► Principles of Operation

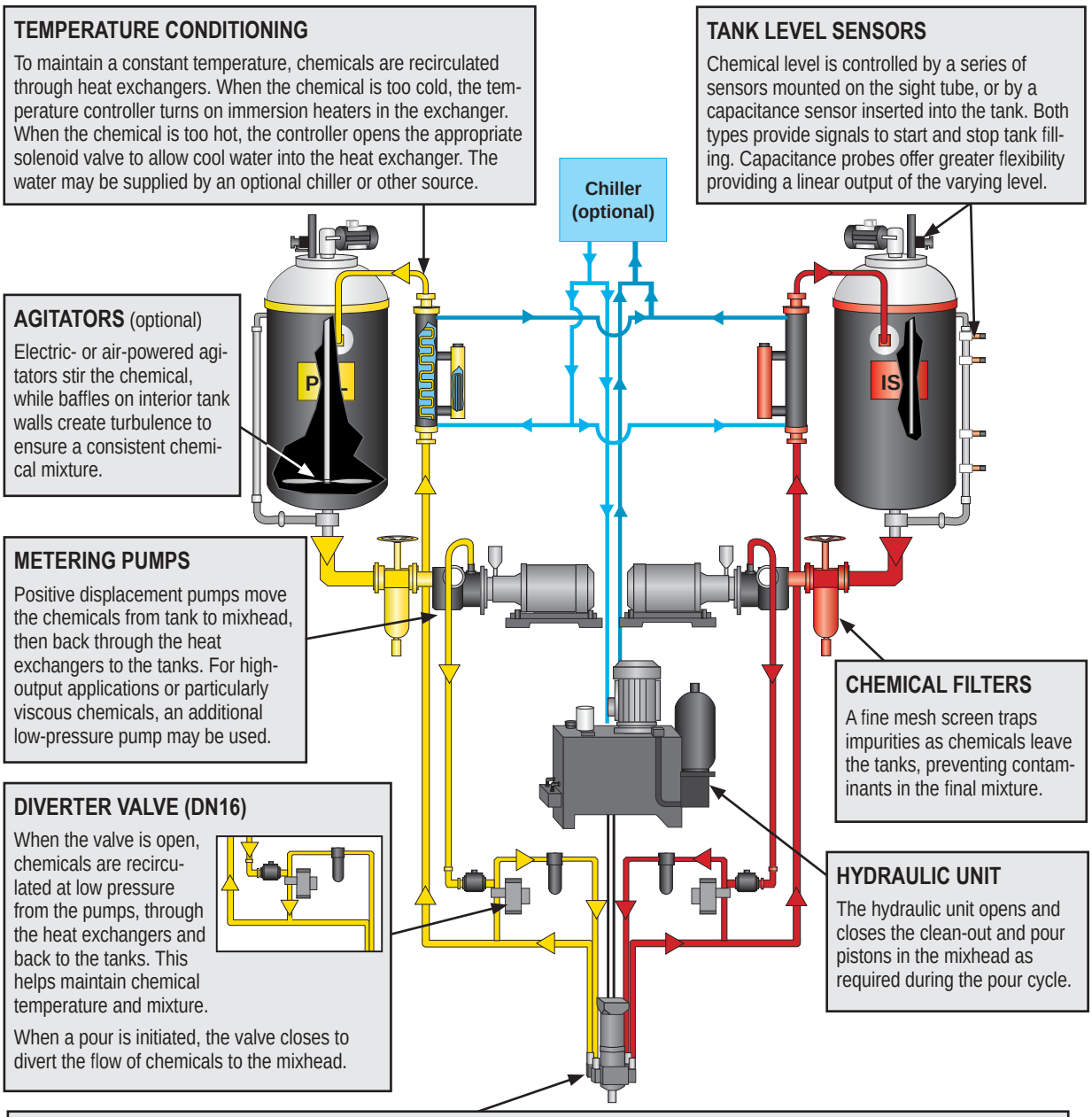
Chemicals are pumped from the day tanks through a filter to the metering pumps. A diverter valve (DN16) closes to direct chemicals to the mixhead, or opens to recirculate the chemicals to the tanks.

TEMPERATURE CONDITIONING

To maintain a constant temperature, chemicals are recirculated through heat exchangers. When the chemical is too cold, the temperature controller turns on immersion heaters in the exchanger. When the chemical is too hot, the controller opens the appropriate solenoid valve to allow cool water into the heat exchanger. The water may be supplied by an optional chiller or other source.

TANK LEVEL SENSORS

Chemical level is controlled by a series of sensors mounted on the sight tube, or by a capacitance sensor inserted into the tank. Both types provide signals to start and stop tank filling. Capacitance probes offer greater flexibility providing a linear output of the varying level.



AGITATORS (optional)

Electric- or air-powered agitators stir the chemical, while baffles on interior tank walls create turbulence to ensure a consistent chemical mixture.

METERING PUMPS

Positive displacement pumps move the chemicals from tank to mixhead, then back through the heat exchangers to the tanks. For high-output applications or particularly viscous chemicals, an additional low-pressure pump may be used.

CHEMICAL FILTERS

A fine mesh screen traps impurities as chemicals leave the tanks, preventing contaminants in the final mixture.

DIVERTER VALVE (DN16)

When the valve is open, chemicals are recirculated at low pressure from the pumps, through the heat exchangers and back to the tanks. This helps maintain chemical temperature and mixture.

When a pour is initiated, the valve closes to divert the flow of chemicals to the mixhead.

HYDRAULIC UNIT

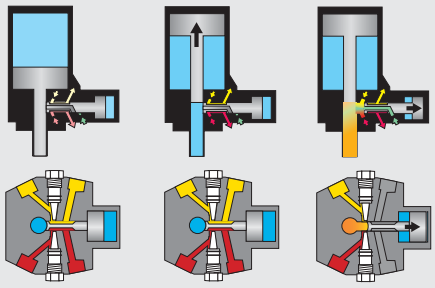
The hydraulic unit opens and closes the clean-out and pour pistons in the mixhead as required during the pour cycle.

MIXHEAD OPERATION DURING A POUR

A. High-Pressure Recycling: Before the shot is taken, chemicals recirculate through grooves on each side of the pour piston for a user-set time. This builds a high-pressure condition as the chemicals pass over the orifices.

B. Ready to Pour: After chemicals have recirculated sufficiently for pressures to stabilize, the clean-out piston retracts to open the discharge duct.

C. Pour: The pour piston retracts, closing the recirculation grooves and allowing the orifices to dispense chemicals to the mixing chamber. The chemicals collide at high pressure, and are thoroughly mixed before exiting through the discharge.



▶ Metering Machine Operating Cycles

The Level 2 control provides seven operating cycles, which can be used for testing, calibration, normal operation, and shutting down the equipment. You select the cycle on the Machine Operations page. The current cycle is displayed in a status box on all screens.

CYCLE	PURPOSE	DESCRIPTION
Dry Cycle	Testing	The machine operates without circulating chemicals through the system. The metering pumps stop, but the hydraulic unit still runs. This allows you to test the hydraulic circuit and mixhead pistons.
Work Cycle	Operation	The machine is in its normal operating mode. Chemicals circulate through the diverter valve and back to the tanks at low pressure until a pour is requested. The machine then switches to High Pressure Recycle, circulating chemicals through the mixhead recirculation grooves in preparation for a shot. When a pour is initiated, chemicals are dispensed at working pressure for the specified shot time.
Adjust Cycle (H.P. Recycle)	Adjustment	The machine operates for the time set during machine setup without actually initiating a pour. During High Pressure Recycle, the diverter valves close to route chemicals through recirculation grooves in the mixhead, then back through the heat exchangers to the tanks. This allows you to adjust pump throughput and chemical pres sures, without dispensing material or triggering an alarm.
Cal ISO	Calibration	Only the isocyanate diverter valve closes during a pour. The polyol diverter valve remains open during a pour, recirculating the polyol through the diverter valve and back to the tanks at low pressure. This allows you to adjust the shot time and pump throughput to produce the correct shot weight of isocyanate. **NOTE***: The operator must close the polyol ori fice at the mixhead before performing this pro cedure.*
Cal POL	Calibration	Only the polyol diverter valve closes during a pour. The isocyanate diverter valve remains open during a pour, recirculating the isocyanate through the diverter valve and back to the tanks at low pressure. This allows you to adjust the shot time and pump throughput to produce the correct shot weight of polyol. **NOTE:** *The operator must close the isocyanate orifice at the mixhead before performing this procedure.*
Weekend Cycle	Shut Down	The machine automatically starts and stops the hydrau lic pump and metering pumps as needed to recirculate the chemicals when the machine is not in production. This maintains the temperature of chemicals in the day tanks.
No Cycle	Shut Down	This cycle appears when the machine is shut down or an Emergency Stop switch has been activated.

Entering Mixhead Setup Parameters

The following screens are found in the Machine Setup Section.

DATA TYPE	OPTION	DESCRIPTION
Weekend Off Time		Enter the number of minutes that the pumps should remain off during the Weekend Cycle operating mode.
Weekend On Time		Enter the number of minutes that the pumps should remain on during the Weekend Cycle operating mode.
Max. Time in High Pressure (sec)		Enter the maximum allowable time that the machine remains in high pressure. This safety feature prevents the machine from remaining too long at high pressure.
Hi. Prs Time Before Shot		Enter the minimum amount of time (0-100 seconds) that the machine should stay in high pressure recycle before permitting a shot. This product quality feature prevents the dispensing of chemicals before the pressures and flow rates have stabilized. If the entered time is too short for the chemicals to fully stabilize,variances in shot weights and ratios may occur.
Hi. Prs Time After Shot		Enter the time that the machine should remain in high pressure after a shot (1-60 seconds). This product quality feature clears the chemical lines in the mix head of undesirable materials to prevent buildup.
Multi-Shot Hi Prs. Time	X	(Appears only if Multi-Shot option is installed.) Enter the number of seconds that the machine should remain in high pressure after a pour is initiated. The Multi-Shot feature saves time between shots by eliminating time needed to build pressure between shots.
ISO Specific Gravity		Enter the specific gravity of the isocyanate to three decimal places. The value should be the actual specific gravity at the pouring temperature and pressure.
POL Specific Gravity		Enter the specific gravity of the polyol to three decimal places. The value should be the actual specific gravity at the pouring temperature and pressure.
Ratio Type		Select the ratio type (Iso/Poly or Poly/ISO) upon which all displays and calculations will be based. Example: For a shot made up of two parts ISO and one part POLY, the ratio setpoint would be 2.000 if I/P is selected or 0.500 if P/I is selected.
ISO Temperature Setpoint	X	(Appears only if internal temperature control option is installed.) Enter the isocyanate temperature setpoint (Fahrenheit) at the point of monitoring. This is used for Alarm Setpoints ONLY.
POL Temperature Setpoint	X	(Appears only if internal temperature control option is installed.) Enter the polyol temperature setpoint (Fahrenheit) at the point of monitoring.

NOTE: If the internal temperature option is not installed, enter the Iso and Poly setpoints at the temperature controllers mounted on the metering machine. See Vendor Manuals for temperature controller instructions.

► Adjusting Chemical Pressures

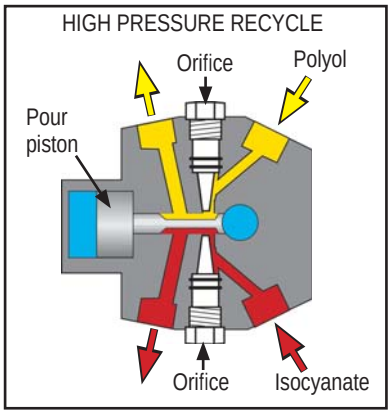
Orifices in the mixhead ensure accurate pressure and flow control of the chemicals as they enter the mixhead. These orifices need to be adjusted to provide the best operating pressure for your application.

This procedure assumes that the metering pumps are operating and that the chemical temperatures have stabilized.

NOTE: You will need to re-adjust the limits on the gauges to the desired values after the machine is calibrated. See Calibrating the Machine in the Operation section.

1. **Verify that the control cycle is set to Adjust (H.P. Recycle).**
2. **Adjust the low and high limits on the high-pressure gauges.**

   Set the low limit for 435 psi less than your desired mixing pressure and the high limit for 290-435 psi above your desired mixing pressure.



3. **Press the pour button at the control panel or pendant.**

   The machine is now in high-pressure recycle. The diverter valves close to route the chemicals through the recirculation grooves in the mixhead, and back through the heat exchangers to the tanks. The machine will stay in high-pressure recycle until the control cycle is changed or the operator-set time has expired.

4. **Adjust the orifices in or out until you see the desired pressure on each chemical high-pressure gauge.**

   Using an allen wrench, turn the orifice clockwise to increase pressure, or counterclockwise to decrease pressure. Pressures should be within the low and high limits you set. If the machine shuts off because of an over- or under-pressure condition, watch the high pressure gauges and adjust the orifice or the limits as needed.

▶Calibrating the Machine

NOTE: Before performing calibration procedures, make sure that all setup parameters have been entered on the machine.

Before beginning normal operation, you must calibrate the metering machine to ensure that the dispensed component ratio and amounts correspond with data displayed on the machine.

During calibration, you will measure the actual outputs of each dispensed component (polyol and isocyanate) individually, then adjusting the chemical pressures and flow at the mixhead and metering pumps to achieve the desired shot output.

WARNING: Chemicals are dispensed at high pressure.

Chemicals are dispensed at high velocity and pres sure. To prevent possible injury to personnel and damage to the equipment, the following precautions should be taken:

- Protective clothing, full face shields, and rubber gloves must be worn when handling isocyanate and polyol.
  Observe all warnings and precautions supplied by the chemical manufacturer and outlined in the Safety Guidelines section of this manual.
- You must close the mixhead orifice that corresponds to the component that is NOT being calibrated.
  If you fail to close this orifice, the chemical that is being cali brated will migrate into the other component lines, causing the formation of foam in the mixhead. The mixhead then must be disassembled, cleaned, and repaired before it can be used.
- Take only 2 or 3 shots from each component before reopening both orifices and operating the mixhead at high pressure.
  Because of the pressure differential between the two com ponent lines, some reacted material can build up on the tip of the closed orifice nozzle. The head must be operated in high pressure recycle to clean the tip of the nozzles.

Calibration procedures should be performed by personnel who have been trained to set up, operate, and service this type of equipment as it applies to the specific application. The person performing the calibration should understand how to calculate the desired shot weight, flow rate, and component ratio.

For additional specifications related to your machine, see:

- The ***Engineering Specifications*** supplied with your machine.
- ***Technical Reference*** in the appendix, which includes mixhead orifice and metering pump flow rates and adjustment data.

Continued on next page.

Calibrating the Machine

(continued)

You will calibrate one component at a time. Before beginning, verify that power to the metering machine is on and that there are no fault conditions. The cooling and hydraulic circuits should be operating.

1. **Determine the approximate shot weight for each component.**

   Shot weights should be calculated in grams.

2. **Adjust the metering pump output.**

   Set the pump speed and handwheel to produce the approximate volume of material you want in the shot.

NOTE: For throughput and output data related to adjustments for specific pump and orifice sizes, see Technical Reference in the appendix

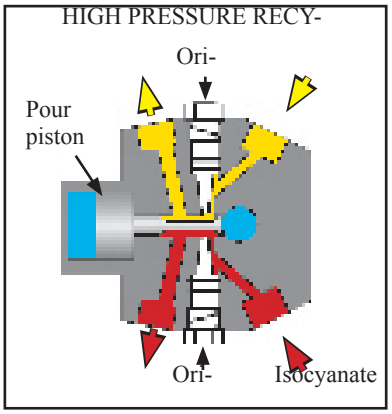
3. **Set the operating cycle to H.P. Recycle (Adjust).**

   Select Wet Calibration from the Maintenance Menu, then use the arrow keys to select H.P. Recycle. This cycle places the machine in high pressure recycle, but prevents the mixhead from pouring even when the Pour button is pushed.

IMPORTANT: If the mixhead is mounted to a manipulator or robot for automatic pouring, make sure that the mixhead has been positioned over the calibration station and that the POUR switch is set to Manual, not Auto.

4. **Start the metering pumps.**
5. **Press the Pour button.**

   The mixhead remains in high pressure recycle for the user-set time without pouring to allow for pressure adjustments.



6. **Adjust the mixhead orifices to the required pressure.**

   Move the orifices in or out until the high-pressure gauges display the required pressure.

7. **Press Pour button again.** The metering machine drops from high pressure to low pressure recycle.
8. **Select the component to be calibrated.**

   Change the operating cycle to Cal/POLY or Cal/ISO.

When the Pour button is pushed during calibration, only the selected component will be dispensed. The other component will continue to circulate at low pressure from the pump, through the diverter valve and heat exchanger, back to the tank.

Continued on next page

Calibrating the Machine

(continued)

9. **Fully close the mixhead orifice corresponding to the component that is NOT selected for calibration.**

   Turn the orifice clockwise until it stops. Do not tighten.

IMPORTANT: You must close the orifice corresponding to the component that is NOT being calibrated to prevent possible component crossover. If the orifice is not closed, the chemical will migrate up the other component lines, which will cause foam to form in the mixhead.

10. **Place the container to be weighed under the mixhead.**
    The container should be of a known weight and sized to catch a full shot of the component being calibrated.

11. **Enter the Calibration shot recipe.**

    From the Maintenance Menu, select Recipe Setup then the Calibration Recipe Entry screen. Using the keypad, enter the shot time for the component (at least 1, 2 and 3 seconds). Enter the total desired flow rate and ratio for both components.

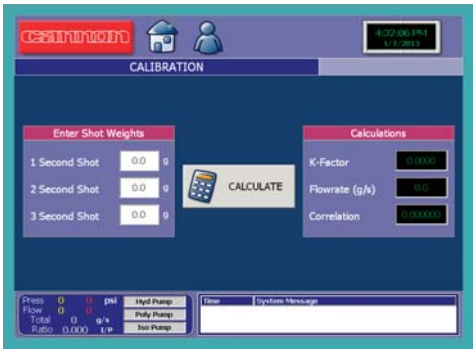
12. **Press the Pour button at the calibration control or pendant.**

    The machine enters high pressure recycle in preparation for a shot, but will not dispense until the Pour button is pressed again.

13. **Press the Pour button again.**

    The mixhead dispenses the component for the set shot time after the HP Recycle Time Before Shot has expired.

14. **Weigh the dispensed material and check the output.**



    Subtract the weight of the container from the total weight. Divide the weight of the dispensed component by the seconds of shot time to determine the output in grams/second.

    The purpose of this screen is to calculate the thoughput of the chemical pumps, the lag time of the mixhead, and the correlation of the shot weights.

    To check individual pump throughput, select either the ISO or Poly calibrate. Follow the procedure for calibrate, using 1, 2, and 3 second shots, weighing each shot. Enter the shot weights

Continued on next page

IMPORTANT: Pour only 2 or 3 shots from each component before reopening both orifices and operating the mixhead at high pressure recycle. Failure to perform this recycle will cause foam to form in the mixhead. Follow the same procedure for both components.

Calibrating the Machine

(continued)

in the PV then press Calculate to perform the calculations. The K factor is an adjustment for the flow meter. If the calculated flow is different from the displayed actual high pressure flow, then this new K Factor can be entered into the PLC to correct the displayed flow rate. The correlation represents the standard deviation of the shot weights with respect to time. A straight line has a value of 1.0.

15. **Repeat Steps 12 to 14 as needed to achieve accurate output.**

16. **Change the operating cycle to H.P. Recycle (Adjust) and open the orifice closed in Step 9.**

    Operate the machine at high pressure recycle to purge any material that may have collected at the tip of the orifice nozzle.

17. **Repeat steps 7 through 16 for the second component.**

    Once calibration is complete, you can switch the operating cycle to the Work Cycle and begin normal operation.

► Connecting the Mixhead(s) to the Machine

The L-System Metering Machine supports up to 16 injection mixheads. Each mixhead must be connected to supply and return hoses for polyol, isocyanate, and hydraulic fluid. Proximity sensors in the mixhead also must be connected to the control.

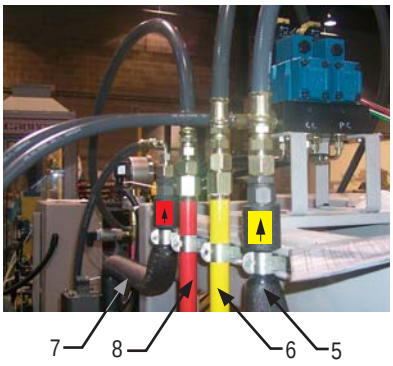
IMPORTANT: Your application may have required installation of additional manifolds between the metering machine and the mixhead. Always refer to the piping, electrical, and mixhead diagrams in the Drawings and Parts sections for the most accurate connection information.

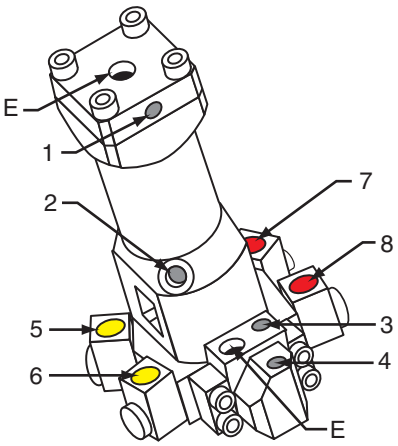
Mixhead hoses connect to component tanks and the hydraulic circuit through a manifold on the metering machine.

Generally, polyol and isocyanate supply lines connect to ports at the outside of the manifold block, while return lines connect to ports to the inside of the manifold block. Pay close attention to colors and markings on the hoses and ports to avoid confusion.

1. **Connect the polyol (POL) supply and return lines.**
2. **Connect the isocyanate (ISO) supply and return lines.**
3. **Connect the hydraulic lines.**
4. **Connect the proximity sensor cables.**
5. **Clearly mark hose and termination points after all interconnections have been made and tested.**

Typical hydraulic, component, and electrical connections from manifold to FPL mixhead.





Mixhead Hydraulic Connections

Model	FPL 10 Hp	FPL 14 Hp	FPL 18 Hp	FPL 24 Hp
Port size	1/4 in.	1/4 in.	1/4 in.	1/4 in.

Connection Key

1..... Cleaning piston, close (black)
2..... Cleaning piston, open (black)
3..... Pour piston, open (black)
4..... Pour piston, close (black)

Mixhead Component Connections

Model	FPL 10 Hp	FPL 14 Hp	FPL 18 Hp	FPL 24 Hp
Port size	1/4 in.	1/2 in.	1/2 in.	3/4 in.

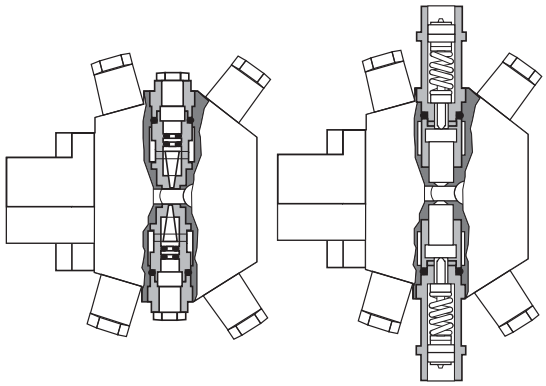
Connection Key

5..... Polyol supply line (yellow)
6..... Polyol return line (yellow)
7..... Isocyanate supply line (red)
8..... Isocyanate return line (red)
E1 ..... Cleanout pour proximity sensor
E2.....Pour piston proximity sensor

► Removing and Cleaning Orifice Nozzles

The mixhead may be equipped with any of a variety of styles of orifice nozzles. These instructions pertain to conical and spring-loaded nozzles only. You will need the following tools: a 3/16 inch Allen wrench; a 9/16 socket wrench, and the nozzle extractor and seat scraper supplied in the mixhead tool kit.

Nozzle Types: Your mixhead may be equipped with two conical orifice nozzles or two spring-loaded orifice nozzles. See the Parts section of your documentation to identify the type and parts of the nozzle installed on your machine.



Conical orifice nozzles Spring-loaded orifice nozzles

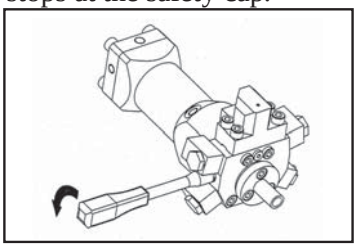
IMPORTANT: Keep parts that have come into contact with polyol separate from parts that have come into contact with isocyanate. These parts should never be washed in the same solvent.

Removing Conical Orifice Nozzles

1. **Remove the safety cap and retainer.**

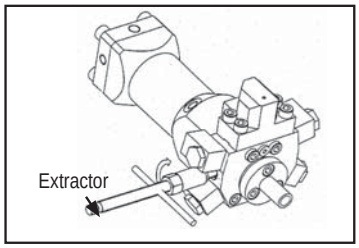
   Back out the nozzle needle until it stops at the safety cap. Then remove the safety cap and retainer. The needle should come out with the retainer.

   Collect any fluid that leaks out of the nozzle and mixhead. Store the material in properly labeled containers, and dispose of it according to local regulations.



3. **Remove the orifice.**

   Use the extractor included in the toolbox supplied with your machine.



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Removing Conical Orifice Nozzles

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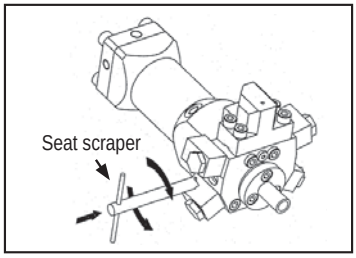
3. Remove any chemical residue in the head seat.

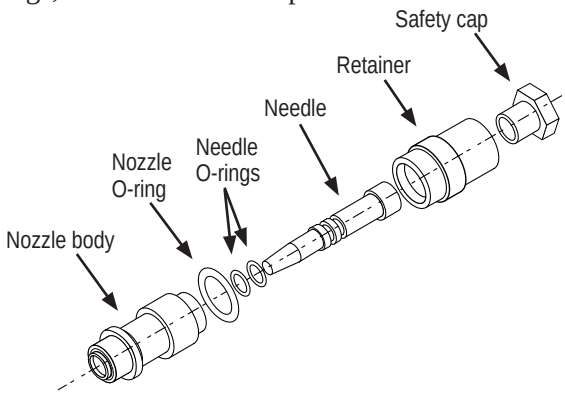
After removing the nozzle and needle, use the seat scraper to clean out any chemical residue. Collect and dispose of residue according to local regulations.



4. Disassemble the orifice nozzle for cleaning.

Separate the needle from the retainer. Remove and discard the O-rings, which should be replaced.

5.



Wash parts with a residue removing solvent.

Place the retainer and safety cap in a container of solvent. Clean the nozzle and needle in solvent that has not been used before. Wash and dry all parts.

6. Reassemble the orifice nozzle, using new O-rings.

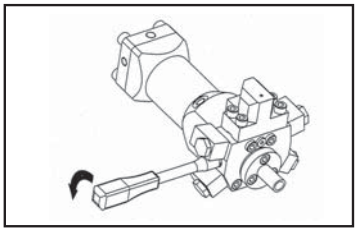
Coat parts, especially the new O-rings, with petroleum jelly before reassembling. Place the needle O-rings on the needle. Insert the needle in the nozzle body. Place the nozzle O-ring on the body, then attach the retainer to the nozzle body.

If you need to disassemble the mixhead for maintenance, do not install the orifice nozzles until after the mixhead has been disassembled, cleaned, serviced, and reassembled.

Removing Spring-Loaded Orifice Nozzles

1. Remove the hexagonal nut.

Collect any fluid that leaks out of the nozzle and mixhead. Store the material in properly labeled containers, and dispose of it according to local regulations.



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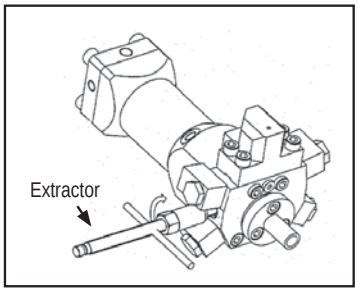
Removing Spring-Loaded Nozzles

(continued)

2. Remove the orifice nozzle connection block.

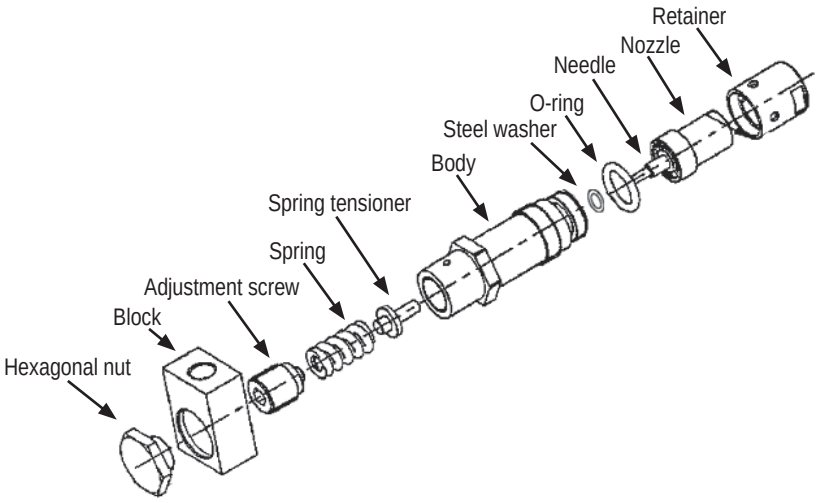
3. Remove the nozzle assembly from the mixhead.

Unscrew the body. Remove the needle, nozzle, and retainer using the extractor included in the tool-box supplied with your machine.



4. Disassemble the orifice nozzle for cleaning.

Remove the adjustment screw from the nozzle. Then remove the spring and spring tensioner. Remove the needle from the nozzle. Remove and discard the O-rings, which should be replaced.



5. Wash parts with a residue removing solvent.

Place the hexagonal nut, body, block, adjustment screw, spring, spring tensioner, and spacer in a container of solvent. Place the nozzle and needle in a separate container of solvent that has not been used before. Wash and dry all parts.

6. Reassemble the orifice nozzle, using new O-rings.

Coat parts, especially the O-rings, with petroleum jelly before reassembling. Insert the needle in the nozzle. Insert the spring tensioner, spring, and adjustment screw in the nozzle opening. Place a new O-ring on the body, then attach the body to the nozzle.

Verify that the needle slides freely in the seat before reinstalling the orifice nozzle in the mixhead.

If you need to disassemble the mixhead for maintenance, do not install the orifice nozzles until the mixhead has been disas-sembled, cleaned, serviced, and reassembled.

MINIMUM / MAXIMUM MIXHEAD OUTPUT Per Component @ 1.0 Specific Gravity, 600 CPS					
		Closed Mold		Open Mold	
Mixhead		Minimum	Maximum	Minimum	Maximum
Standard Models					
FPL-10		30 grams/sec	120 grams/sec	30 grams/sec	90 grams/sec
FPL-14		50 grams/sec	300 grams/sec	50 grams/sec	225 grams/sec
FPL-18		90 grams/sec	550 grams/sec	90 grams/sec	410 grams/sec
FPL-24		300 grams/sec	1,100 grams/sec	300 grams/sec	825 grams/sec
FP2L-22	Polyol	120 grams/sec	600 grams/sec	—	—
	Iso	70 grams/sec	400 grams/sec	—	—
Deep Groove Models					
FPL-10		30 grams/sec	160 grams/sec	—	—
FPL-14		50 grams/sec	400 grams/sec	—	—
FPL-18		90 grams/sec	700 grams/sec	—	—
FPL-24		300 grams/sec	1,300 grams/sec	—	—
FPL-24/RRIM	Polyol	350 grams/sec	900 grams/sec	—	—
	Iso	300 grams/sec	1,000 grams/sec	—	—

TOTAL MIXHEAD OUTPUT vs. COMPONENT RATIO Total of Both Components @ 1.0 Specific Gravity, 600 CPS					
	Minimum / Maximum Output Range by Ratio				
Mixhead	**1:1**	**2:1**	**3:1**	**4:1**	**1:1 (Deep Groove)**
FPL-10	60-240 g/sec	90-180 g/sec	120-160 g/sec	—	60-320 g/sec
FPL-14	100-600 g/sec	150-450 g/sec	200-400 g/sec	250-375 g/sec	100-800 g/sec
FPL-18	180-1,200 g/sec	270-825 g/sec	360-770 g/sec	450-685 g/sec	180-1,400 g/
sec					

NOTE: All values indicate Closed Mold pour conditions. For Open Mold pour conditions, reduce the maximum throughput by 25%.

The nozzle sizes can be varied according to throughput requirements. Any size nozzle can be installed on any size FPL/HP-FPL mixhead, or two differently sized nozzles can be used on the same mixhead to ensure the desired chemical flow and pressure.

MIXHEAD ORIFICE NOZZLE FLOW RATES

Orifice Nozzle Type	Nozzle Size (nominal)	Minimum Output (gram/sec)	Maximum Output (gram/sec)
L'Orange Style Diesel Type Injectors			
L'Orange D-70	0.7 mm	7.5	25
L'Orange D-80	0.8 mm	10	35
L'Orange D-90	0.9 mm	15	45
L'Orange 903	1 mm	20	50
L'Orange 904	2 mm	50	170
L'Orange 905	3.5 mm	90	330
L'Orange 909	4.2 mm	140	440
15° Conical Tapered Orifices for Unfilled Chemicals			
15° Conical 0.6	0.6 mm	7.5	30
15° Conical 0.8	0.8 mm	10	40
15° Conical 1.0	1.0 mm	25	60
15° Conical 1.5	1.5 mm	35	140
15° Conical 2.0	2.0 mm	50	220
15° Conical 2.5	2.5 mm	65	310
15° Conical 3.0	3.0 mm	90	430
15° Conical 3.5	3.5 mm	120	500
15° Conical 4.0	4.0 mm	150	560
15° Conical 4.5	4.5 mm	190	620
15° Conical 5.0	5.0 mm	260	750
15° Conical 6.0	6.0 mm	350	1200
60° Conical Profiled Orifices for Unfilled Chemicals			
60° Conical 2.0	2.0 mm	50	220
60° Conical 3.0	3.0 mm	90	430
60° Conical 4.0	4.0 mm	150	560
60° Conical 5.0	5.0 mm	260	750
60° Conical Profiled Orifices for Filled Chemicals			
60° Conical 2.0	2.0 mm	50	220
60° Conical 3.0	3.0 mm	90	430
60° Conical 4.0	4.0 mm	150	560
60° Conical 5.0	5.0 mm	260	750

NOTE: Flow ranges are only indicative. Actual capabilities depend on viscosity and operating pressure.

RECOMMENDED LUBRICANTS FOR A-SYSTEM METERING MACHINES

	MIXHEAD HYDRAULIC UNIT OIL	OIL FOR PNEUMATIC MIST LUBRICATOR	OIL FOR GEAR REDUCERS	HYDRAULIC OIL FOR CYLINDERS	GENERAL MECHANICAL GREASE	MULTIPURPOSE GREASE	MINERAL OIL FOR MACHINE FLUSHING
	Viscosity: 68 sq mm^2/S (cst) at 40°C ISO classification: VG68	Viscosity: 10 sq mm^2/S (cst) at 40°C ISO classification: VG10	Viscosity: 460 sq mm^2/S (cst) at 40°C, ISO ISO classification: VG460EP	Viscosity: 46 sq mm^2/S (cst) at 40°C ISO classification: VG46	NLGI grade 3, ASTM working penetration (mm/10) 220+ 250 dropping point: UBBELHODE C50	NLGI grade 2, ASTM 265-296	
AGIP	OBI 10	OSO 10	BLASIA 460	OSO 46		GR MU EP2	
ARAL		ARAL DURAL SR 10	ARAL DEGOL BG 460	ARAL VITAM GF 46		ARAL ARLUB HL,2	
BP		ENERGOL HP 10	ENERGOL GR-XP 460	ENERGOL HPL 46		GREASE LTX 2 GREASE LTX-EP	
CHEVRON		SPINDLE OIL 10 X	NL GEAR COMPOUND 460	EP HYDRAULIC OIL 46		DURALITH GREASE EP 2	
ELF		SPINELF 10	REDUCTELF SP 460	ELFOLNA 46		ROLEX A 2 EPEXA 2	
ESSO		SPINESSO 10	SPARTAN EP 460	NUTO H 46		BEACON 2 ESSO GP	
FINA		HYDRAN 10	GIRAN 460	HYDRAN 46		MARSON EPL 2	
GULF		HARMONY 16 AW	EP LUBRICANT HD 460	HARMONY 46 AW			
IP		IP HYDRUS OIL 10	IP MELLANIA OIL 460	IP HYDRUS OIL 46		IP ATHESIA GR 2 IP ATHESIA GR-EP 2	
MOBIL		MOBIL VELOCITE MOBIL DTE 21	MOBIL GEAR 634	MOBILE DTE 25		MOBILPLEX 47	WHITEREX 425
SHELL	ONDINA OIL 68	TELLUS OIL C10	OMALA OIL 460	TELLUS OIL 46 HYDRAULIC OIL 46		ALVANIA GREASE SUPERGREASE R2	
TEXACO	00788 SPINDURA OIL 22						
TOTAL		AZ OLLA Z S 10	AZ OLLA EP 460	AZ OLLA Z S 46		MULTIS EP 2	
VANGUARD	WH/FU	KOMOL SRV 10	GEARING EP 460	HYDRAULIC 46	WH/FF	LIKO 2 & EP 2	
VALVOLINE		ETC 10	GEAR EP 460	HYDRAULIC HLP 46		L2 GREASE L2 EP GREASE	

NOTE: The listed lubricants are general recommendations for standard Cannon-supplied equipment. These recommendations are provided as a guideline and are not meant to supersede vendor recommendations. Consult the vendor's information for specific recommendations.