Fixed or variable ratio systems. For accurate metering, mixing, and dispensing of two-component materials. For professional use only.
Not approved for use in European explosive atmosphere locations.

Models U81923 and U82204
3000 psi (21 MPa, 207 bar) Maximum Working Pressure
100 psi (0.7 MPa, 7 bar) Maximum Air Inlet Pressure

Important Safety Instructions
Read all warnings and instructions in this manual. Save these instructions.
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Related Manuals

<p>| PR70 and PR70v Operation and Parts Manuals | |</p>
<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A0429</td>
<td>PR70 with Standard Display Module Operation and Maintenance Manual</td>
</tr>
<tr>
<td>312759</td>
<td>PR70 and PR70v with Advanced Display Module Operation and Maintenance Manual</td>
</tr>
<tr>
<td>312760</td>
<td>PR70 and PR70v Repair and Parts Manual</td>
</tr>
<tr>
<td>312394</td>
<td>PR70 and PR70v Feed Systems Manual</td>
</tr>
<tr>
<td>312761</td>
<td>PR70v Integrated Heat Instructions - Parts Manual</td>
</tr>
</tbody>
</table>

<p>| MD2 Dispense Valve Manual | |</p>
<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>312185</td>
<td>MD2 Dispense Valve Instructions and Parts Manual</td>
</tr>
</tbody>
</table>
Warnings

The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbols refer to procedure-specific risks. When these symbols appear in the body of this manual or on warning labels, refer back to these Warnings. Product-specific hazard symbols and warnings not covered in this section may appear throughout the body of this manual where applicable.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRIC SHOCK HAZARD</strong></td>
</tr>
<tr>
<td>This equipment must be grounded. Improper grounding, setup, or usage of the system can cause electric shock.</td>
</tr>
<tr>
<td>• Turn off and disconnect power at main switch before disconnecting any cables and before servicing or installing equipment.</td>
</tr>
<tr>
<td>• Connect only to grounded power source.</td>
</tr>
<tr>
<td>• All electrical wiring must be done by a qualified electrician and comply with all local codes and regulations.</td>
</tr>
</tbody>
</table>

| **SKIN INJECTION HAZARD** |
| High-pressure fluid from dispensing device, hose leaks, or ruptured components will pierce skin. This may look like just a cut, but it is a serious injury that can result in amputation. **Get immediate surgical treatment.** |
| • Engage trigger lock when not dispensing. |
| • Do not point dispensing device at anyone or at any part of the body. |
| • Do not put your hand over the fluid outlet. |
| • Do not stop or deflect leaks with your hand, body, glove, or rag. |
| • Follow the **Pressure Relief Procedure** when you stop dispensing and before cleaning, checking, or servicing equipment. |
| • Tighten all fluid connections before operating the equipment. |
| • Check hoses and couplings daily. Replace worn or damaged parts immediately. |

| **TOXIC FLUID OR FUMES HAZARD** |
| Toxic fluids or fumes can cause serious injury or death if splashed in the eyes or on skin, inhaled, or swallowed. |
| • Read MSDSs to know the specific hazards of the fluids you are using. |
| • Store hazardous fluid in approved containers, and dispose of it according to applicable guidelines. |
| • Always wear chemically impermeable gloves when spraying, dispensing, or cleaning equipment. |

| **PERSONAL PROTECTIVE EQUIPMENT** |
| Wear appropriate protective equipment when in the work area to help prevent serious injury, including eye injury, hearing loss, inhalation of toxic fumes, and burns. This protective equipment includes but is not limited to: |
| • Protective eyewear, and hearing protection. |
| • Respirators, protective clothing, and gloves as recommended by the fluid and solvent manufacturer. |
**WARNING**

**FIRE AND EXPLOSION HAZARD**
Flammable fumes, such as solvent and paint fumes, in work area can ignite or explode. To help prevent fire and explosion:

- Use equipment only in well ventilated area.
- Eliminate all ignition sources; such as pilot lights, cigarettes, portable electric lamps, and plastic drop cloths (potential static arc).
- Keep work area free of debris, including solvent, rags and gasoline.
- Do not plug or unplug power cords, or turn power or light switches on or off when flammable fumes are present.
- Ground all equipment in the work area. See **Grounding** instructions.
- Use only grounded hoses.
- Hold gun firmly to side of grounded pail when triggering into pail. Do not use pail liners unless they are antistatic or conductive.
- **Stop operation immediately** if static sparking occurs or you feel a shock. Do not use equipment until you identify and correct the problem.
- Keep a working fire extinguisher in the work area.

**EQUIPMENT MISUSE HAZARD**
Misuse can cause death or serious injury.

- Do not operate the unit when fatigued or under the influence of drugs or alcohol.
- Do not exceed the maximum working pressure or temperature rating of the lowest rated system component. See **Technical Data** in all equipment manuals.
- Use fluids and solvents that are compatible with equipment wetted parts. See Technical Data in all equipment manuals. Read fluid and solvent manufacturer’s warnings. For complete information about your material, request MSDS from distributor or retailer.
- Do not leave the work area while equipment is energized or under pressure.
- Turn off all equipment and follow the **Pressure Relief Procedure** when equipment is not in use.
- Check equipment daily. Repair or replace worn or damaged parts immediately with genuine manufacturer’s replacement parts only.
- Do not alter or modify equipment. Alterations or modifications may void agency approvals and create safety hazards.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Use equipment only for its intended purpose. Call your distributor for information.
- Route hoses and cables away from traffic areas, sharp edges, moving parts, and hot surfaces.
- Do not kink or over bend hoses or use hoses to pull equipment.
- Keep children and animals away from work area.
- Comply with all applicable safety regulations.

**MOVING PARTS HAZARD**
Moving parts can pinch, cut or amputate fingers and other body parts.

- Keep clear of moving parts.
- Do not operate equipment with protective guards or covers removed.
- Pressurized equipment can start without warning. Before checking, moving, or servicing equipment, follow the **Pressure Relief Procedure** and disconnect all power sources.

**BURN HAZARD**
Equipment surfaces and fluid that is heated can become very hot during operation. To avoid severe burns:

- Do not touch hot fluid or equipment.
Component Identification
U81923

FIG. 1: Typical Installation

Key:
A Tanks
B Main Power Disconnect
C Foot Switch
D PR70 Servo with Shield
E Agitator
F Power On / E-stop Switch
G Tank Stand
H Cart
J USB Port for Data Collection
K Human Machine Interface (HMI)
L Heated Over / Under Block
M Inlet for Hardener / Catalyst
N Inlet for Base / Resin
P Inlet for Flush
R Static Mixer
S Mixer Heater
T Pressure Transducer
U Mixed Material Temperature Probe
V Material Outlet
Component Identification
U82204

FIG. 2: Typical Installation

Key:
A  Tanks/Feed
B  Main Power Disconnect
C  Foot Switch
D  PR70 Servo with Shield
E  Power On / E-stop Switch
F  Human Machine Interface (HMI)
G  Pressure Transducer
H  Material Outlet
I  Dispense Valve
Installation

1. **Locate PR70 Servo.**

Locate on a level surface and lock casters. See *Dimensions* on page 46 for space requirements.

2. **Electrical Requirements.**

   Installing this equipment requires access to parts which may cause electric shock or other serious injury if work is not performed properly. Have a qualified electrician connect power and ground to main power switch terminals, see step 3 in this installation procedure. All electrical wiring must be done by a qualified electrician and comply with all local codes and regulations.

   **NOTICE**

   Never connect to 480V, 3 phase power. Severe equipment damage will occur.

   **NOTE:**

   PR70 Servo without heat requires 240VAC single phase, 15 amps, 50/60 hertz.
   PR70 Servo with heat requires 240VAC single phase, 40 amps, 50/60 hertz.

3. **Connect Electrical Cord.**

   **NOTE:** Power cord is not supplied.

   **Electrical Cord Wires**
   
   240V, 1 phase: L1, L2, GND

   **Typical Voltage Readings 240V, 1 phase:**
   
   L1-L2: 240V
   L1 or L2-GND: 115V

   Use a screwdriver to connect the two power leads to L1 and L2. Connect green to ground (GND).
4. **Ground the System.**

The equipment must be grounded to reduce the risk of static sparking and electric shock. Electric or static sparking can cause fumes to ignite or explode. Improper grounding can cause electric shock. Grounding provides an escape wire for the electric current.

*Control enclosure and Pump:* grounded through power cord. See **Connect Electrical Cord.**

*Fluid supply container:* follow local code.

*Solvent pails used when flushing:* follow local code. Use only conductive metal pails, placed on a grounded surface. Do not place the pail on a nonconductive surface, such as paper or cardboard, which interrupts grounding continuity.

*To maintain grounding continuity when flushing or relieving pressure:* hold metal part of the spray gun/dispense valve firmly to the side of a grounded metal pail, then trigger the gun/valve.

5. **Connect Air (if applicable for MD2 valve).**

If the system requires air to open and close a dispense valve, connect a compressed airline to the inlet found in the rear of machine.

6. **Connect the Dispense hoses.**

Connect the heated hoses to the outlets of the pumps. Plug the heater connections into the proper outlets on the control panel.

**NOTE:** The non-drip valves on the ends of the hoses are different diameters and only plug into the over / under block in one location.

7. **Connect the Over / Under Block, U81923 Only.**

Connect the other ends of the heated hoses with the non-drip valve fittings into the over / under block. Plug the over / under block heater with probe and mixer heater with probe into the proper outlets on the panel. Connect the pressure transducer and mixed material temperature probe connections into the proper outlets on the panel.

8. **Flush the System.**

The machine is tested at the factory with mineral oil. Flush the machine before the first use.
HMI Navigation Overview

STARTUP/MAIN MENU

STATUS

SETUP HOME

FEED

FACTORY SETUP

TEMPERATURE
  U82204 ONLY

TEMPERATURE GAINS
  U82204 ONLY

ALARM STATUS

ALARM HISTORY

DATA STORAGE
  U82204 ONLY

SCALING

SHOT/FLOW SETUP

SHOT/FLOW SETUP 2
HMI Navigation Overview

The screens all have the same menu at the bottom that navigates from one screen to another.

NOTE: Some icons may not appear depending on the model.

Change HMI Values

To edit a value such as flow rate or percentages, press the button.

When the keypad comes up, enter the new value.

NOTE: The limits are displayed between the readout and keypad.
## Main Menu

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Enable Drive" /></td>
<td>Enables the pump drive. When the system is powered up or the drive faults, it needs to be enabled.</td>
</tr>
<tr>
<td><img src="image" alt="Disable Drive" /></td>
<td>Disables the pump drive. This is useful for maintenance. It also is need to clear some drive faults; disable the drive and then enable it.</td>
</tr>
<tr>
<td><img src="image" alt="DISABLED" /></td>
<td>Indicates if the pump drive is disabled or enabled.</td>
</tr>
<tr>
<td><img src="image" alt="Home Pumps" /></td>
<td>Indicates pump motor position. This is a useful reference to where the pump is. Units are revolutions.</td>
</tr>
<tr>
<td><img src="image" alt="Cycle Pumps" /></td>
<td>This is used to send the pumps to the home position. Note the home position is the point in the dispense cycle when the pistons begin metering material.</td>
</tr>
<tr>
<td><img src="image" alt="Jog Forward" /></td>
<td>This starts a pump dispense cycle. Green indicates the pumps are in a dispense cycle. This signal works the same as the start cycle hard wired input.</td>
</tr>
<tr>
<td><img src="image" alt="Jog Reverse" /></td>
<td>This is used to jog the pumps in the forward direction. This is used for maintenance.</td>
</tr>
<tr>
<td><img src="image" alt="Start Data Log" /></td>
<td>This is used to jog the pumps in the reverse direction. This is used for maintenance.</td>
</tr>
<tr>
<td><img src="image" alt="Start Data Log" /></td>
<td>Used to start data logging when the system is powered up. See Appendix C - Data Logging U81923 Only for more information. U81923 Only.</td>
</tr>
<tr>
<td><img src="image" alt="Close HMI Pgm" /></td>
<td>This closes the HMI program and returns the HMI to it's operating environment. This is only used for changing HMI programs or updating the software.</td>
</tr>
<tr>
<td><img src="image" alt="Alarm Silence" /></td>
<td>This is used to silence the audible alarm.</td>
</tr>
</tbody>
</table>
### HMI Navigation Overview

#### Icon | Description
--- | ---
Login | Used to login to gain access to functions a regular user can’t get to. See Appendix B - Logging In and Out for more information.
Logout | Used to logout. See Appendix B - Logging In and Out for more information.
Status | Shows the current user that is logged in.
Fault Active | Indicates if there is an active fault.

#### Status

This screen shows the current values for various operating parameters such as pressure, flow rate, and temperature.

**NOTE:** Temperatures only show up for model U81923.
Setup Home

This screen is used to set the home position and adjust the home position based on where the piston begins to enter the metering tube. See Appendix A - Homing Pumps for more information.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Enable/Disable Drive" /></td>
<td>The Enable/Disable Drive push buttons and indicators function the same as the main screen.</td>
</tr>
<tr>
<td><img src="image" alt="Set Home" /></td>
<td>The motor has an absolute encoder built in that retains the position even when powered down. In the event the encoder cable is disconnected between the drive and motor, the home position (zero) will need to be set again. This sets the new home position. See below for more details.</td>
</tr>
<tr>
<td><img src="image" alt="Adjusted box" /></td>
<td>The Adjusted box shows the adjusted position value set for home. The actual value shows the motor position as it is incremented with the up/down keys. The units are in motor revolutions.</td>
</tr>
<tr>
<td><img src="image" alt="Forward-Reverse keys" /></td>
<td>These keys bump the position of the motor forward or backward. The current motor position is located in the box marked “Actual”.</td>
</tr>
<tr>
<td><img src="image" alt="Home Pumps" /></td>
<td>This rehomes the pumps. The home cycle sends the pump to the reload (retracted) position and then to the Adjusted home position. This push button functions the same as the one on the main screen.</td>
</tr>
<tr>
<td><img src="image" alt="Set Phasing Offset" /></td>
<td>Once the new home position is determined, this moves the Actual value into the Adjusted value. This will always be the new home position.</td>
</tr>
<tr>
<td><img src="image" alt="Drive Fault Reset" /></td>
<td>This resets any drive faults that occur.</td>
</tr>
<tr>
<td><img src="image" alt="Drive Shutdown Reset" /></td>
<td>This resets any drive faults that occur that shutdown the drive.</td>
</tr>
<tr>
<td><img src="image" alt="Drive Power On" /></td>
<td>Turns on the power circuit to the pump drive. When the system is powered up it needs to be powered up.</td>
</tr>
<tr>
<td><img src="image" alt="Drive Power Off" /></td>
<td>Turns off power to the pump drive. Note 24VDC is still supplied to the drive, this only turns off the power circuit.</td>
</tr>
</tbody>
</table>
# Feed Control

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tank Status</strong></td>
<td>This indicates the tank status: No Levels Used = system is set up without any level sensors, High Level = the high level switch is tripped, Low Level = material is below the low level sensor, Filling = the tank is auto filling, Material Present = tank is loaded, Fill Fault = the amount of time to fill the tank has been exceeded, Accumulator Mode- feed is accumulators, Sensor Fault = the tank sees material on the high level sensor but not on the low level sensor.</td>
</tr>
<tr>
<td><strong>Fill Time (sec)</strong></td>
<td>Accumulated time readout when tank is filling in seconds.</td>
</tr>
<tr>
<td><strong>Tank Mode</strong></td>
<td>Tank Mode: Choose how feed is set up. Low Level Shutdown is used to disable pumps when either tank has a low level. Engage Alarm is used to sound the audible alarm when the tanks is low (the pumps stay enabled). Engage Autofilfill is used to automatically refill the tank when the low level is sensed. Accumulator Mode is when pumps are feed with accumulators instead of tanks. Disable feed controls is used when level sensing is not needed. Note both tanks are set up in the same mode.</td>
</tr>
<tr>
<td><strong>A Fill</strong></td>
<td>In Auto Fill Mode, either tank can begin filling by pushing the Start Fill push button or when material goes below the low level sensor. The filling stops when the high level sensor is tripped or the Stop Filling push button is pushed. Note the Stop Filling button stops filling on both tanks.</td>
</tr>
<tr>
<td><strong>Fill Time (sec)</strong></td>
<td>This is where the operator sets the amount of time it takes to fill the tanks. If the tank doesn't fill within this amount of time, a fill fault occurs. This only is enabled in Auto Fill mode.</td>
</tr>
<tr>
<td><strong>Stop Filling</strong></td>
<td>In Low Level Shutdown Mode, once the low level sensor see the material is low, it allows the pumps to cycle however many more times is set on this counter.</td>
</tr>
<tr>
<td><strong>Silence</strong></td>
<td>This silences the audible alarm.</td>
</tr>
<tr>
<td><strong>Alarm</strong></td>
<td>When a fill fault occurs, this pushbutton resets it.</td>
</tr>
</tbody>
</table>
Setup

NOTE: These values are set at the factory and typically do not need to be changed.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Pump Size mm²</td>
<td>This enters the pump size used for calculating shot size and flow rates. The units are mm². For example if An LC1960 metering assembly (960 pump) was on the A side, 960 is the value entered.</td>
</tr>
<tr>
<td>Gear Reduction</td>
<td>This is the gear reduction (if any) used between the servo motor and actuator. If there is no gear box, enter ‘1’.</td>
</tr>
<tr>
<td>Home Reload Speed mm/sec</td>
<td>This is the speed the actuator moves during the reload and home cycle in mm/sec.</td>
</tr>
<tr>
<td>Metered Stroke (in)</td>
<td>This is the metered stroke or the distance the piston travels in the pump tube. This value is used for calculating shot size and flow rates. For standard PR70's the value is 1.5”.</td>
</tr>
<tr>
<td>Reload Distance (in)</td>
<td>This is the reload stroke or the distance the piston travels to the retracted position to reload the pump. For standard PR70's the value is 1.0”. This value may be less for thinner materials to shorten cycle times.</td>
</tr>
<tr>
<td>Effective Screw/Lead</td>
<td>This is the lead of the actuator in millimeters per motor revolution. The typical value for the PR70 is 10.</td>
</tr>
<tr>
<td>FIXED</td>
<td>These pushbuttons choose the type of PR70, either the fixed ratio frame or the variable ratio frame.</td>
</tr>
<tr>
<td>VARIABLE</td>
<td></td>
</tr>
<tr>
<td>SPEED CONTROL</td>
<td>These pushbuttons allow the pump speed to be set as a fixed value entered by the user on the Shot/Flow screen or to be a variable speed set by a user entered voltage on an analog input in the PLC. Note the remote speed is not active in Pressure Mode.</td>
</tr>
</tbody>
</table>
Temperature U81923 Only

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="ON OFF DISABLED" /></td>
<td>These pushbuttons enable and disable the heat circuit for each heat load. The enabled or disabled status for each heat load is displayed underneath.</td>
</tr>
<tr>
<td><img src="image" alt="HEATER ON" /></td>
<td>This indicates if heater is heating or not. Red “Heater On” indicates that the heater is active. Yellow “Heater Off” indicates the heater is not active.</td>
</tr>
<tr>
<td><img src="image" alt="SET POINT NNN" /></td>
<td>This is the set point of the heat zone. Units are degrees Celsius.</td>
</tr>
<tr>
<td><img src="image" alt="TEMP EXP TEMPERATURE" /></td>
<td>Displays the actual temperature of the heat zone. In the case of the tanks, it also displays the temperature of the probe under the blanket.</td>
</tr>
<tr>
<td><img src="image" alt="ALL ON ALL OFF" /></td>
<td>Are used to enable or disable all heat zones at the same time.</td>
</tr>
<tr>
<td><img src="image" alt="OFFLINE TEMP NNN" /></td>
<td>Indicates the temperature of the mixed material at the outlet.</td>
</tr>
<tr>
<td><img src="image" alt="Temp. Game" /></td>
<td>This navigates to the screen where the heater gains are set.</td>
</tr>
</tbody>
</table>
### Shot/Flow Setup 1

#### Icon Description

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Pump Mode" /></td>
<td>Picks the operating mode for the pumps. Off Mode disables the pumps. Pressure Mode allows the pumps to cycle within a pressure window to deliver a defined shot size at a defined flow rate. Shot Mode allows the pumps dispense a defined shot size at a defined flow rate. Continuous Mode allows the pumps to cycle continuously at a defined flow rate. Operator Mode lets the operator determine the shot size by how long the start device is actuated at a defined flow rate. In operator mode, the pumps must be retracted with an external customer signal or the “Home” push button.</td>
</tr>
<tr>
<td><img src="image" alt="Dispense Valve Mode" /></td>
<td>If the system is equipped with a dispense valve, this sets the mode that it will operate. Open Mode holds the dispense valve open. Close Mode holds the valve closed. Auto Mode opens the valve when the pumps are dispensing and closed the valve when the pumps are done. Note cycling the pumps with the dispense valve in Close Mode and no other valves open will cause the servo motor to stall and fail.</td>
</tr>
<tr>
<td><img src="image" alt="Current Pressure" /></td>
<td>If the system is equipped with a pressure transducer, this displays the current material pressure at the outlet.</td>
</tr>
<tr>
<td><img src="image" alt="High Limit" /> <img src="image" alt="Low Limit" /></td>
<td>If the system is equipped with a pressure transducer and the pump mode is set to Pressure Mode, these values determine when the pumps will stop and start. If the High Limit is set at 100psi and the Low Limit is set at 50psi, the pumps will cycle until the pressure reaches 100psi and stop. The pressure will drift down and when it gets to 50psi the pumps will start up again. This repeats until the value in the shot size is reached. Units are pounds per square inch (psi).</td>
</tr>
<tr>
<td><img src="image" alt="Shot Size Flow Rate" /></td>
<td>This sets the shot size (cc's) and flow rate (cc's/sec) for ten programmed shots. Push the button on the left of the values to pick the shot to dispense. The push button will change green to indicate the chosen shot/flow rate. Push the shot size or flow rate field to change the value.</td>
</tr>
<tr>
<td><img src="image" alt="Home Pumps" /></td>
<td>This is used to send the pumps to the home position. Note the home position is the point in the dispense cycle when the pistons begin metering material.</td>
</tr>
<tr>
<td><img src="image" alt="Stroke" /></td>
<td>The top row shows how many total strokes the pumps will take to get the user entered shot size. The bottom row shows how many strokes have been taken as the pumps cycle.</td>
</tr>
</tbody>
</table>
### Icon Description

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Position Icon" /></td>
<td>Displays the position and speed of the servo motor in units of motor revolutions and motor revolutions per second.</td>
</tr>
<tr>
<td><img src="image2" alt="Start Cycle Icon" /></td>
<td>This starts the cycle. The color is green as long as the pumps are cycling.</td>
</tr>
<tr>
<td><img src="image3" alt="Ratio Icon" /></td>
<td>Enter the volumetric ratio of A to B material. This value is used for calculating shot size only, it doesn't change the ratio.</td>
</tr>
<tr>
<td><img src="image4" alt="Flow Rate Icon" /></td>
<td>This displays the flow rate the pumps will cycle at. Note if the speed control is User Entered, the value of the chosen programmed flow rate will be displayed. If the Remote Speed is chosen, the converted analog speed value will be displayed.</td>
</tr>
<tr>
<td><img src="image5" alt="Shot Size Icon" /></td>
<td>This displays the shot size the pumps will dispense based on the chosen programmed shot size.</td>
</tr>
</tbody>
</table>
**Mixed Material Pump Pressure Setpoints (psi):** For RTM applications, this box displays the current pressure of the mixed material. The user can enter a high limit and low limit. When the machine is set to pressure mode, the pumps cycle until the high pressure limit is reached, then the pumps stop and the mixed material pressure drifts down below the low limit and the pumps begin to cycle again.

**Current Pressure:** This displays the current A and B pressure of the pump.

**Low Limit Warning:** This is a user settable pressure for the A and B pumps. If during pumping the low limit pressure is not reached (due to a bad piston or leak), the low limit trips and the audible alarm sounds. The pumps can still run during this warning. The silence alarm button turns off the alarm.

**High Limit Warning:** This is a user settable pressure for the A and B pumps. If during pumping the high limit pressure is exceeded, the high limit trips and the audible alarm sounds. The pumps can still run during this warning. The silence alarm button turns off the alarm.
### Icon | Description
---|---
[High Limit Shut Down](#) | Temperature Gains U81923 Only

High Limit Shut Down: This is a user settable pressure for the A and B pumps. If during pumping the high limit pressure is exceeded, the high limit trips and the audible alarm sounds. The drive shuts down and pumping stops. The silence alarm button turns off the alarm. The pressure must be relieved to restart the drive.

**NOTE:** Pressure transducers must be plugged in for the pumps to cycle.

**NOTE:** If the pressure exceeds 3000 psi, the drive will shut down. This is a factory setting and cannot be changed by the operator.

[Shot Mode Purge Timer: Off/On](#) | Shot Mode Purge Timer: Shot Size/Flow Rate. These are the values the user can enter to determine how much material to purge and at what flow rate. When the purge timer times down the pumps cycle at these parameters. When the operator takes the next shot, the regular shot parameters are used again.

Shot Mode Purge Timer: Shot Size/Flow Rate. This turns the purge timer off and on. When the purge is on, the pumps will cycle after a period of inactivity. Note this is only active in shot mode. This timer can also be used to recirc material if equipped with the proper hardware.

[Shot Mode Purge Timer: Purge Timer (sec)](#) | Shot Mode Purge Timer: Purge Timer (sec). This is the user entered value that determines how long the pumps will sit idle before they purge. Note when the timer times down the audible alarm sounds for a brief time to warn the operator the machine will cycle.

Shot Mode Purge Timer: Time before Purge. This show the purge timer timing down.

### Temperature Gains U81923 Only

See Appendix D - Setting Temperature Gains U81923 Only for information on setting temperature gains.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="#">A Tank</a></td>
<td>This is the value of the gain used for determine how fast the heat load heats up on initial startup and how much the temperature fluctuates. The default value is 100.</td>
</tr>
</tbody>
</table>
Scaling

To scale the pressure transducer:

- Plug the transducer into a fitting with a gauge to read pressure.
- Put the highest value of air pressure (500psi maximum) on the fitting.
- Enter the pressure reading from the gauge in the High (PSI) field.
- Press the Set High Pressure Scale Factor button.
- Remove the air pressure, verify the gauge reads zero.
- Enter the value (zero) reading from the gauge in the Low (PSI) field.
- Press the Set Low Pressure Scale Factor button.
- Run the air pressure up and down and verify the gauge reading matches the reading in the Scaled field.
- Repeat if necessary.
Enter the A Pump size in mm squared. This number can be found engraved on the pump tube. Enter the B Pump size in mm squared. This number can be found engraved on the pump tube.

To scale the customer speed input:

- Hook up the voltage signal to the analog input on the PLC.
- Put the highest value of voltage on the input.
- Enter the desired flow rate in the High (cc/sec) field.
- Press the Set High Velocity Scale Factor button.
- Lower the voltage value to the desired slowest flow rate value.
- Enter the desired flow rate in the Low (cc/sec) field.
- Press the Set Low Velocity Scale Factor button.
- Raise and lower the voltage input values and verify the velocity scaled value changes as desired.
- Repeat if necessary.
<table>
<thead>
<tr>
<th><strong>High (cc/sec)</strong></th>
<th>Set the voltage input at the highest value possible and enter the flow rate desired at this point.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set High Velocity Scale Factor</strong></td>
<td>With the voltage input set to the highest value possible and the flow rate value entered, push this push button to enter the high end of the flow rate slope.</td>
</tr>
<tr>
<td><strong>Low (cc/sec)</strong></td>
<td>Set the voltage input at the lowest value possible and enter the flow rate desired at this point.</td>
</tr>
<tr>
<td><strong>Set Low Velocity Scale Factor</strong></td>
<td>With the voltage input set to the lowest value possible and the flow rate value entered, push this push button to enter the low end of the flow rate slope.</td>
</tr>
<tr>
<td><strong>Raw</strong></td>
<td>This displays the raw voltage number the PLC input is seeing.</td>
</tr>
<tr>
<td><strong>Scaled</strong></td>
<td>This displays the scaled flow rate conversion value. Raise and lower the voltage input and compare the actuator motion to verify the values.</td>
</tr>
<tr>
<td><strong>Enable User Entered Pressure Warnings Only</strong></td>
<td>The enable and disable buttons allow the low and high pressure warning alarms to be enabled or disabled by the operator.</td>
</tr>
<tr>
<td><strong>Disable User Entered Pressure Warnings Only</strong></td>
<td>NOTE: The high pressure shut down cannot be disabled.</td>
</tr>
</tbody>
</table>

**NOTE:** The variable velocity does not work in pressure mode.

### Alarm History

This displays all alarms that have occurred.

- The blue window contains the date and time the alarm and a description of the alarm.
- **SORT** Push button: switches the order from newest to oldest or oldest to newest.
- The assorted arrow keys page/scroll up or down the lists.
Alarm Status

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Alarm Silence" /></td>
<td>This is used to silence the audible alarm.</td>
</tr>
<tr>
<td><img src="image" alt="Alarm Reset" /></td>
<td>Some alarms may require an operator to acknowledge the alarm by manually pushing this button.</td>
</tr>
<tr>
<td><img src="image" alt="Reset Alarm Data" /></td>
<td>Resets alarm data if needed.</td>
</tr>
<tr>
<td><img src="image" alt="Sort" /></td>
<td>Switches the order of alarms from newest to oldest or oldest to newest.</td>
</tr>
</tbody>
</table>

Arrow keys

Arrow keys page/scroll up or down to see the complete list.
Startup

1. Turn on the main disconnect.

2. Push the power on push button.

3. Open the air valve to dispense valve solenoid (if applicable).

4. Enable the drive:
   a. On the main screen, press the Disable Drive pushbutton.
   b. On the main screen, press the Enable Drive pushbutton.
   c. Ensure the drive status indicator says “Enabled”.

5. Press the Home Pump pushbutton and verify the pump retracts and extends to the home position.
Setup

Setup includes entering parameters, homing pumps, priming, phasing, and setting the ratio.

Enter Data

Entering data for the desired application includes the following:

1. On the Shot/Flow screen enter the shot size and flow rate in the one of the ten preset values. Pick the preset shot by pushing the parameter number push-button.

2. On the Shot/Flow screen enter the volumetric ratio. Note this value must be entered even on fixed ratio PR70's. This value is used to calculate the maximum shot size that can be dispensed before reloading. Also note on the PR70 variable ratio model the mechanical ratio beam must still be manually set to the correct ratio.

3. On the Shot/Flow screen pick the pump mode and dispense mode. If the pump mode is pressure, enter the high and low pressure setpoints.

4. On the Feed Control screen pick the operating mode for the tanks or accumulators. If using the auto fill mode, set the fill timers.

5. If the PR70 is heated, go to the Temperature screen and enter the desired temperature values for the loads being used.

Prime the Dispense Head

For MD2 Valve:

1. Remove static mixer from the dispense head (102) if installed.

2. Turn snuff-back adjustment knob fully clockwise. This will prevent the dispense valve from closing between priming shots.

3. Use a 4 mm hex key to loosen the screws (102a) holding the dispense head in place.

4. Rotate dispense head (102) so the tip is above the fluid input hoses.

5. Use a 4 mm hex key to tighten screws (102a) holding dispense head in place.

6. Route the fluid hoses connected to the dispense head so they are always below the dispense head. This ensures any air in the hoses will travel to the dispense head.


NOTICE

If the dispense head is not primed, chemical crossover may occur resulting in cured material in the dispense head, hoses, and/or pumps.
8. Select a large size shot.

9. Hold a waste container at the end of the dispense head (102) and press the cycle pumps button or the footswitch.

10. Repeat the previous step until no air comes out of the dispense valve.

11. If phasing adjustments and ratio checking are not required, use the following procedure to attach the static mixer.
   - Attach the static mixer with the dispense head pointed up.
   - Hold waste container at end of dispense head (102) and press the cycle pumps button or the footswitch.
   - Repeat the previous steps until static mixer has been purged of air.

12. Use a 4 mm hex key to loosen screws (102a) holding dispense head in place.

13. Rotate dispense head back to normal dispensing position.

14. Use a 4 mm hex key to tighten the screws (102a) holding the dispense head in place.

15. Adjust snuff back to proper setting for operation. See Adjust Dispense Valve Snuff Back (MD2 Valve Only) on page 30.

---

For Over/Under Block:

1. Remove the pins (200) holding the hoses in the over/under block. Pull the non drip valves and hoses (201) out of the block.

2. Select a large size shot.

3. Hold the hoses and non drip valves stretched out at a slight incline with the non drip valves over a waste container and press the cycle pumps pushbutton or the footswitch.

4. Repeat the previous step until no air comes out either non drip valve.

5. If phasing adjustments and ratio checking are not required plug the non drip valves back into the over/under block.

6. Hold the block and mixer at a slight incline with the outlet over a waste container and press the cycle pumps pushbutton or footswitch.

7. Repeat the previous step until the static mixer has been purged of air.
**Phasing Adjustment**

When the machine executes a shot, materials from Tank A and Tank B enter the static mixer where they are mixed and then dispensed. In order for the materials to mix at the desired ratio, both materials must enter the static mixer at the same time. The timing of the materials entering the static mixer is dependent on the adjustment of the phase adjustment screw for each piston.

This step assumes the home position is set at zero from the factory. If the encoder cable has been unplugged during shipment, the zero point will need to be reset. See setting home in [Appendix A - Homing Pumps](#).

**Prepare Machine**

1. Place a waste container under the dispense valve to catch dispensed material.
2. For an MD2 valve, remove static mixer and install ratio check nozzle onto valve.
3. For an over/under block, remove the pins and pull the non drip valves out of the block.
4. If necessary, place a stand under the ratio check nozzle or non drip valves.
5. Enter a small size shot.

6. Adjust the home position:

This step assumes the home position is set at zero from the factory. If the encoder cable has been unplugged during shipment, the zero point will need to be reset. See setting home in [Appendix A - Homing Pumps](#).

Once the zero point is set and material is loaded into the pumps, it may be necessary to adjust the zero point so material begins dispensing at the correct time (phasing).

- **a.** Determine if the home position needs adjusted in the forward or reverse direction. The zero point will need adjusted forward if the start signal is given and material doesn't start dispensing right away. The zero point will need adjusted toward the reverse position if the start signal is given and a material spurts out at a high pressure and then the flow levels off.

- **b.** Bump the motor in the correct direction. The position showing up in the Actual box will change.

- **c.** Press the set Home Offset button and the Actual position transfers into the Adjusted position.

- **d.** Re-home the pumps.

- **e.** Start a dispense cycle and verify material begins dispensing at the proper time.

- **f.** Repeat steps b through e as needed.
7. Adjust Phasing.

- If the B side material exits the dispense nozzle before the A side material:
  a. Use two 13 mm wrenches to break loose the locking nut (302) from the phase adjustment screw (303) on the A material side.
  b. Hold the phase adjustment screw (303) stationary with a 13 mm wrench.
  c. Use a 7 mm wrench to turn the piston shaft (301) counterclockwise 1/4 turn or less to move the A piston forward.

**NOTE:** It is highly recommended that all of the phasing adjustment be done to one side or the other; not both.

**NOTE:** Ensure the piston shaft and phase adjustment screw do not rotate while tightening the locking nut (302) in the following step.

  c. Hold piston shaft (301) and phase adjustment screw (303) in place with a 7 mm and 13 mm wrench and tighten locking nut (302) against phase adjustment screw with a 13 mm wrench.

- If the A side material exits the dispense nozzle before the B side material:
  a. Use two 13 mm wrenches to break loose the locking nut (302) from the phase adjustment screw (303) on the B material side.
  b. Hold the phase adjustment screw (303) stationary with a 13 mm wrench.
  c. Use a 7 mm wrench to turn the piston shaft (301) counterclockwise 1/4 turn or less to move the B piston forward.

  d. Watch the dispense valve carefully to observe which material is dispensed first. Press the cycle start button or the foot switch to dispense material. If one material exits the dispense nozzle before the other, go back to step b.
Adjust Dispense Valve Snuff Back (MD2 Valve Only)

At the end of a shot, a small amount of material is drawn back into the static mixer to prevent extra material from being dispensed. If too much snuff back occurs air will enter the static mixer and can travel up into the dispense valve. If too little snuff back occurs the materials may drip out of the static mixer and affect dispense quantity.

It is most efficient to adjust the snuff back while material is dispensing but it can also be adjusted when there is no air pressure in the system.

1. Select a small size shot.
2. If a static mixer is not in place, install one then prime the machine. See Prime the Dispense Head, page 26.
3. Place a waste container under static mixer.
4. Press the cycle start button.
5. Inspect the tip of the static mixer for dripping material or for air bubble traveling up the mixer.
6. Perform another shot and while dispensing adjust the snuff-back adjustment knob as follows.
   - If an air bubble is moving up the mixer, turn knob clockwise to decrease snuff back.
   - If material is hanging from tip of mixer, turn knob counterclockwise to increase snuff back.
7. Repeat step 6 until snuff back is adjusted as desired.

Calibrate Dispense Weight Ratio

Key:
- 201 Ratio Adjustment Knob
- 202 Ratio Beam
- 203 Socket Head Cap Screws
- 204 Hex Head Cap Screw
- 205 Ratio Beam Guide
- 206 Ratio Beam Snap Ring

Fig. 5: Ratio Adjustment
The PR70v base unit can dispense volume ratios in the range of 1:1 to 24:1. The range of A to B cylinder size ratios is 1:1 to 12:1. The mechanical ratio arm multiplies the constant cylinder size ratio by a range of 1:1 to 2:1 depending on the ratio arm adjustment.

Prepare Machine for Dispense Weight Ratio Calibration

1. Verify the dispense head is properly primed. See Prime the Dispense Head, page 26.

2. Verify the machine is properly phased. See Phasing Adjustment, page 28.

3. Find the desired ratio arm setting from 1:1 to 2:1.

**NOTE:** For this step, the desired volume ratio must be known. Using the desired weight ratio will cause calculation errors.

   a. Divide the side A piston size by the side B piston size to get the piston volume ratio. For example, if the A piston size is 960 mm² and the B piston size is 480 mm² then \( \frac{960}{480} = 2 \).

   b. Divide the desired dispensing volume ratio by the piston volume ratio to get the desired ratio arm setting. For example if the desired dispensing volume ratio is 2.38:1 and the piston volume ratio is 2:1 then \( \frac{2.38}{2} = 1.19 \).

4. Change the mechanical ratio adjustment to the desired setting (1.19 in the example) as follows.

   a. Ensure the machine pistons are in the retracted position.

   b. Ensure the purge timer is off and the machine is not in recirculation mode.

   c. Press the Home Pumps command button.

   d. The ratio beam should be parallel to the back of the machine frame casting.

   e. Loosen the socket head cap screw (203) on the adjustment clevis. See Fig. 5.

   f. Loosen the hex head cap screws (204) on the ratio adjustment pivot.

   g. Turn the ratio adjustment knob (201) clockwise to increase the ratio and counterclockwise to decrease the ratio until the mechanical ratio arm is set to the desired setting (1.19 in the example).

   h. Tighten the hex head cap screws (204) on the ratio adjustment pivot.

   i. Slide the ratio beam guide (205) so there is approximately a 0.5 mm gap between the ratio beam guide (205) and the snap ring (206) shown in Fig. 6.

**NOTICE**

Damage to the ratio mechanism will result if the proper clearance is not present.
Setup

- Tighten the socket head cap screw (203) on the adjustment clevis.


Perform Weight Ratio Check Shot

6. Install ratio check nozzle onto dispense valve (MD2 valve only).

7. Place a waste container under the dispense valve to capture any dispensed material.

8. Go to shot mode.

9. Select a shot.

10. Press the cycle pumps button or the foot-switch to dispense material.

11. Discard the shot.

12. Label one scale as “A” and a second scale as “B”.

13. Label one new container as “A” and a second new container as “B”.

14. Place container “A” on scale “A” and tare the scale. Place container “B” on scale “B” and tare the scale.

15. Place container “A” under the A material output of the ratio check nozzle. Place container “B” under the B material output of the ratio check nozzle.

16. Press the pump cycle button or the foot-switch to dispense material.

17. Place container “A” on scale “A” and note the weight. Place container “B” on scale “B” and note the weight.

18. Divide the weight of container “A” by the weight of container “B” to get the weight ratio of the dispensed materials.

19. Repeat steps 13 through 18 at least two more times for an overall total of at least three ratio check shots, or repeat as needed.

20. If the average A to B ratio of the dispensed materials is too high or too low, adjust the mechanical ratio arm as required by repeating steps 4 through 19 until the dispensing ratio is correct.
   - If the A to B ratio is too high, turn the ratio adjustment knob (201) counterclockwise to adjust the mechanical ratio arm towards the 1:1 position.
   - If the A to B ratio is too low, turn the ratio adjustment knob (201) clockwise to adjust the mechanical ratio arm towards the 2:1 position.

Secure Dispensing Ratio

21. Once the ratio check shots confirm the A to B dispensing ratio is correct, tighten all screws holding the ratio beam (202) in place.
   a. Tighten the socket head cap screws (203) holding the ratio beam (202) in place to 140 in-lb (15.8 N·m).
   b. Tighten the hex head cap screw (204) holding the ratio beam guide (205) in place to 350 in-lb (39.5 N·m).

Prepare Machine for Operation

22. Remove ratio check nozzle and install static mixer or night cap as necessary.
Pressure Relief Procedure

Follow the Pressure Relief Procedure whenever you see this symbol.

This equipment stays pressurized until pressure is manually relieved. To help prevent serious injury from pressurized fluid, such as skin injection, splashing fluid and moving parts, follow the Pressure Relief Procedure when you stop spraying and before cleaning, checking, or servicing the equipment.

The following steps are for a system with an MD2 valve.

1. Place a waste container below the dispense valve.
2. Go to the Shot/Flow screen and Put the DV in Open mode.
3. Allow the material to bleed out.

The following steps are for a system with an over/under block.

1. Place a waste container below the mixer outlet.
2. The non drip valves hold a minimal amount pressure.
3. Remove the pins from the block holding the non drip valves in.
4. Place the non drip valve hoses over a waste container.
Flush out old fluid with new fluid or flush out old fluid with compatible solvent before introducing a new fluid. All fluid components are compatible with common solvents. Use only moisture-free solvents. See solvent manufacturer's information for material compatibility. Do not use water.

Ground the solvent pails used when flushing: Refer to Ground the system.

If flushing with a compatible solvent, perform the following procedure:

**NOTE:** Flushing must be used on systems with an over/under block.

1. Turn power off.

2. Blow compressed air through the supplied flush port in the over/under block to get mixed material out of the over/under block and mixer.

3. Pressure feed solvent through the same port until no mixed material comes out of the outlet.

4. Blow air through a second time to dry out the components.

**NOTE:** Even though flushing will get the majority of the material out of the over/under block and mixer, for best results disassemble and clean this parts individually.
If the machine is to remain idle for an extended period of time, perform the following steps.

**Systems with an MD2 valve:**

1. Place a waste container below the dispense valve.
2. If installed, remove static mixer from the end of the dispense valve.
3. Place a container below the dispense valve and activate a small shot to flush mixed material out of the valve.
4. Relieve pressure. See Pressure Relief Procedure.
5. With a clean rag and cotton swabs, clean the end of the dispense valve.
6. Install nightcap on the dispense valve.

**Systems with an over/under block:**

1. Relieve pressure. See Pressure Relief Procedure.
2. Flush over/under block. See Flushing Procedure.
### Maintenance

#### Schedule

<table>
<thead>
<tr>
<th>Action</th>
<th>Schedule</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check Desiccant Dryer (only installed if chemical is moisture sensitive)</td>
<td>Daily before use</td>
<td>1. Check the color of the desiccant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replace as required.</td>
</tr>
<tr>
<td>Check Tanks</td>
<td>Daily before use</td>
<td>1. Check material levels and refill as necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Verify the material reservoirs are vented properly.</td>
</tr>
<tr>
<td>Check Dispensing Ratio</td>
<td>Daily before use or as required</td>
<td>See Calibrate Dispense Weight Ratio page 30. If ratio accuracy is critical to the application, perform ratio check procedure daily before use.</td>
</tr>
<tr>
<td>Clean Pump Shafts</td>
<td>Daily after shutdown</td>
<td>See Clean the Pump Shafts on this page 36</td>
</tr>
<tr>
<td>Clean Dispense Head</td>
<td>Daily</td>
<td>See Shutdown on page 35</td>
</tr>
<tr>
<td>Lubricate pneumatic air motor</td>
<td>Every 8 hours</td>
<td>See Lubricate Pneumatic Air Motor on page 37.</td>
</tr>
<tr>
<td>Lubricate pneumatic air motor 01/0368-1/11 gear box</td>
<td>Every 2 days</td>
<td>See Lubricate Gear Box of Pneumatic Air Motor 01/0368-1/11 on page 37.</td>
</tr>
<tr>
<td></td>
<td>Every 6 months (or 2500 operating hours)</td>
<td></td>
</tr>
<tr>
<td>Flush pneumatic air motor 82/0216/11</td>
<td>As required</td>
<td>Flush Pneumatic Air Motor 82/0216/11 on page 37.</td>
</tr>
<tr>
<td>Disassemble and Clean Dispense Head</td>
<td>As required</td>
<td>See Disassemble and Clean the Dispense Head (MD2 Valve Only) on page 36</td>
</tr>
</tbody>
</table>

#### Clean the Pump Shafts

1. Put the pump mode in off.
2. Jog the pumps to the fully retracted position.
3. Clean both pump shafts with solvent and lubricate with mesamoll or silicone oil.

#### Disassemble and Clean the Dispense Head (MD2 Valve Only)

1. Relieve pressure. See Pressure Relief Procedure.
2. Remove dispense head from machine.
3. Dismantle the dispense head. See MD2 Dispense Valve manual referenced at the beginning of this manual.
4. Clean all parts.
5. Lubricate all parts with a thin coat of mesamoll or silicone oil.
7. Reinstall dispense head on machine.
Flush Pneumatic Air Motor
82/0216/11

If the motor is sluggish or inefficient, flush it with a non-flammable solvent in a well ventilated area. The recommended solvent for air motors and lubricated pumps is Gast® Flushing Solvent (Part No. AH255 or AH255A) or Inhibisol® Safety Solvent.

1. Disconnect the air line and muffler.
2. Add several teaspoons of solvent or spray the solvent directly into the motor.
3. Rotate the shaft by hand in both directions for a few minutes.
4. Reconnect the air line, and slowly increase the air pressure until there is no trace of solvent in the exhaust air.
5. Re-lubricate the motor with a squirt of light-weight oil in the chamber.

Lubricate Gear Box of Pneumatic Air Motor
01/0368-1/11

NOTE: This section does not apply to pneumatic air motors 24J182 or 24J183.

Check Oil Level

Perform the following procedure every two days.

1. Remove oil fill plug and check oil level. The proper oil level is indicated on the outside of the gear box housing.
2. If the oil level is low, add 140-weight SAE gear oil or a high quality worm gear lubricant.
3. Replace fill plug and torque to 20 ft-lb (27 N•m).

NOTE: Gear box oil is easiest to drain immediately following motor operation while oil is still warm.

Lubricate Pneumatic Air Motor

NOTICE
Not lubricating the air motor will cause motor failure.

If an air line lubricator is not installed, the air motor must manually be lubricated every eight hours. Lubricate the agitator air motor by placing 10-20 drops of SAE #10 light oil in the air inlet of the motor. Run the agitator for about 30 seconds.

Replace Oil

Perform the following procedure after the first 250 hours of operation. After that, perform every six months or every 2500 operating hours.

1. Remove gear box and drain oil.
2. Refill gear box with 140-weight SAE gear oil or a high quality worm gear lubricant.
3. Replace fill plug and torque to 20 ft-lb (27 N•m).

NOTE: Replace gear oil more often if the environment causes oil to become contaminated during use.
Troubleshooting

Before starting any troubleshooting procedures, perform the following procedure. See PR70 and PR70v Repair - Parts manual referenced at the beginning of this manual for detailed procedures.

2. Disconnect AC power from the machine.
3. Allow the machine to cool if the machine has a heat control option.

Try the recommended solutions in the order given for each problem to avoid unnecessary repairs. Verify all circuit breakers, switches, and controls are properly set and wiring is correct.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Module completely dark</td>
<td>No power</td>
<td>Verify rear AC Power switch is ON.</td>
</tr>
<tr>
<td></td>
<td>Fuse blown</td>
<td>Replace machine fuses.</td>
</tr>
<tr>
<td></td>
<td>Loose connection</td>
<td>Tighten cable on Display Module.</td>
</tr>
<tr>
<td></td>
<td>Bad display module</td>
<td>Replace Display Module.</td>
</tr>
<tr>
<td>No or incorrect amount of material dispensed from either side.</td>
<td>Ball valve closed (if installed)</td>
<td>Open tank ball valve.</td>
</tr>
<tr>
<td></td>
<td>Tank empty</td>
<td>Fill tank with material.</td>
</tr>
<tr>
<td></td>
<td>Tank clogged</td>
<td>Verify no obstruction in the tank.</td>
</tr>
<tr>
<td></td>
<td>Air in material</td>
<td>Prime the machine until the air is removed.</td>
</tr>
<tr>
<td></td>
<td>Check valve malfunction</td>
<td>Remove; clean or replace check valve.</td>
</tr>
<tr>
<td></td>
<td>Piston worn or broken</td>
<td>Remove and replace piston if worn.</td>
</tr>
<tr>
<td>Piston stalled</td>
<td>Input air reduced or removed</td>
<td>Reconnect input air line to machine. Increase air pressure regulator adjustment.</td>
</tr>
<tr>
<td></td>
<td>Mixer blocked</td>
<td>Replace static mixer. Incorporate purge timer or decrease purge timer delay to prevent mixer blockage.</td>
</tr>
<tr>
<td></td>
<td>Open Dispense Valve (ODV) adjustment too late</td>
<td>Readjust the ODV setting to occur sooner.</td>
</tr>
<tr>
<td></td>
<td>Blocked check valve</td>
<td>Remove check valve; clean and replace.</td>
</tr>
<tr>
<td></td>
<td>Actuator failure</td>
<td>Replace actuator/servo motor.</td>
</tr>
<tr>
<td>Significant material leaking from pump rear seal</td>
<td>Pump shaft worn and/or shaft seal worn</td>
<td>Remove pump shaft assembly, and reinstall rear pump rebuild kit.</td>
</tr>
<tr>
<td>Problem</td>
<td>Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Material dispensed not correct weight</td>
<td>Specific gravity of one or more of the two materials has changed since calibration</td>
<td>Recalibrate machine.</td>
</tr>
<tr>
<td></td>
<td>Machine air pressure has changed since calibration</td>
<td>Readjust air pressure regulator to value used when machine was calibrated, or recalibrate machine.</td>
</tr>
<tr>
<td></td>
<td>Not enough material in one or more tanks</td>
<td>Check tank levels; fill and prime as necessary.</td>
</tr>
<tr>
<td></td>
<td>Mixer has slight obstruction</td>
<td>Replace static mixer. Prime machine.</td>
</tr>
<tr>
<td></td>
<td>Check valve malfunction</td>
<td>Remove check valve; clean or replace as necessary.</td>
</tr>
<tr>
<td></td>
<td>Piston worn or broken</td>
<td>Replace piston.</td>
</tr>
<tr>
<td>Machine dispensing off ratio</td>
<td>One tank is empty</td>
<td>Check tank levels. Add material if necessary.</td>
</tr>
<tr>
<td></td>
<td>Tank ball valve closed</td>
<td>Open tank ball valve. Prime machine.</td>
</tr>
<tr>
<td></td>
<td>Machine out of phase</td>
<td>Re-phase machine.</td>
</tr>
<tr>
<td></td>
<td>Check valve malfunction</td>
<td>Remove check valve; clean or replace as necessary.</td>
</tr>
<tr>
<td></td>
<td>Piston worn or broken</td>
<td>Replace piston.</td>
</tr>
<tr>
<td>Pumps drawing material back from valve hose</td>
<td>Check valve stuck open</td>
<td>Remove check valve, clean or replace as necessary.</td>
</tr>
</tbody>
</table>
Kits

Mixer and Shroud Options

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC0063</td>
<td>Mixer, 3/16 in. (6.5 mm) x 32, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0057</td>
<td>Mixer, 1/4 in. (6.5 mm) x 24, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0058</td>
<td>Mixer, 3/8 in. (9.8 mm) x 24, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0059</td>
<td>Mixer, 3/8 in. (9.8 mm) x 36, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0060</td>
<td>Mixer, 3/8 in. (9.8 mm) Combo, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0061</td>
<td>Mixer, 3/16 in. (4.8 mm) x 32 Luer Lock, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0062</td>
<td>Mixer, 1/4 in. (6.5 mm) x 24 Luer Lock, 10 Mixers with shroud</td>
</tr>
<tr>
<td>LC0077</td>
<td>Mixer, 3/16 in. (4.8 mm) x 32, 50 Mixers</td>
</tr>
<tr>
<td>LC0078</td>
<td>Mixer, 1/4 in. (6.5 mm) x 24, 50 Mixers</td>
</tr>
<tr>
<td>LC0079</td>
<td>Mixer, 3/8 in. (9.8 mm) x 24, 50 Mixers</td>
</tr>
<tr>
<td>LC0080</td>
<td>Mixer, 3/8 in. (9.8 mm) x 36, 50 Mixers</td>
</tr>
<tr>
<td>LC0081</td>
<td>Mixer, 3/8 in. (9mm) combo, 50 Mixers</td>
</tr>
<tr>
<td>LC0082</td>
<td>Mixer, 3/16 in. (4.8 mm) x 32 Luer Lock, 50 Mixers</td>
</tr>
<tr>
<td>LC0083</td>
<td>Mixer, 1/4 in. (6.5 mm) x 24 Luer Lock, 50 Mixers</td>
</tr>
<tr>
<td>LC0084</td>
<td>Mixer, 3/16 in. (4.8 mm) x 32, 250 Mixers</td>
</tr>
<tr>
<td>LC0085</td>
<td>Mixer, 1/4 in. (6.5 mm) x 24, 250 Mixers</td>
</tr>
<tr>
<td>LC0086</td>
<td>Mixer, 3/8 in. (9.8 mm) x 24, 250 Mixers</td>
</tr>
<tr>
<td>LC0087</td>
<td>Mixer, 3/8 in. (9.8 mm) x 36, 250 Mixers</td>
</tr>
<tr>
<td>LC0088</td>
<td>Mixer, 3/8 in. (9.8 mm) combo, 250 Mixers</td>
</tr>
<tr>
<td>LC0089</td>
<td>Mixer, 3/16 in. (4.8 mm) x 32 Luer Lock, 250 Mixers</td>
</tr>
<tr>
<td>LC0090</td>
<td>Mixer, 1/4 in. (6.5 mm) x 24 Luer Lock, 250 Mixers</td>
</tr>
</tbody>
</table>

Machine Rebuild Kits

NOTE: See the PR70 and PR70v Repair - Parts manual referenced at the beginning of this manual for parts included in each kit.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC0091</td>
<td>3.0 in. Air Cylinder rebuild kit</td>
</tr>
<tr>
<td>LC0092</td>
<td>4.5 in. Air Cylinder rebuild kit</td>
</tr>
<tr>
<td>LC0093</td>
<td>Check Valve rebuild kit, Stainless Steel Ball</td>
</tr>
<tr>
<td>LC0318</td>
<td>Check Valve rebuild kit, Carbide Ball</td>
</tr>
<tr>
<td>LC0094</td>
<td>Rear Pump Seal rebuild kit</td>
</tr>
</tbody>
</table>

Tank Accessories

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC0097</td>
<td>Desiccant Dryer, 3/8 in. NPT with adapter and cartridge</td>
</tr>
<tr>
<td>LC0098</td>
<td>Desiccant Dryer refill cartridge</td>
</tr>
<tr>
<td>LC0095</td>
<td>Nitrogen Harness Kit for 30 L and 60 L tank, 1 tank</td>
</tr>
<tr>
<td>LC0096</td>
<td>Nitrogen Harness Kit for 30 L and 60 L tank, 2 tanks</td>
</tr>
<tr>
<td>LC0099</td>
<td>Vacuum Transfer Pump, 120V, down to 25 Torr</td>
</tr>
<tr>
<td>LC0100</td>
<td>Vacuum Transfer Pump, 240V, down to 25 Torr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC0099</td>
<td>Vacuum Transfer Pump, 120V, down to 25 Torr</td>
</tr>
<tr>
<td>LC0100</td>
<td>Vacuum Transfer Pump, 240V, down to 25 Torr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC0099</td>
<td>Vacuum Transfer Pump, 120V, down to 25 Torr</td>
</tr>
<tr>
<td>LC0100</td>
<td>Vacuum Transfer Pump, 240V, down to 25 Torr</td>
</tr>
</tbody>
</table>

† Item includes only the pump. A vacuum kit must be purchased to install the pump onto the tank.
◆ Kit includes all parts needed to connect a nitrogen tank to the material tank.

MD2 Valve Kits

NOTE: See MD2 Dispense Valve instruction manual referenced at the beginning of this manual for installation instructions or for more information.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>255217</td>
<td>MD2, kit rebuild, air cylinder</td>
</tr>
<tr>
<td>255218</td>
<td>MD2, kit rebuild, back-end of wet section (no needle or seat)</td>
</tr>
<tr>
<td>255219</td>
<td>MD2, Soft Seat rebuild, needle and nose</td>
</tr>
<tr>
<td>255220</td>
<td>MD2, convert Soft Seat nose to Hard Seat (Hard Seat rebuild), needle and nose</td>
</tr>
</tbody>
</table>
Vacuum Kits

These vacuum kits contain the parts necessary to attach a vacuum pump to the tanks.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>256205</td>
<td>Vacuum Kit, Single On-Board Tank</td>
</tr>
<tr>
<td>256206</td>
<td>Vacuum Kit, Two On-Board Tanks</td>
</tr>
<tr>
<td>256207</td>
<td>Vacuum Kit, Single Off-Board Tank</td>
</tr>
<tr>
<td>256209</td>
<td>Vacuum Kit, Two Off-Board Tanks</td>
</tr>
</tbody>
</table>

Refill Kits

Refill Kits 256659 and 256660 are designed to turn on and off a transfer pump as needed to keep the tanks at the proper fluid level. Tank Refill Kit 256577 is designed to open and close a valve to allow fluid to flow into the tank from an always-on transfer pump. Tank Refill Kit 256577 includes the parts necessary to install on the base or lid of a 7.5 L, 30 L, or 60 L tank.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>256659</td>
<td>Refill Kit, 1/4 npt, solenoid, 24V</td>
</tr>
<tr>
<td>256660</td>
<td>Refill Kit, 1/2 npt, solenoid, 24V</td>
</tr>
<tr>
<td>256577</td>
<td>Tank Refill Kit</td>
</tr>
</tbody>
</table>

External Control Interface Connection Kit

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC0008</td>
<td>Cord, I/O interface and splitter</td>
</tr>
</tbody>
</table>
Appendix A - Homing Pumps

Setting Home:

The actuator has an absolute encoder that has a battery backup to store the motor position when the power is turned off. The home position is set at the factory and would only need reset if the encoder cable between the servo drive and servo motor is disconnected.

**NOTE:** If the electrical connections between the encoder and drive need to be disconnected make sure the actuator is in the home position before disconnecting the cable. This ensures everything is in position when the connector is reattached and the below steps will not be necessary to perform.

1. Login as supervisor and go to the SETUP HOME screen.
2. Remove the motor from the actuator.
3. Using a wood dowel rod (or equivalent); turn the actuator lead screw manually to locate the home position. CW retracts the pumps, CCW extends the pumps.
4. With pistons installed, manually retract the actuator. When the pistons are out of the pump tube there is much less drag.
5. Manually extend the actuator until it becomes hard to turn. This is the point where the pistons are entering the pump tube; the home position. Also note on a variable ratio PR70 at this point the ratio mechanism is parallel with the back of the frame.
6. Disable the drive. The motor will be able to be turned manually.
7. Push the Set Home pushbutton.
8. Press the Enable Drive pushbutton.
9. Reattach the motor to the actuator.
10. The Actual motor position will now read zero.
Appendix B - Logging In and Out

On power up, the user is the default with limited access to screens. To log in to the supervisor level:

1. Press the login button on the Startup screen.
2. The login entry screen appears.
3. Press User (F2) button to enter supervisor. The Keyboard screen appears.
4. Type in supervisor and enter (the lower right key).
5. The Login entry screen pops up again.
6. Press Password (F3) button to enter the password. The Keyboard screen pops up again.
7. Type in the password “1492” and hit enter.
8. If the password is correctly entered, the Startup screen will show the user as supervisor.
9. To logout, press the logout button on the startup screen. The screen will show Default as the user if the Supervisor is logged out.
Appendix C - Data Logging U81923 Only

When the system is powered up, the Data Logging feature is not available until the Start Data Log button is pressed on the main screen. If there is an empty space between the Scaling and Alarm History pushbuttons on the menu bar, the data logging feature is not active. Follow the procedure below to activate and use the data logging feature.

1. Press the Start Data Log pushbutton.

2. The “aStor” button appears on the menu bar:

3. Press the “aStor” button to enable the data logging feature. It will become highlighted in green:

4. Insert memory stick into the USB port on the front panel.

5. Dispense a shot. At the end of the shot the data log will record the following data in a CSV file:
   - Date
   - Time
   - Average Pressure
   - Average Dispense Temperature
   - Shot Size Set Point
   - Flow Rate Set Point
   - Ratio Set Point
   - A Tank Temperature
   - A Pump Temperature
   - A Tank Temperature
   - B Tank Temperature
   - B Pump Temperature
   - B Hose Temperature
   - O/U Block Temperature
   - Mixer Temperature
   - Low Pressure Set Point
   - High Pressure Set Point
   - A Tank Temperature Set Point
   - A Pump Temperature Set Point
   - A Hose Temperature Set Point
   - B Tank Temperature Set Point
   - B Pump Temperature Set Point
   - B Hose Temperature Set Point
   - O/U Block Temperature Set Point
   - Mixer Temperature Set Point

6. The data is stored on a file test.csv. Every time a shot is taken, the information gets added to the same file. The maximum file size is 100MB. At this point the oldest data gets overwritten by the newest data.

7. To start a new file on the existing memory stick, delete the file test.csv. When the memory stick is reinserted and a shot is taken, a new file will be created.

NOTE: New data will not be stored on a modified file.

8. To start a new file on a new memory stick, copy the folder “FILES” with the file “template.csv” from the original memory stick to the new one. This is where the header information is stored. Insert the new memory stick in and after the first shot a new test.csv file will be created.
Appendix D - Setting Temperature Gains U81923 Only

**NOTICE**

Adjusting the temperature gains should only be performed by a technician knowledgeable in the operation of this machine. Incorrect adjustment of the temperature gains can lead to overheating, erratic temperature control, and/or poor chemical reaction due to poor temperature control.

Gains control two things: temperature fluctuation from the set point and heating time at startup. If the temperature gains have been changed and temperature control is not performing as desired, reset all gains to “100”. If the temperatures are not controlled to the desired performance with the default settings at “100”, adjust the gains for the specific application. Things to consider when adjusting the gains:

- It is recommended all gains are set to the same number.
- Higher gains will lead to faster heating at initial startup but will increase temperature fluctuation.
- Lower gains will lead to smaller temperature margins and slower heating at initial startup.
- Lower material flow rates require higher gains to keep the materials from overheating.
- Higher flow rates may accept lower gains without overheating.

1. Insert memory stick into the USB port on the front panel.

2. Dispense a shot. At the end of the shot the data log will record the following data in a CSV file:
   - Date
   - Time
   - Average Pressure
   - Average Dispense Temperature
   - Shot Size Set Point
   - Flow Rate Set Point
   - Ratio Set Point
   - A Tank Temperature
   - A Pump Temperature
   - A Tank Temperature

3. To start a new file on a new memory stick, copy the folder “FILES” with the file “template.csv” from the original memory stick to the new one. This is where the header information is stored. Insert the new memory stick in and after the first shot a new test.csv file will be created.

**NOTICE**

Adjusting the temperature gains should only be performed by a technician knowledgeable in the operation of this machine. Incorrect adjustment of the temperature gains can lead to overheating, erratic temperature control, and/or poor chemical reaction due to poor temperature control.
Dimensions

Stationary PR70 Servo
(Shown with accumulators)

Cart Mounted PR70 Servo
(Shown with 30 and 60 liter tanks)
# Technical Data

## PR70 with Servo

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metering Pump Effective Area</td>
<td>0.124 to 1.49 in.² per side</td>
<td>80 to 960 mm² per side</td>
</tr>
<tr>
<td>Maximum Stroke Length</td>
<td>1.50 in.</td>
<td>38.1 mm</td>
</tr>
<tr>
<td>Minimum Stroke Length</td>
<td>0.23 in.</td>
<td>5.8 mm</td>
</tr>
<tr>
<td>Volume per Cycle</td>
<td>0.12 to 4.3 in.³</td>
<td>2 to 70 cc</td>
</tr>
<tr>
<td>Pump Cycles per 1 L (0.26 gal)</td>
<td>14.3 to 500 cycles (varies by piston size)</td>
<td></td>
</tr>
<tr>
<td>Ratios (fixed)</td>
<td>1.1 to 12:1 (depending upon cylinders selected)</td>
<td></td>
</tr>
<tr>
<td>Maximum Fluid Working Pressure</td>
<td>3000 psi</td>
<td>20.7 MPa, 207 bar</td>
</tr>
<tr>
<td>Maximum Air Input Pressure (Air only used for MD2 valve)</td>
<td>100 psi</td>
<td>0.7 MPa, 7 bar</td>
</tr>
<tr>
<td>Compressed Air (Air only used for MD2 valve)</td>
<td>Less than 10 scfm typical (varies with cycle times)</td>
<td></td>
</tr>
<tr>
<td>Maximum Cycle Rate</td>
<td>15 cpm</td>
<td></td>
</tr>
<tr>
<td>Sound Pressure Level</td>
<td>82 dBA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Materials of Construction</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Wetted Parts on all models: 303/304, 17-4 PH, hard chrome, Chromex™, carbide, Chemical Resistant O-rings, PTFE, nylon, UHMWPE, torlon

## Electrical Power

- No heat: 240 V 50/60 hertz, 1 phase, 15 amp
- With heat: 240 V 50/60 hertz, 1 phase, 40 amp

## Weight

- With two 7.5 L tanks: 120 lb, 55 kg
- With two 60 L tanks: 330 lb, 150 kg

## Maximum Operating Temperature

- Nylon Pistons: 160°F, 70°C
- UHMWPE Pistons or PE Tanks: 120°F, 50°C
- Torlin Pistons or Peek Bearings: 300°F, 150°C

## Inlet/Outlet Sizes

- Air inlet size: 1/4 in. npt(f)
- Pump Fluid Outlet Size: -03, -04, -06, -08, or -12 JIC fittings for 3/16 in. (4.8 mm), 1/4 in. (6.4 mm), 3/8 in. (9.5 mm), 1/2 in. (12.7 mm), 3/4 in. (19.1 mm) hoses

## Notes

**All fluid contact materials are FDA-compliant and meet the United States Code of Federal Regulations (CFR) Title 21 for repeated use in food-processing machinery. The pump user must verify that the construction materials meet their specific application requirements.**
Graco Standard Warranty

Graco warrants all equipment referenced in this document which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco’s written recommendations.

This warranty does not cover, and Graco shall not be liable for general wear and tear, or any malfunction, damage or wear caused by faulty installation, misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-Graco component parts. Nor shall Graco be liable for malfunction, damage or wear caused by the incompatibility of Graco equipment with structures, accessories, equipment or materials not supplied by Graco, or the improper design, manufacture, installation, operation or maintenance of structures, accessories, equipment or materials not supplied by Graco.

This warranty is conditioned upon the prepaid return of the equipment claimed to be defective to an authorized Graco distributor for verification of the claimed defect. If the claimed defect is verified, Graco will repair or replace free of charge any defective parts. The equipment will be returned to the original purchaser transportation prepaid. If inspection of the equipment does not disclose any defect in material or workmanship, repairs will be made at a reasonable charge, which charges may include the costs of parts, labor, and transportation.

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Graco’s sole obligation and buyer’s sole remedy for any breach of warranty shall be as set forth above. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available. Any action for breach of warranty must be brought within two (2) years of the date of sale.

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Sealant and Adhesive Dispensing Equipment

For the latest information about Graco products, visit www.graco.com. For patent information, see www.graco.com/patents.

TO PLACE AN ORDER, contact your Graco distributor, go to www.graco.com and select “Where to Buy” in the top blue bar, or call to find the nearest distributor.

   If calling from the US: 800-746-1334
   If calling from outside the US: 0-1-330-966-3000

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Graco Headquarters: Minneapolis
International Offices: Belgium, China, Japan, Korea

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