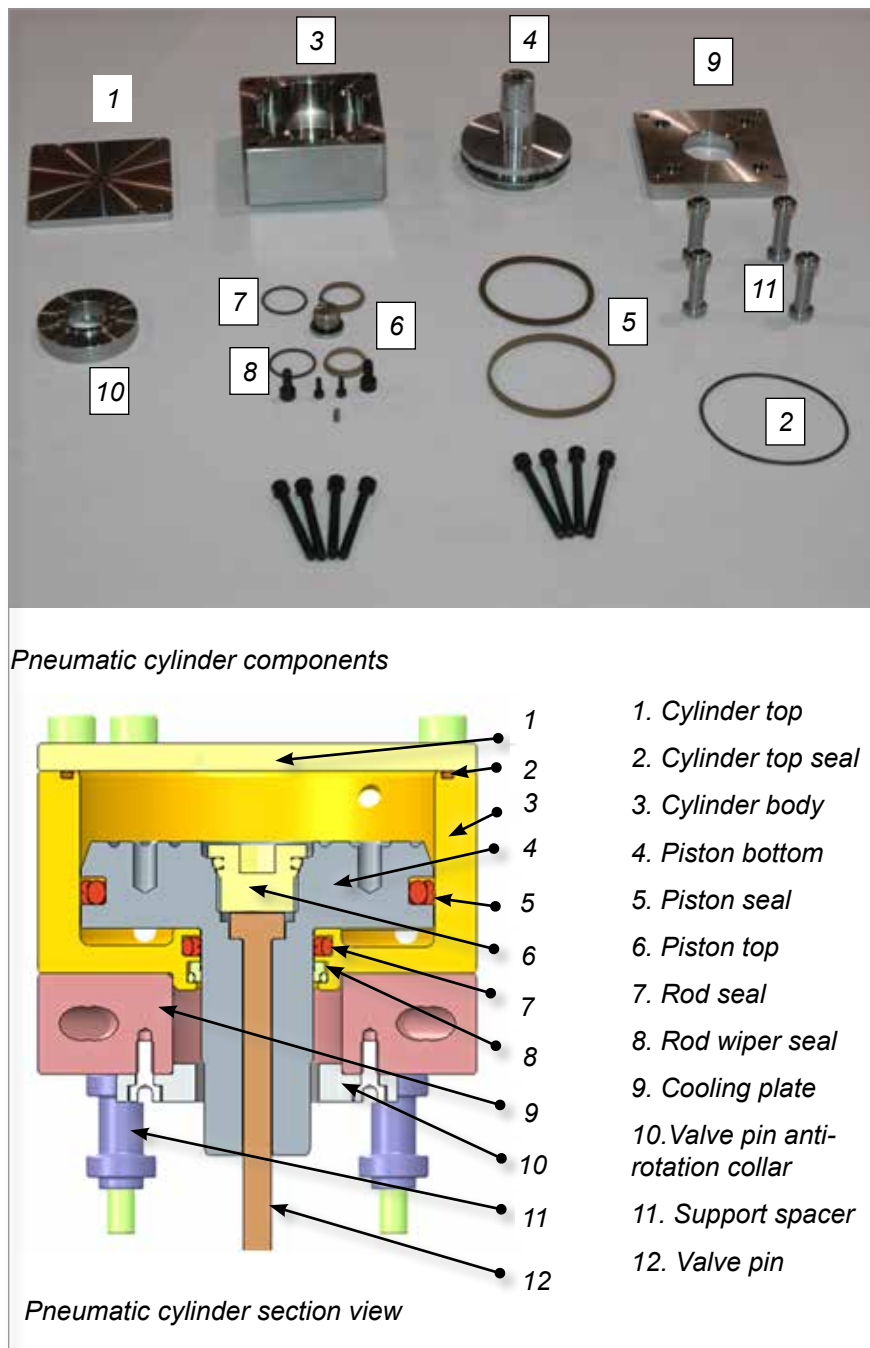


Figure 5-2 Pneumatic cylinder components

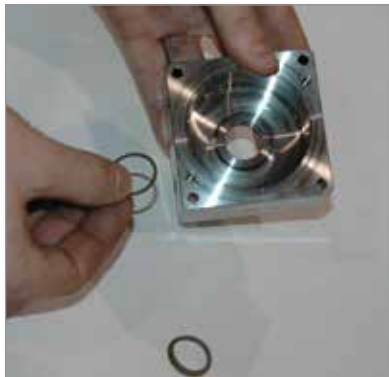


NOTE

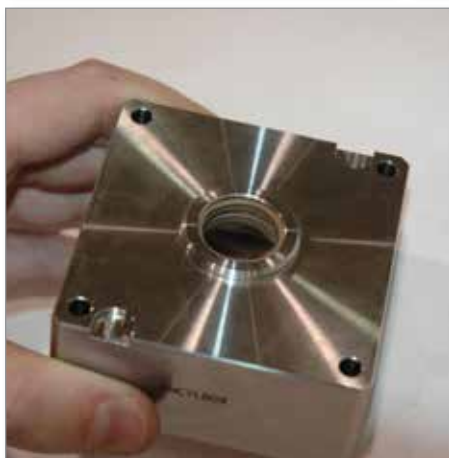
Pneumatic actuators with spring packages are available for certain sizes. See General Assembly drawing for details.

Install Pneumatic Actuator Assembly - continued

1. Install the rod seal (2 pieces).



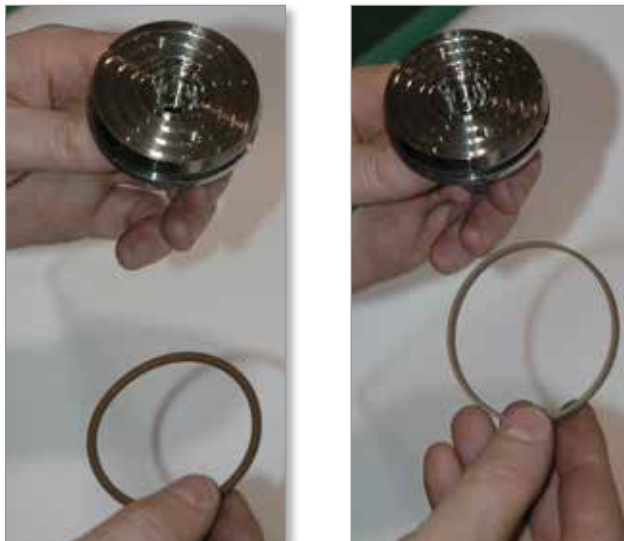
2. Use the piston to push the seal into position.
3. Install the rod wiper seal (2 pieces).



4. Use the piston to push the seal into position.

Install Pneumatic Actuator Assembly - continued

5. Install the piston seals (2 pieces).



6. Install the piston top.
7. Tighten the piston top.



NOTE

Use soft vise jaws with cutout for piston body to prevent damage to the part.



8. Assemble the piston into the cylinder body.

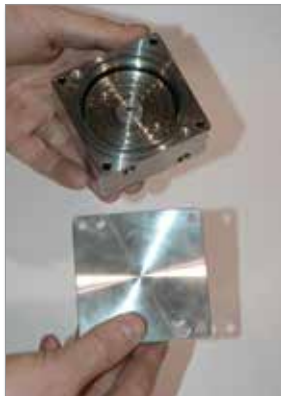


Install Pneumatic Actuator Assembly - continued

9. Install the cylinder top seal.



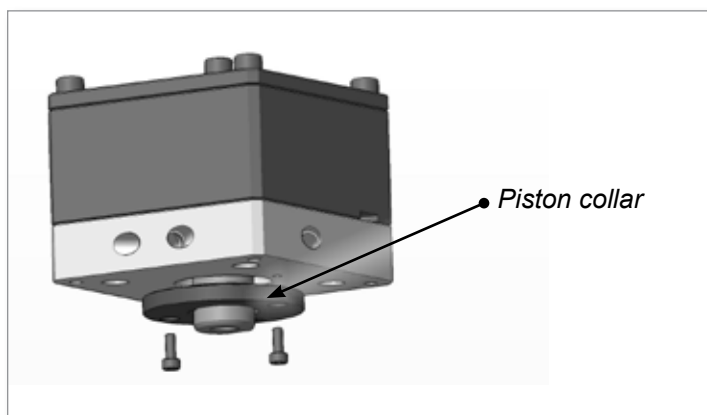
10. Assemble the cylinder top to the cylinder body.

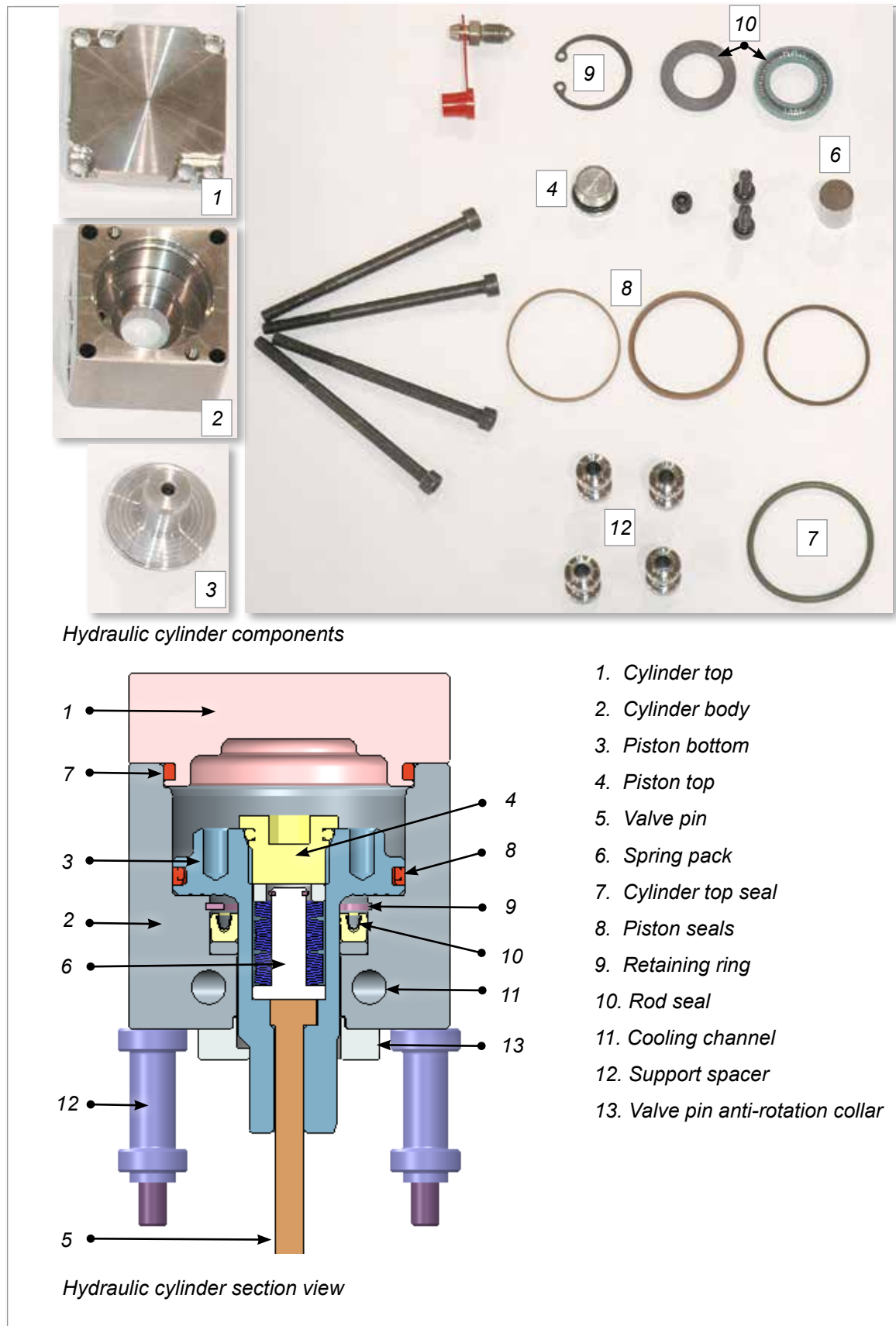


11. Apply anti-seize compound to the screws.

12. Install the cylinder top screws.

13. Install the piston collar to the cylinder body.



**5.6.2 Install Hydraulic Actuator Assembly****Figure 5-3 Hydraulic cylinder assembly components**

Install Hydraulic Actuator Assembly - continued

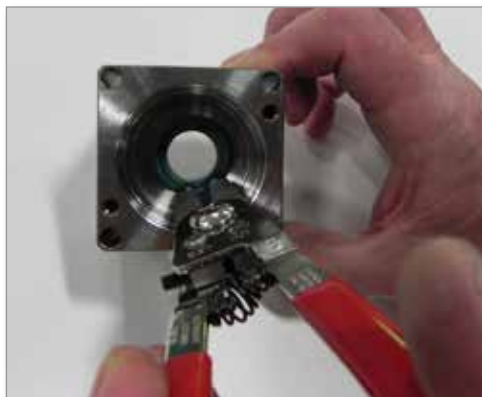
1. Place the two pieces that make the rod seal into the pocket of the cylinder body.



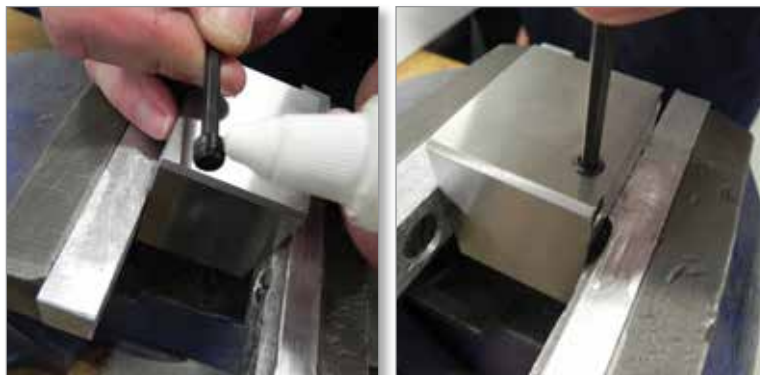
2. Press the seals into the housing.



3. Install the rod seal retainer clip.



4. Place pipe sealant on threads of the water circuit pipe plug. Install the water circuit pipe plug.



Install Hydraulic Actuator Assembly - continued

5. Install the piston seals (3 pieces).



6. Install the O-ring.



7. Install the piston seal.



8. Install the split retainer ring.

Install Hydraulic Actuator Assembly - continued

9. Install the valve pin.



10. Install the spring pack.



11. Install the piston top.



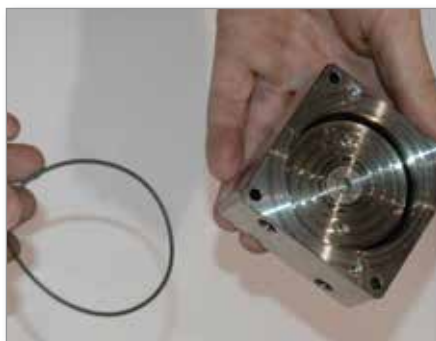
12. Tighten the piston top.

Install Hydraulic Actuator Assembly - continued**NOTE**

Use soft vise jaws with cutout for piston body to prevent damage to the part.



13. Install the cylinder top seal.



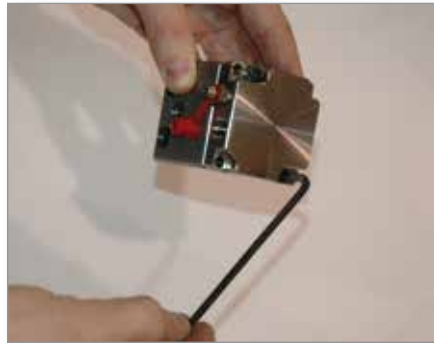
14. Assemble the piston into the cylinder body.



15. Assemble the cylinder top to the cylinder body.



16. Apply anti-seize compound to the screws. Install the cylinder top screws.



5.7 Install Sub-Manifold Heater Plates (if applicable)

1. Apply anti-seize compound to the screws (M6).
2. Bolt and torque screws in a cross pattern, gradually increasing torque to specified value. Refer to the General Assembly drawing for torque values.



NOTE

If you need to install the optional sub-manifold wire armor, please refer to "5.10.4 Wiring Channel" on page 5-40.

5.8 Install Bridge Heater Plates (if applicable)

5.8.1 Installing Heater Plate Thermocouple

These procedures apply to systems with external heater plates. Refer to the General Assembly drawing to determine which heater plate applies to your system.



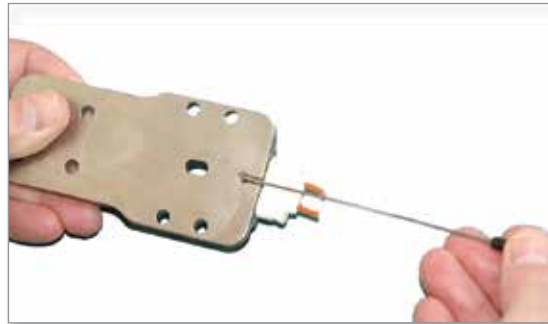
NOTE

The controlling thermocouple for the heater plates is located in the heater plates.

The controlling thermocouples for the heater elements are located in the manifold.

Current bronze heater plates are directly interchangeable with previous copper based plates that may exist on your *Mold-Masters* system. However, when multiple heater plates are controlled by one thermocouple, these heater plates must be made of the same material, must be of equal voltage and must be located in similar thermal environments.

1. Insert the thermocouple into the bore. Ensure the thermocouple is touching the bottom of the bore hole.
2. Press down on the thermocouple and gently bend to 90°.



5.8.2 Install Heater Plates



CAUTION

This is a pinch point area. Use caution when installing the heater plate to the manifold plate. Failure to do so could result in damage to the thermocouple.



CAUTION

Do not overtighten the mounting screws. This could result in the heater plate losing contact with the manifold plate.

Refer to the General Assembly drawing for the correct torque values.

It is recommended that the heater plate wires be isolated and grouped so that they do not have to be disconnected if the manifold needs to be dismantled for repair.

Install Heater Plates - continued

1. Install the heater plate to the manifold. Refer to the General Assembly drawing for location. Use anti-seize compound on threads. Bolt and torque screws in a crossing pattern, gradually increasing torque to specified value. Refer to the General Assembly drawing for torque values.



2. The heater plates are supplied with the power wires connected. Place a zone number on each wire and thermocouple.

5.9 Tubular Heater Installation and Replacement for Bridge

For Field Replacement of Flexible Heaters Only



WARNING

Heater elements should be installed by qualified personnel.

The heater element and heated block must be connected and grounded during maintenance according to local electrical standards, e.g. DIN EN 60204-1 or NFPA79.



CAUTION

Mold-Masters only recommends field replacement of flexible heater elements only. We do not recommend field replacement of heater elements that are brazed or pasted into the manifold. For these types of heater elements, please contact your service representative.

5.9.1 Storage

Heater elements should be stored at room temperature and in a dry atmosphere.

The heater element insulation material attracts and hold moisture. If there is a chance it has been exposed to humidity during storage, then the insulation resistance should be confirmed prior to installation ($R_{min} = 5 \text{ M}\Omega$ at 500 V DC). If necessary, heating elements should be dried at a temperature of 120°C (250°F) for a few hours.

5.9.2 Removing a Heater Element

1. Disassemble wires and ceramic terminal connector from the failed heater element. Label the wires to identify them for reassembly.
2. Use pliers to lift the heater element's exit portion and insert a brass stick below the heater element. Pull the heater element out of the groove while prying it up with the brass stick.
3. Clean the manifold heater element groove with a brass brush and make sure there is no contamination or sharp edges.

5.9.3 Installing a New Heater Element



CAUTION

To protect the heat element from failure at startup, we highly recommend using the soft start feature on the controller.



CAUTION

Use a plastic (nylon) mallet only. A regular soft rubber hammer will not work. A smaller head size is preferred. Do not use a metal hammer. It will damage the heater and the manifold surface.

1. Prior to installation, check the General Assembly drawing for the correct heater element size and confirm the replacement conforms.
2. Check that the connection voltage does not exceed the heater element's operating (nominal) voltage.
3. Remove the spare nut and washers supplied on the threaded heater element pin. Tighten the remaining nut, next to the ceramic ring, to 1 Nm to provide proper sealing and protection.



Installing a New Heater Element - continued

4. Align the center of the heater element to the centre marking on the manifold groove. Always start the heater element installation from the middle point of the path. We recommend installing the heater element gradually from both sides in parallel. This will help to get an equal exit length.



5. Use a plastic (nylon) mallet to tap the element straight down into the groove. This will help to prevent the heater element from stretching.

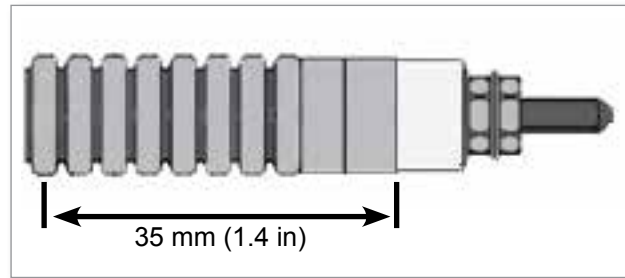


6. For the curved areas of the groove, pre-bend the heater element manually before hammering it into the groove. This will prevent the shielding from being damaged by the groove edge.
7. Make sure the heater element is completely seated inside the groove. The heater element should be 0.5 mm lower than the top surface.



Installing a New Heater Element - continued

8. Do not bend the unbendable zones of the heater element. This is the last 35 mm (1.4 in) area on each end. See below:



9. Crimp the wire with the proper size crimper pin. Connect it to the heater threaded pin with the ceramic terminal connector.



10. After all connections are finished, test the electrical connections to proper electrical standards.



5.10 Bridge Assembly

5.10.1 Installation of Inlet Components



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.



CAUTION

Ensure the machine nozzle opening matches the melt entrance for the hot runner system, or is not more than 1.0 mm (0.040") smaller.

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

5.10.2 Heated Back Plate Installation

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

1. Check the machine nozzle radius.
2. Check the seating on the bottom face of the back plate and manifold using die spotting blue compound.



3. Clean die spotting blue compound off all components.
4. Place the center heater on the manifold.
5. Rotate the center heater to align with the tapped holes in the manifold and align terminals with cutout.

Heated Back Plate Installation - continued

6. Install mounting screws through the center heater into the tapped holes of the manifold. Use anti-seize compound on the screws.



7. Torque screws. Refer to the General Assembly drawing for torque values.



8. Place a zone number on each wire and thermocouple.
9. Tape wires for each zone together.
10. Install the wires into the wire channels and secure with high temperature cable ties.
11. Feed wires back through the wire channel in the mold base to the electrical box.

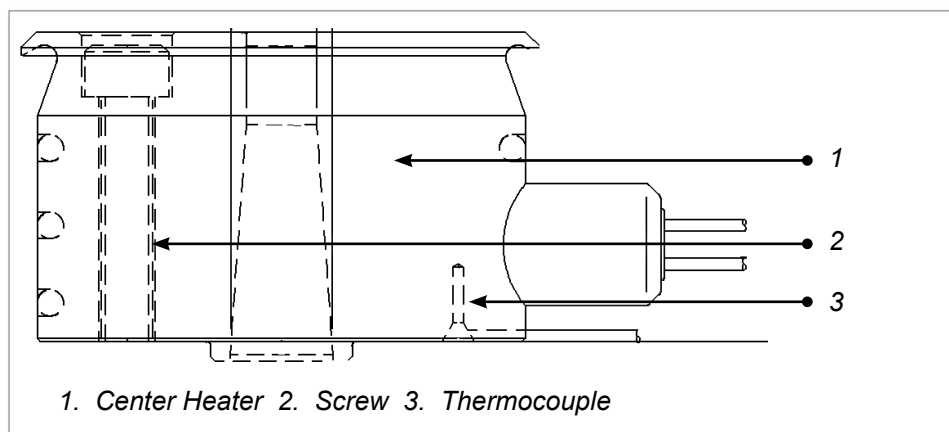


Figure 5-4 Back plate (heated)

5.10.3 Inlet Extension with Heater Sleeves

1. Apply die spotting blue compound to bottom of inlet.



2. Apply anti-seize compound to the screws and install inlet to manifold.



3. Torque screws in a crossing pattern, gradually increasing torque to specified value. Refer to the General Assembly drawing for torque values.



4. Remove inlet to verify blue surfaces.
5. Clean the die spotting blue compound from the inlet and manifold.



Inlet Extension with Heater Sleeves - continued

6. Reinstall inlet. Torque screws in a crossing pattern, gradually increasing torque to specified value. Refer to the General Assembly drawing for torque values.



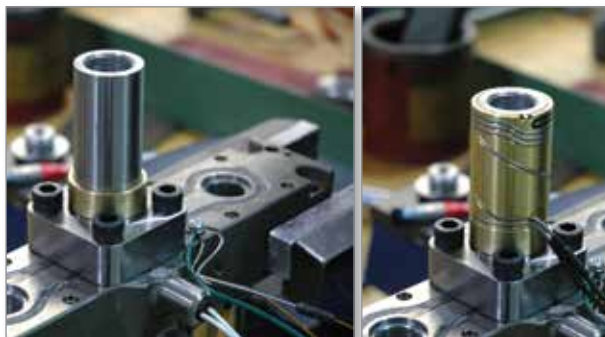
7. Apply die spotting blue compound to the inlet seal and verify these surfaces to check fit of seal in the inlet.



8. Clean die spotting blue compound from inlet seal and inlet.



9. Install inlet heaters and sleeves as per specified drawing.



Inlet Extension with Heater Sleeves - continued

10. Apply anti-seize compound to threads and install inlet seal to inlet.



11. Torque to specified value. Refer to the General Assembly drawing for torque values.



12. Install thermocouple into slot until it bottoms out.



13. Bend 180 degrees.



14. Install thermocouple clip.



5.10.4 Wiring Channel

The wiring channel connects the electrical system, control system and cooling system to the hot runner system. It collects the wires and hoses from the control and cooling systems and routes them to the customer interface components. All wires for power and control are collected in an intermediate space, and it routes the hoses for control and cooling above the wiring channel for protection. All wire channels are custom designed to suit. See your General Assembly drawing for specific details.

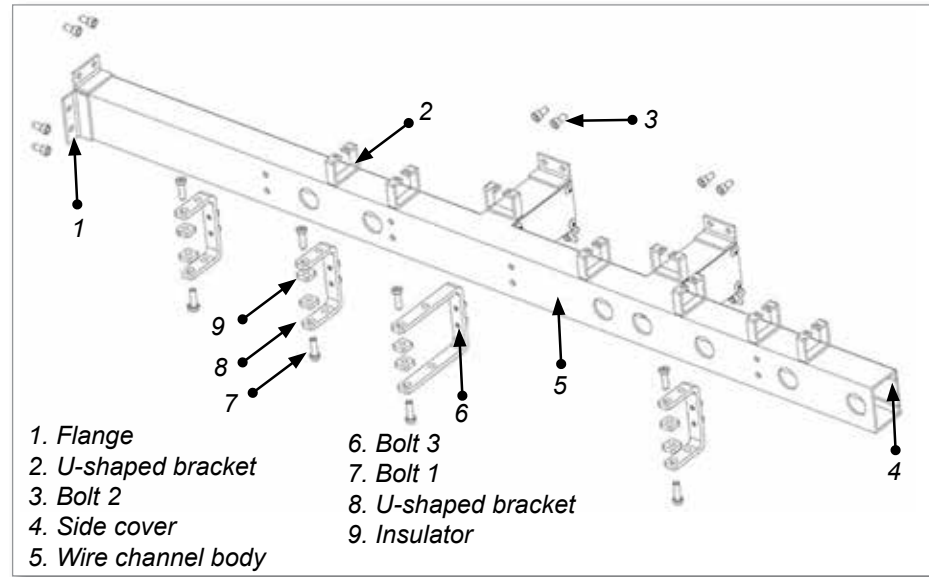


Figure 5-5 Wiring channel

5.10.4.1 Wiring Channel Components

1. Flange: allows for secure connections of power / control / cooling to customer interface components
2. U-shaped locker: supplies protection and fastening points for actuator pressure and cooling water hosing
3. Bolt 2: used to mount interface components to the wiring channel
4. Side cover: protects wires in the wiring channel body, improves the strength of the structure and provides easy maintenance access
5. Wiring channel body: the material of wiring channel is structural carbon steel, ensuring strength, and the hollow space inside allows wires for power, thermocouple and controls
6. Bolt 3: used to mount the wiring channel body and U-shaped bracket
7. Bolt 1: used to mount the U-shaped bracket and hot runner manifold
8. U-shaped bracket: joins the hot runner system and the wiring channel body with two holes for function extension
9. Insulator: prevents heat transfer from the manifold to the wiring channel, when the process temperature is above 320°C

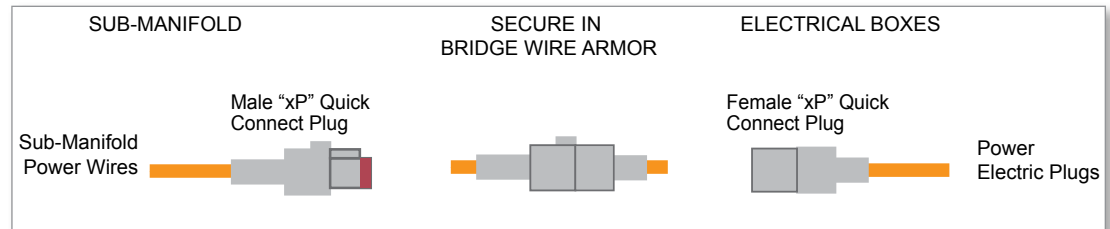
5.10.5 Sub-Manifold Wiring



CAUTION

All wires close to a heat source require high temperature sheathing.

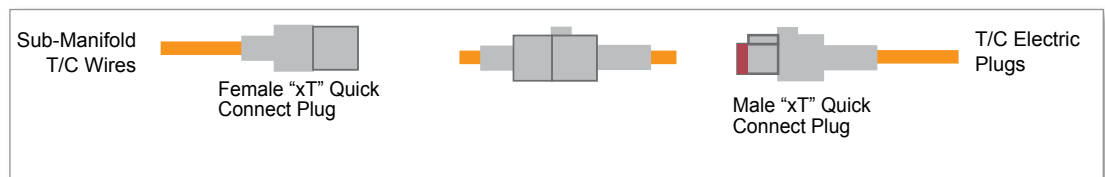
5.10.6 Power Wiring



1. Run all the power wires to the bridge and locate a position for quick connector sitting, and cut the wires to a proper length.
2. Label the wires and install high temperature sheathing.
3. Crimp all heater plates and nozzle power wires with female contacts.
4. Insert the power wires contacts into the male plug of quick connector '1P' per wiring schematic in General Assembly drawing.
5. Insert the coding pin to the male plug as per wiring schematic, if applicable.
6. Get six spare wires crimped with male contacts in one end, insert into the female plug of quick connect '1P', and label the wires according to the male side.
7. Snap '1P' plugs together. Run the open end of the wires to the electrical plugs. Cut the wires to the proper length and crimp them. Install high temperature sheathing if needed.
8. Install the power wires into electric plugs per wiring schematic in the General Assembly drawing.
9. Repeat above for each zone. Name connector number according to drop number. Be sure to locate the connectors inside the wire armor. See "5.10.4 Wiring Channel" on page 5-40 for further details.

5.10.7 Thermocouple Wiring

1. Run all the thermocouple wires to the bridge wire armor and locate a position for quick connector sitting. Cut the wires to a proper length.
2. Label the wires and install high temperature sheathing.
3. Crimp all thermocouple wires with male contacts.
4. Insert the thermocouple wire contacts into the female plug of quick connector '1T' as per wiring schematic in the General Assembly drawing.
5. Get six spare wires crimped with female contacts in one end, insert into the male plug of quick connect '1T', and label the wires accordingly to the female side.



6. Insert the coding pin to the male plug as per wiring schematic, if applicable.
7. Snap '1T' plugs together, run the open end of the wires to the electrical plugs, cut the wires to the proper length and crimp them. Install high temperature sheathing if needed.
8. Install all the thermocouple wires into electric plugs per wiring schematic drawing in the General Assembly drawing.
9. Repeat above for each zone. Name connector number according to drop number. Be sure to locate the connectors inside the wire armor. See "5.10.4 Wiring Channel" on page 5-40 for further details.

5.10.8 Preparing to Wire the Bridge



CAUTION

All wires close to a heat source require high temperature sheathing.

1. Group thermocouple and heater wires for a single zone together and install high temperature wire sheathing.
2. Label all heater and thermocouple zones.
3. Use heat resistant tape to group thermocouple heater zones together and to avoid losing labels.
4. Repeat for all zones.

5.10.9 Wiring Channel Installation



WARNING - BODY CRUSH HAZARD

During installation of the wiring channel, a crushing hazard exists between the wiring channel and the manifold and any other accessories that may be mounted to the wiring channel.



WARNING

When doing any work that requires moving and lifting the the wiring channel, 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.



WARNING

The screws securing the wiring channel to the manifold and / or other accessories must be tightened to the correct torque. See “Table 9-3 Torque Chart for System Assembly Screws” on page 9-13.



CAUTION

The wiring channel presents a tip / crush hazard when being moved.

1. Inspect the wiring channel before installation.



2. Mount the wiring channel to the manifold from the side. The slot holes of U-shaped bracket must align with the manifold mounting holes.

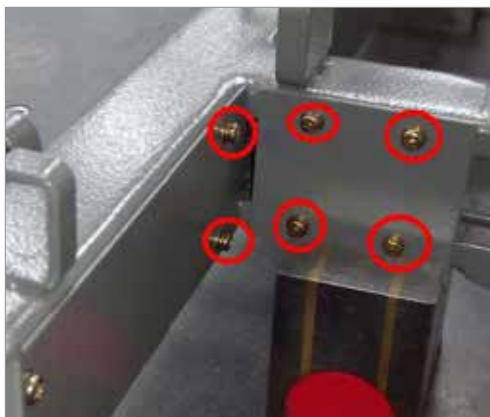


3. Mount any other accessories or adapter plates to the wiring channel.



Wiring Channel Installation - continued

4. Unscrew the bolts and remove the side covers.



5. Organize all sorted power, thermocouple and other control wires to the wiring channel then install side covers.



6. Run all hoses above the wiring channel. Fasten to the U-shaped bracket, if needed.



Wiring Channel Installation - continued

7. Inspect wires and hoses. Wires must not be overstretched. Hoses must be held at the proper bending angle. All hoses must be run through the U-shaped bracket.

**5.10.10 Electrical Box**

1. Install plugs into electrical box.

**5.10.11 Solenoid Valve Wiring**

1. Install solenoid coil wires into electrical plugs as per wiring schematic in General Assembly drawings.



2. Install plugs into electrical box.



Section 6 - Electrical Testing

This section contains guidelines for electrical testing of your *Mold-Masters* Dura Plus system.



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.

To avoid serious burns 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.

Contact with heated components may cause serious burns. Use a sign in a visible location indicating “Danger: Do Not Touch”.

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 do so could lead to serious injury or death.

6.1 Wiring Check



WARNING

Ensure that a qualified electrician performs all wiring.

A disassembled nozzle should only be connected to an electrical supply when the nozzle has been grounded or a safety isolating transformer is used.



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.

6.2 Ground Shorts Test



CAUTION

Never apply full power to a heater if the insulation resistance reading is below 300 K Ω .

Always check the insulation resistance reader if the mold has not been in use for a number of weeks or months.



NOTE

Heater resistance above 500 K Ω is acceptable.

1. Use an ohm meter to check for continuity between the mold power connector ground pin (metal tabs on side) and the manifold steel. The ohm reading should be zero.
2. Measure the resistance between each pin of the mold power connector. See "Figure 6-1 Mold plug" and ground (mold base). The reading should be ∞ (infinity). Occasionally, the electric heaters accumulate moisture, which can reduce the resistance value to between 100 K Ω to 10 M Ω . The controller should be designed to remove this moisture during startup.
3. If necessary, remove excess moisture before placing the heater under full current.

6.3 Thermocouple Continuity Test

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



NOTE

The resistance should be between 2.5 Ω and 25 Ω .

2. To verify alignment of the 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.

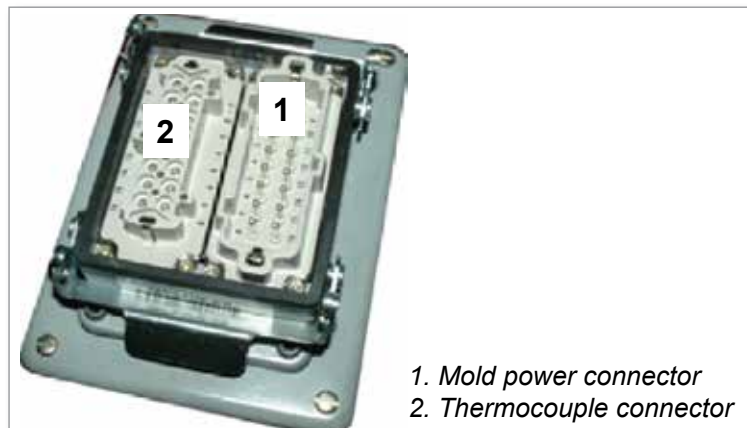


Figure 6-1 Mold plug

6.4 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.
4. 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.

6.5 Heater Continuity

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

6.6 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 = “+” and 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.

6.7 Heating Test with a Temperature Controller



CAUTION

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

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

6.8 Retesting

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

Section 7 - System Installation

The following section is a step-by-step guide to install your *Mold-Masters* Dura Plus hot runner into the existing manifold plate system or spacer block system.

7.1 Prior to Assembly



WARNING

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.

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.



CAUTION

Do not assemble / disassemble cavity plate with the valve pins forward.

Valve pins must be retracted prior to cavity plate installation.

Potential pinch point. Ensure that all wires are retained.



NOTE

Refer to the General Assembly drawings for instructions.

1. Unpack and clean the system as outlined in "Section 4 - Preparation".

System Installation

7.1.1 Water Cooling Nozzle Jacket Assembly



NOTE

Your system may not include the water cooling nozzle jacket option. Refer to your General Assembly drawing for details.

1. Clean the insert-seating bore.
2. Install O-rings onto the water cooling nozzle jacket.
3. Insert water cooling nozzle jacket assembly into seating bore.
4. Fasten the water cooling nozzle jacket to the mold plate with the supplied button head cap screw and washer.

7.1.2 Install Sub-Manifold Assembly



CAUTION

Match drop numbers stamped on bridge during assembly.

1. Measure and confirm height as specified on General Assembly drawing.
2. Insert nozzle into seating bore or water cooling nozzle jacket, ensuring that the anti-rotation dowel is engaged in the slot.
3. Take care not to pinch the wires.
4. Remove any installation tools used.
5. Apply anti-seize compound to the four system screws and install.
6. Torque system screws in a crossing pattern, gradually increasing torque to specified value. Refer to the General Assembly drawing for torque values.
7. Measure and confirm the angled sub-manifold height as specified on the General Assembly drawing.
8. Repeat for each drop.

7.1.3 Install Manifold Locator and Anti-Rotation Dowel



CAUTION

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



NOTE

Check the General Assembly drawing for information for your system.

1. For some systems, locators are supplied oversize and must be ground to the same level as the top of the nozzles. Remove the material from the bottom face of the locator (FACE Y). Please check the General Assembly drawing for exception notations.

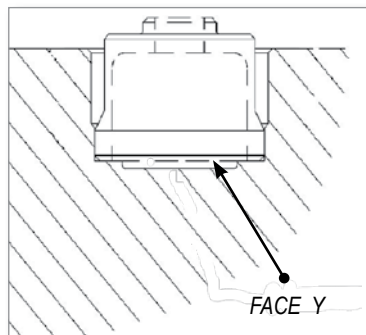
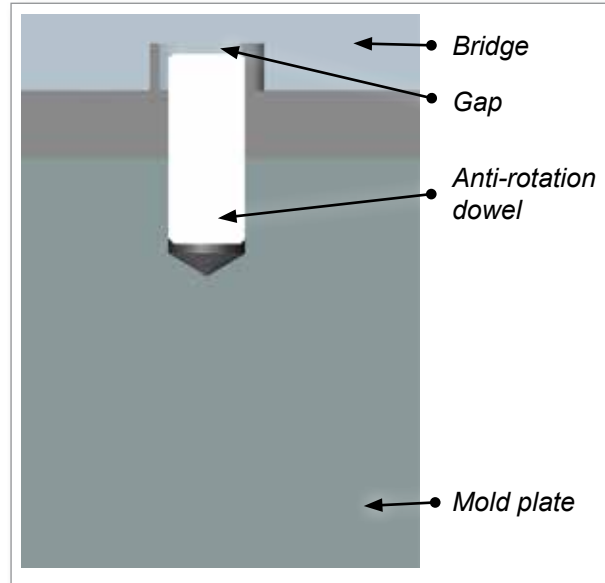


Figure 7-1 Locator surface

Install Manifold Locator and Anti-Rotation Dowel - cont.

2. Using a depth micrometer, verify the dimensions of the manifold pocket to those specified on the print.
3. Apply die spotting blue the manifold locator into the bore to ensure proper seating.
4. Install the anti-rotation dowel into the mold.



7.1.4 Install Bridge Assembly



CAUTION

Match drop numbers stamped on bridge during assembly.



NOTE

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

1. Measure and confirm locator height as specified on General Assembly drawing.
2. Align bridge to sub-manifold and locate on manifold locator.
3. Take care not to pinch the wires.
4. Remove any installation tools used.
5. Apply anti-seize compound to the bridge screws.
6. Torque bridge screws in a crossing pattern gradually increasing torque to specified value. Refer to the General Assembly drawing for torque values.
7. Measure and confirm drop height as specified on General Assembly drawing.
8. Repeat for each drop.

7.1.5 Final Installation Steps

1. Connect the sub-manifold power wires to the bridge using quick connectors, if applicable. Ensure quick connectors are locked.
2. Connect all the plumbing (air and water hoses) to the sub-manifold unit.
3. Install screws to secure electrical and solenoid interface to exterior of mold base.
4. Install clamp plate.

Section 8 - System Startup and Shutdown

This chapter explains how to startup and shutdown your Dura Plus system.

Pre-Startup



CAUTION

Check that the system is heated to processing temperature. Failure to do so could cause damage to the valve pins. Water must be turned on for Dura Plus actuation before turning on temperature controls. Actuator water temperature cannot exceed 85 °F (29.4 °C).



NOTE

Ensure the machine nozzle opening matches or is not more than 1.0 mm (0.040") smaller than melt entrance for the hot runner system.

1. Install the mold into the molding machine.
2. Connect all water lines and test. Water temperature is not to exceed 85 °F. Water to valve actuators must be turned on before heating is activated.
3. Connect all hydraulic / pneumatic lines, if applicable.
4. Test the pin actuation only after the hot runner is at processing temperature.
5. Connect all electrical components.

8.1 Startup



WARNING

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

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 the below procedure may result in leakage / damage occurring in the hot runner.



NOTE

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

Startup - continued

1. Turn on the machine barrel and mold cooling system.
2. Prior to startup, ensure that the:
 - a) Dura Plus valve gate actuator water is on
 - b) maximum inlet water temperature does not exceed 85 °F (29.4 °C)
 - c) machine barrel is up to processing temperature
 - d) mold cooling is on and at cooling temperature
3. Heat up the hot runner system to processing temperature. Wait until ALL heating zones reach processing temperature before continuing.
4. Startup for empty hot runner system: extrude material through the hot runner system using 200 PSI (14 bar) of back pressure.
5. Startup 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 in coordination to part size, gate size and material.

**NOTE**

For hot runner systems using heater plates, allow 20 minutes of soak time after the system reaches processing temperature.

8.2 Shutdown

1. Turn off all heat to the system.
2. Leave the mold cooling system ON, including valve actuator water, until the hot runner system temperature is within 100 °F (37.7 °C) of the mold temperature.

**NOTE**

Thermally sensitive materials should be purged from the hot runner system prior to shut down using a thermally stable material with a similar processing temperature. For example, a system running PVC should be initially started and subsequently shut down on LDPE.

Section 9 - Maintenance Procedures

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.



NOTE

Please contact your local *Mold-Masters* representative - see "Section 2 - Global Support" - to ensure you have the correct repair kit and crimping tool. Available tools and lead wire replacement kits are shown below.

Table 9-1 Crimping Tool Chart	
Product Name	Description
PUNCHHANDLE01	Ratchet tool for securing crimp to terminal end assemblies
CRIMPDIE01	4.0 mm Heater Element (Mates with CRIMPPUNCH01)
CRIMPPUNCH01	4.0 mm Heater Element (Mates with CRIMPDIE01)
CRIMPDIE02	2.5 - 3.0 mm Heater Element (Mates with CRIMPPUNCH02)
CRIMPPUNCH02	2.5 - 3.0 mm Heater Element (Mates with CRIMPDIE02)
CRIMPDIE03	1.8 - 2.0 mm Heater Element (Mates with CRIMPPUNCH03)
CRIMPPUNCH03	1.8 - 2.0 mm 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)

9.1 Terminal End Removal



CAUTION

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



Figure 9-1 Nozzle terminal assembly

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



Terminal End Removal - continued

5. Remove the power leads.

**9.2 Terminal Assembly****CAUTION**

Keep an eye on the silicon seal. It should not rotate with the sleeve during the assembly process or the wires may break.

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.



Terminal Assembly - continued

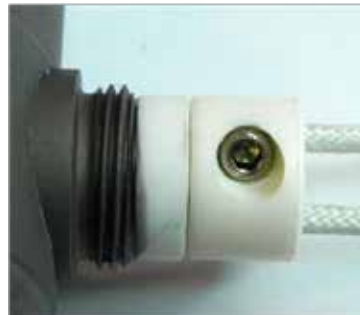
5. Spread the wire strands and insert the lead wire onto the terminal posts.



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 insulators and silicon seal into place.



8. Complete the repair by screwing the element sleeves into position.



Terminal Assembly - continued

9. Slide the second ceramic insulator and silicone seal into place



10. Complete the assembly by screwing the element sleeve into position.

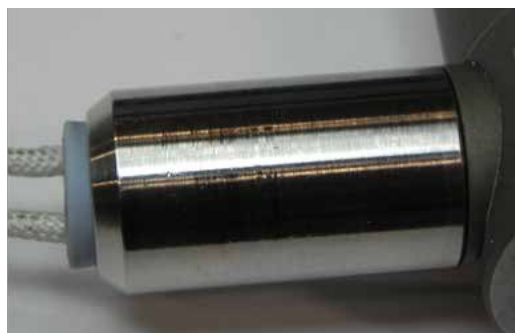


Figure 9-2 Nozzle terminal assembly

9.3 Heater Plate Power Lead Replacement

9.3.1 Removal

1. Remove the set screws.
2. Slide ceramic sleeve off.
3. Remove the power leads using crimp removal tool.

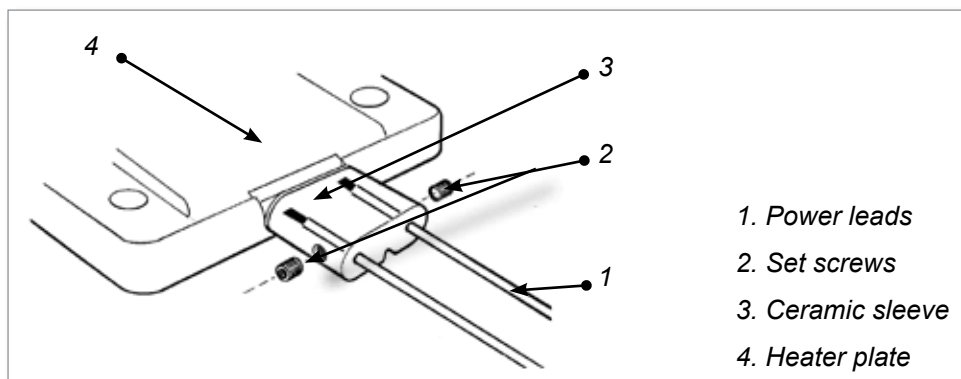


Figure 9-3 Terminal end assembly

9.3.2 Installation

1. Push the replacement leads into the holes in the ceramic sleeve.
2. Crimp the leads to the terminal ends.
3. Slide ceramic sleeve over the terminal end.
4. Tighten the set screws on the ceramic sleeve to secure the terminal assembly.

9.4 Gate Seal Maintenance

Reasons for gate seal maintenance:

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



9.5 Multi-Cavity Systems

It is advisable to heat the system to ensure the temperature condition is met to remove the gate seals.



NOTE

Use the socket supplied in the *Mold-Masters* tool kit to loosen the gate seal.

It is recommended to use a temperature controller for this procedure. If a temperature controller is not available, contact your nearest *Mold-Masters* Service Department.

For gate seal installation and torquing procedures refer to “Gate Seal Replacement” section.

9.6 Gate Seal Removal



WARNING

High temperature on the nozzle. Wear safety clothing such as heat resistant coat and heat resistant gloves.

Failure to do so may cause serious injury.



CAUTION

The terminal end is a sensitive area and can easily break if not handled to specifications.

Hot runner systems must be within 40 °C (70 °F) of mold temperature before the cavity plate can be removed.



NOTE

If the cavity plate is easily removed you can access the nozzle seals while still in the system.

It is recommended the nozzle be removed from the system before removing the gate seal.

Use the socket supplied in the *Mold-Masters* tool kit to loosen the gate seal.

The following procedure applies to all gate seals, including carbide, with threads larger than an M6.

1. Apply penetrating lubricant to gate seal area.



2. Leave the nozzle in the mold or remove it to a vice and clamp carefully.
3. Using the temperature controller, heat the nozzle body until all residual plastic is melted from the gate area. If the nozzle is inside the mold, heat up the whole system and turn on the cooling or remove all O-rings.
4. While the nozzle is still hot, apply a loosening pressure to the gate using the socket to remove the seal.
5. Turn off the controller and wait for five minutes.

Gate Seal Removal - continued

6. Remove the gate seals.



9.7 Gate Seal Replacement



WARNING

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

High temperature on the nozzle. Wear safety clothing such as heat resistant coat and heat resistant gloves. Failure to do so may cause serious injury.



CAUTION

It is critical that seal surface is perfectly clean. Failure to clean properly 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 melt.

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



CAUTION

Gate seals are torqued at ambient (room) temperature at *Mold-Masters*. Please torque each seal at processing temperature to the torque value specified to prevent material leakage from the gate seal.

1. Clean the nozzle, especially the thread and runner.
2. Clean all residual plastic from the threads and counter bore of the gate seal.

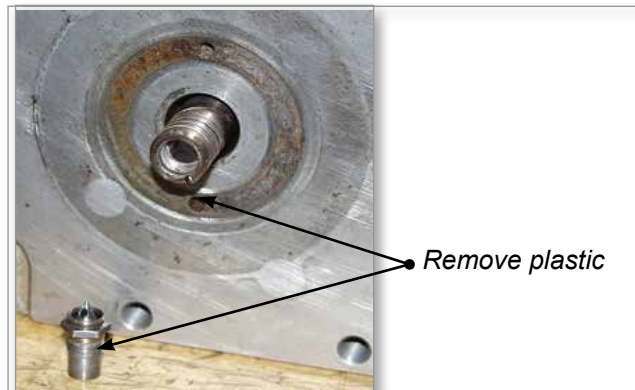


Figure 9-4 Cleaning locations

Gate Seal Replacement - continued

3. Check the bottom face of the nozzle counterbore for damage. If damaged, lap the bottom face of the nozzle in a circular fashion with a hardened tool and 300 grit lapping compound. If the nozzle counterbore is free of damage, proceed to step 5.



4. After lapping is complete, apply die spotting blue to the liner to the nozzle to ensure proper mating. If the liner is making good contact, clean the die spotting blue compound off both faces.



5. Apply anti-seize compound (nickel based) to the gate seal threads ONLY. Make sure that the internal runner is clean and free from anti-seize compound



6. Using a socket wrench, reinstall the gate seal being careful not to damage it.
7. Torque the gate seal to the appropriate value. Refer to "Gate Seal Torque Settings" on page 9-12.
8. Check that the seal has bottomed out, heat nozzle to process temperature and re-torque seal.

9.8 Checking 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 vernier to spacer blocks.



4. Move vernier to correct reference point on nozzle tip (per drawing).



5. Check that nozzle height is within drawing specification.
6. Repeat for each nozzle.

9.9 Nozzle Thermocouple Removal



NOTE

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.

9.10 Torque Settings

9.10.1 Gate Seal Torque Settings



CAUTION

Gate seals are torqued at ambient (room) temperature at *Mold-Masters*. Please torque each seal at processing temperature to the torque value specified to prevent material leakage from the gate seal.

Table 9-2 Gate Seal Torque Settings

Nozzle	Nm	ft-lb
Deci	34-38	25-28
Hecto	47-54	35-40
Mega	57-65	42-48

9.10.2 System and Plate Screw Torques



CAUTION

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

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

Table 9-3 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 9-4 Torque Chart for Plate Assembly Screws

Metric	Torque Setting	Imperial	Torque Setting
M5	10 Nm / 7 ft lbs	#10-32	9 Nm / 6 ft lbs
M6	16 Nm / 12 ft lbs	1/4-20	22 Nm / 16 ft lbs
M8	39 Nm / 29 ft lbs	5/16-18	48 Nm / 35 ft lbs
M10	77 Nm / 57 ft lbs	3/8-16	85 Nm / 63 ft lbs
M12	135 Nm / 100 ft lbs	1/2-13	209 Nm / 154 ft lbs
M16	330 Nm / 243 ft lbs	5/8-11	384 Nm / 283 ft lbs
M20	650 Nm / 479 ft lbs	3/4-10	678 Nm / 500 ft lbs

Section 10 - Troubleshooting

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.

10.1 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.

10.1.1 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

10.1.2 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 manufacturer's instructions

10.1.3 Importance of Pre-drying Resin

Thermoplastic resins can be hygroscopic and 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.

10.2 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.

10.2.1 History

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

10.2.2 Material

1. 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.
2. Verify that the pigment / dye to be used meets manufacturer's specifications and is compatible with the resin / molding machine / mold.
3. Verify the correct recycle ratio and adjust settings accordingly.

10.2.3 Hardware

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

10.2.4 Settings

Ensure that all batch job parameters are correct:

- Temperatures
- Pressures
- Injection Speed
- Back Pressure

10.3 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 that was functioning normally suddenly produces sub-standard parts, the data in the following pages may be used to determine the possible cause, but it should only be used as a guide.

A correct setup procedure that has been proven 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.

10.4 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 setup which was producing standard parts:

- Injection speed
- Screw speed
- Melt temperature
- Back pressure
- Melt heating
- Locking
- Cushion
- Mold heating

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

10.5 Troubleshooting Typical Problems



WARNING

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.

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.



NOTE

Refer "Section 3 - Safety" for proper procedures to be followed.

10.5.1 Dark Specks

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



Probable Causes:

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 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, backflow valve
5. Inspect feed screw for degradation

Troubleshooting Typical Problems - continued

10.5.2 Blisters or Bubbles

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



Probable Causes:

1. Molding Machine
 - Low injection pressure
 - Backflow valve malfunctioning
 - Suck-back 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 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

Troubleshooting Typical Problems - continued

10.5.3 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 Causes:

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

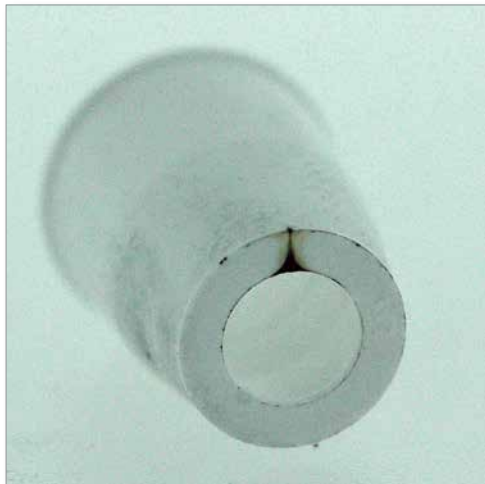
Solution (in sequence):

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

Troubleshooting Typical Problems - continued

10.5.4 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 Causes:

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

Troubleshooting Typical Problems - continued

10.5.5 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 and non-homogeneous material.



Probable Causes:

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

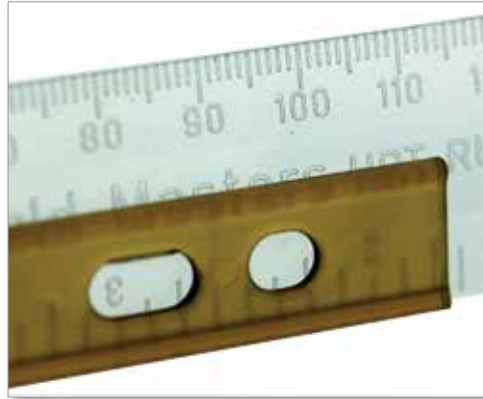
Solution (in sequence):

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

Troubleshooting Typical Problems - continued

10.5.6 Dimensional Irregularities

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



Probable Causes:

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

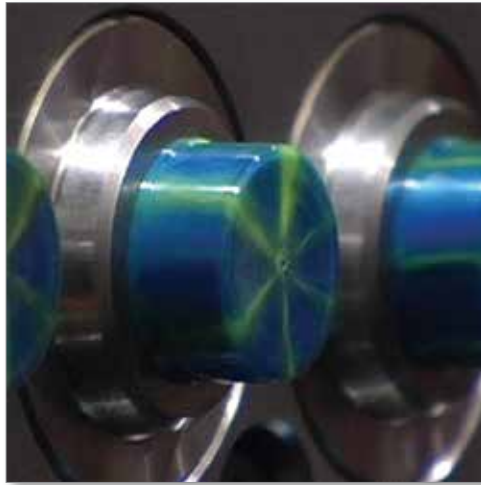
Solution (in sequence):

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

Troubleshooting Typical Problems - continued

10.5.7 Discolored Parts

The finished product varies in color on different surfaces.



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.8 Flash

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



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.9 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 Causes:

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

Troubleshooting Typical Problems - continued

10.5.10 Pitted Parts

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



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.11 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 Causes:

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

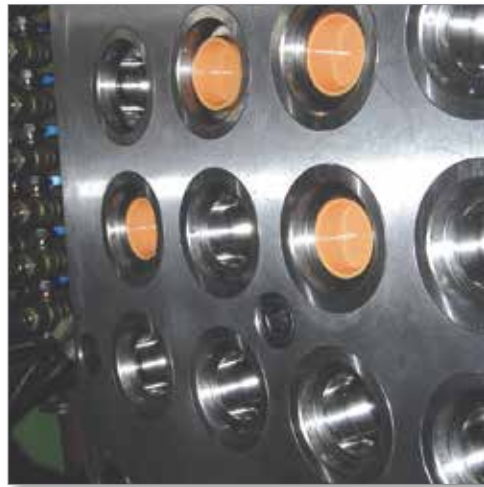
Solution (in sequence):

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

Troubleshooting Typical Problems - continued

10.5.12 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

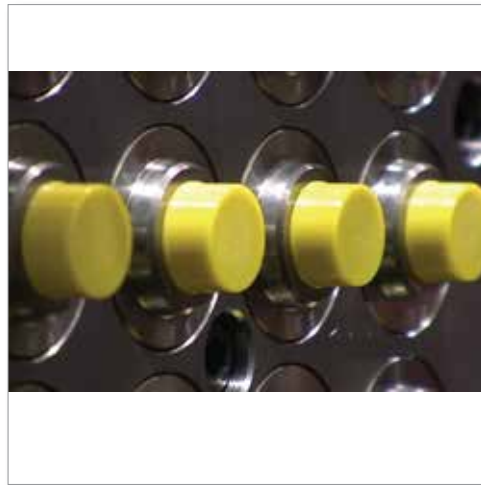
Solution (in sequence):

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

Troubleshooting Typical Problems - continued

10.5.13 Parts Sticking to Core

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



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.14 Short Parts

The finished product is not completely formed.



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.15 Sinks or Voids

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



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.16 Splay

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



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.17 Streaks

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



Probable Causes:

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

Troubleshooting Typical Problems - continued

10.5.18 Stringing

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



Probable Causes:

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

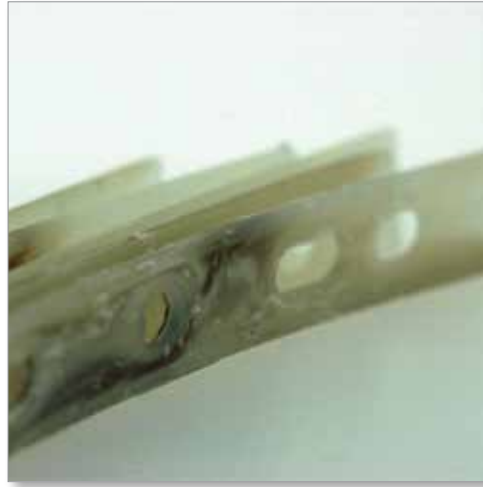
Solution (in sequence):

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

Troubleshooting Typical Problems - continued

10.5.19 Warped Parts

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



Probable Causes:

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

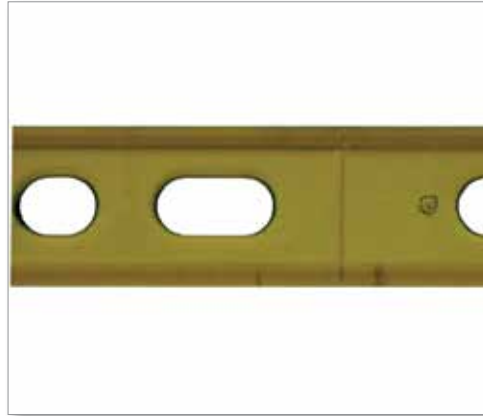
Solution (in sequence):

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. Redesign part if necessary

Troubleshooting Typical Problems - continued

10.5.20 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 Causes:

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

Troubleshooting Typical Problems - continued**10.5.21 Vestige or Temperature Marks at Gate**

The gate area has vestige or other temperature marks.

**Probable Cause:**

1. Material
 - Resin sticking onto the hot valve pin

Solution (in sequence):

1. Check mold cooling
2. Reduce tip temperature
3. Increase holding time

Section 11 - 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.

Glossary of Terms - continued

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.

Glossary of Terms - continued

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 sub-manifolds 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 back flow 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.

Glossary of Terms - continued

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 reheated 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.

Glossary of Terms - continued

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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Index

A

Actuator Assembly 5-20

B

Blisters or Bubbles 10-5
Bridge Assembly 5-35
Burn Marks 10-7

C

Ceramic Sleeve 9-2
Clamp Force 11-1
Cleaning 4-3
Cooling Channels 11-2
Crimping Tool Chart 9-1
Cycle Time 11-1

D

Dark Specks 10-4
Delaminating Parts 10-8
Dimensional Irregularities 10-9
Discolored Parts 10-10
Disposal 3-9
Documentation 1-2

E

Electrical Box 5-45
Electrical Testing 6-1
External Heater Plates 5-30

F

Field Replacement of Flexible Heaters 5-31
Flash 10-11
Flow Marks 10-6

G

Gate Seal Torque Settings 9-12
Glossary of Terms 11-1

H

Hazard Areas 3-2
Heater Continuity 6-3
Hot Tip Gate: 11-2

I

Intended Use 1-1

J

Jetting 10-12

N

Nozzle Tip Height-Checking 9-11

P

Parts Sticking to Cavity 10-15
Parts Sticking to Core 10-16
Pitted Parts 10-13
Pre-Drying Resin 10-2
Pre-Molding Precautions 10-2

R

Release Details, document 1-2
Resin Drying Issues 10-1
Resin Moisture Contamination 10-1
Rod Wiper Seal 5-21
Rough Surface 10-14

S

Safety
 hazard areas 3-2
Safety symbols
 general descriptions 3-5
Short Parts 10-17
Sinks or Voids 10-18
Solenoid Valve Wiring 5-45
Splay 10-19
Streaks 10-20
Stringing 10-21
System and Plate Screw Torques 9-13

T

Thermocouple Installation (Dura Line) 9-12
Thermocouple Removal 9-12
Torque 9-12
Torques 9-13
Torque Settings 9-12
Troubleshooting 10-1

V

Vestige or Temperature Marks at Gate 10-24

W

Warped Parts 10-22
Warranty 1-2
Water Cooled Gate Insert Installation 7-1
Weld Lines 10-23
Wiring Check 6-1

**Global Headquarters**

Mold-Masters (2007) Limited
tel: +1 905 877 0185
fax: +1 905 873 2818
e: hotrunners-na@milacron.com

Brazil

Mold-Masters do Brasil Ltda.
tel: +55 19 3518 0699
fax: +55 19 3518 0699
e: hotrunners-br@milacron.com

Mexico

MM Hot Runner Injection México,
S.A. de C.V.
tel: +52 728 282 48 33
e: hotrunners-mx@milacron.com

U.S.A.

Mold-Masters Injectioneering LLC
tel: +1 (248) 544 5710
fax: +1 (248) 544 5712
e: hotrunners-na@milacron.com

European Headquarters

Mold-Masters Europa GmbH
tel: +49 7221 50990
fax: +49 7221 53093
e: hotrunners-eu@milacron.com

Austria / East and South East Europe

Mold-Masters Handelsges.m.b.H.
tel: +43 7582 51877
fax: +43 7582 51877 18
e: hotrunners-at@milacron.com

France

Mold-Masters France
tel: +33 (0) 1 78 05 40 20
fax: +33 (0) 1 78 05 40 30
e: hotrunners-fr@milacron.com

Spain

Mold-Masters España
tel: +34 93 575 41 29
fax: +34 93 575 34 19
e: hotrunners-es@milacron.com

United Kingdom

Mold-Masters (UK) Ltd
tel: +44 1432 265768
fax: +44 1432 263782
e: hotrunners-uk@milacron.com

Turkey

Mold-Masters Europa GmbH
Tel: +90 216 577 32 44
Fax: +90 216 577 32 45
e: hotrunners-tr@milacron.com

Asian Headquarters

Mold-Masters (KunShan) Co, Ltd
tel: +86 512 86162882
fax: +86 512-86162883
e: hotrunners-cn@milacron.com

India

Mold-Masters Technologies Private Ltd.
tel: +91 422 423 4888
fax: +91 422 423 4800
e: hotrunners-in@milacron.com

Japan

Mold-Masters K.K.
tel: +81 44 986 2101
fax: +81 44 986 3145
e: hotrunners-jp@milacron.com

Korea

Mold-Masters Korea Ltd
tel: +82 2 2082 4755
fax: +82 2 2082 4756
e: hotrunners-kr@milacron.com

Singapore

Mold-Masters Singapore PTE Ltd.
tel: +65 6261 7793
fax: +65 6261 8378
e: hotrunners-sg@milacron.com



milacron.com

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