X DUAL SEAL PLUNGER

SERIES OF METERING PUMPS

Committed to Delivering Fluid Metering Products, Services & Technology of the Highest Quality, and To Always Exceed Our Customer's Expectations.

- PNEUMATIC OPERATION
- HIGH FLOW TURNDOWN
- INTRINSICALLY SAFE
- GREATER RELIABILITY

- 316 SS LIQUID END
- SIMPLE MAINTENANCE
- EASE OF INSTALLATION

WILLIAMS
INSTRUMENT INCORPORATED
MILTON ROY

MEETS API 675 REQUIREMENTS

WILLIAMS INSTRUMENT INCORPORATED
MILTON ROY

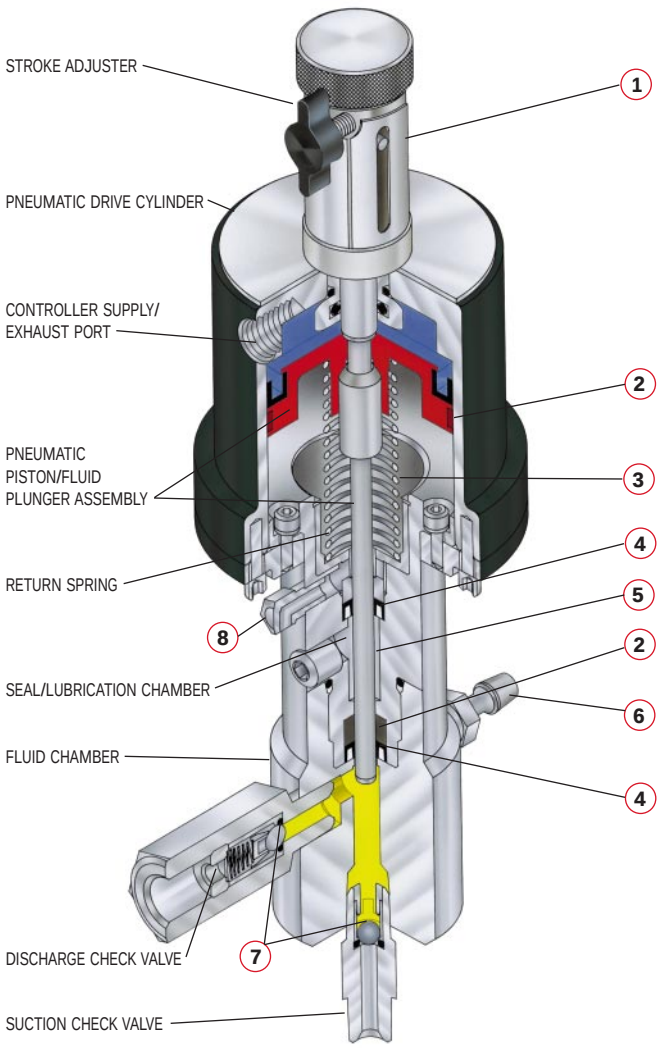
X DUAL SEAL PLUNGER

SERIES OF METERING PUMPS

SIMPLICITY IN DESIGN, OPERATION AND MAINTENANCE

PUMP FEATURES:

1. Stroke Adjuster is made more compact and adjustment is simplified with an internally threaded design. The positive locking device to hold stroke length is readily accessible and easy to operate.
2. The Pneumatic Piston and Fluid Plunger Assembly is guided at both ends on TFE composite bearings ensuring concentric movement of the plunger through the seals.
3. The clearance between the return spring and plunger has been optimized to eliminate any possible contact.
4. A true double sealing arrangement is used so that secondary seal containment is provided.
5. Lubrication has been simplified with the use of synthetic grease. The lubrication chamber is filled once over the life of the seals.
6. The bleeder is equipped with a barbed fitting for plastic tubing so that the fluid bled from the fluid chamber can be collected.
7. Both the discharge and suction check valves have tough TFE composite seats for long life and positive sealing.
8. Threaded port after the secondary seal provides for the indication, collection or containment of any seal leakage.



MATERIALS:

Wetted Parts: 316 SS
Check Valves:
Body/Retainer/Ball: 316 SS
Spring: Elgiloy
Seat: TFE
Plunger: As specified
Bleeder: 316 SS
Seals: As specified
Pneumatic Section:
Motor Cylinder Face Plate: Anodized Aluminum
Piston: Anodized Aluminum
Piston Seal: Buna N
Return Spring: 17-7ph
Controller: Anodized Aluminum

OPERATING CYCLE

POWER STROKE: As the CONTROLLER air or gas enters the PNEUMATIC DRIVE CYLINDER, the PISTON-PLUNGER ASSEMBLY is driven down into the FLUID CHAMBER, displacing fluid and compressing the RETURN SPRING. As the plunger displaces the fluid, the rise in pressure closes the SUCTION CHECK VALVE and opens the DISCHARGE CHECK VALVE. A precise amount of fluid, corresponding to the stroke of the plunger, is discharged.

SUCTION STROKE: When the air or gas is exhausted from the PNEUMATIC DRIVE CYLINDER the RETURN SPRING forces the PISTON-PLUNGER ASSEMBLY to return to its original position. The drop in pressure in the FLUID CHAMBER caused by the retraction of the piston allows the spring loaded DISCHARGE CHECK VALVE to close and the SUCTION CHECK VALVE to open so that the FLUID CHAMBER is again filled and ready for the power stroke.

PERFORMANCE SPECIFICATIONS *

MODEL @ AIR/GAS SUPPLY PRESSURE	MAX VOLUME GPH/LPH	VOLUME PER STROKE CC	STROKE LENGTH INCH	STROKES PER MINUTE (RANGE)	MAX DISCHARGE PRESSURE PSIG / BARG	MAX AIR CONSUMPTION 100 PSIG SCF PER DAY	MAX AIR CONSUMPTION 6.9 BAR SCM PER DAY
CP125X125 @ 65 PSI / 4.5 BAR	.07 / .27	.1	.5	1-45	5,000 / 344.8	180	5
CP250X225 @ 65 PSI / 4.5 BAR	.57 / 2.16	.8	1	1-45	4,100 / 282.7	1150	32
CP250X300 @ 65 PSI / 4.5 BAR	.57 / 2.16	.8	1	1-45	6,500 / 448.2	2100	59
CP500X225 @ 90 PSI / 6.2 BAR	2.26 / 8.55	3.2	1	1-45	1,300 / 89.6	1150	32
CP500X300 @ 90 PSI / 6.2 BAR	2.26 / 8.55	3.2	1	1-45	2,550 / 175.7	2100	59
CRP500X400 @ 50 PSI / 3.5 BAR @ 90 PSI / 6.2 BAR	2.26 / 8.55 2.26 / 8.55	3.2 3.2	1 1	1-45 1-45	2,900 / 203.9 5,400 / 379.7	3584	101
CRP750X400 @ 50 PSI / 3.5 BAR @ 90 PSI / 6.2 BAR	5.00 / 18.9 5.00 / 18.9	7.0 7.0	1 1	1-45 1-45	1,150 / 80.9 2,300 / 161.7	3584	101

*** This data should only be used to provide you with your initial size selection. You must refer to the actual performance graphs in order to verify your pump selection. Discharge pressures with use of MK II or MK VII controllers.**

PLUNGER PUMP SELECTION GUIDELINES

PLEASE NOTE THAT OUR PLUNGER PUMPS HAVE PRESSURE-ACTIVATED SEALS. THEY SHOULD NOT BE USED AT PRESSURES BELOW 100 PSI.

STROKE RATE AND LENGTH
Even though the pumps are designed to operate over their entire stroke rate and length ranges, we suggest that you take into consideration your future flow requirements. Rather than operating at the flow extremes you may wish to use the next pump size larger or smaller.

FILTRATION
Plunger pumps are susceptible to contamination. Therefore we recommend a 25 micron filter in the suction line of the pump.

SUCTION CONDITIONS
The X Series plunger pumps are designed for flooded suction only. They are NOT recommended for a suction lift condition. The recommended pressure at the suction inlet is:
1 ft. (.3 meters) min. • 10 ft. (3 meters) max.

NOTE: The normal cracking pressure of the discharge check valve is 90 PSI.

VISCOSITY
The maximum recommended viscosity is 4500 SSU (Saybolt Seconds Universal) or 960 CP (Centipoise).

FLOW TURNDOWN RATIO: 100:1
NOTE: The flow turndown ratio is defined as the total flow range of the pump, which includes both speed and stroke length adjustments.

ACCURACY
± 0.5% with Solenoid Valve and WPC-9001
± 1.5% with MK II or MK VII Controller

TEMPERATURE
The seals are the limiting factor. Please refer to the seal selection guide for temperature limits.

AIR/GAS SUPPLY
The air/gas supply must always be regulated since fluctuating pressures will affect speed and accuracy. The air/gas must be free from particulate and we recommend dry air/gas for trouble free operation.

PUMP SETTING GAUGE
We recommend the use of a pump setting gauge as a simple method of adjusting the flow of the pump.

DISCHARGE LINE CHECK VALVE
It is good design practice to install a check valve in the pump discharge line at the point it enters the process line. This will prevent the process fluid from reaching the pump.

USING THE GRAPHS

Use the following Performance Flow Curves in order to:

1) Determine the flow capability of the pump you have selected. If you have sized the pump too close to the upper or lower stroke rate limit, you may wish to change to a different pump size. Of course you can also change your flow for a given stroke rate by adjusting the stroke length. Example:

These Settings Will Produce The Same Pump Flow Rate	
STROKE RATE	STROKE LENGTH
10	1" (100%)
20	1/2" (50%)
40	1/4" (25%)

2) Determine the air pressure necessary to provide the desired pump discharge pressure.

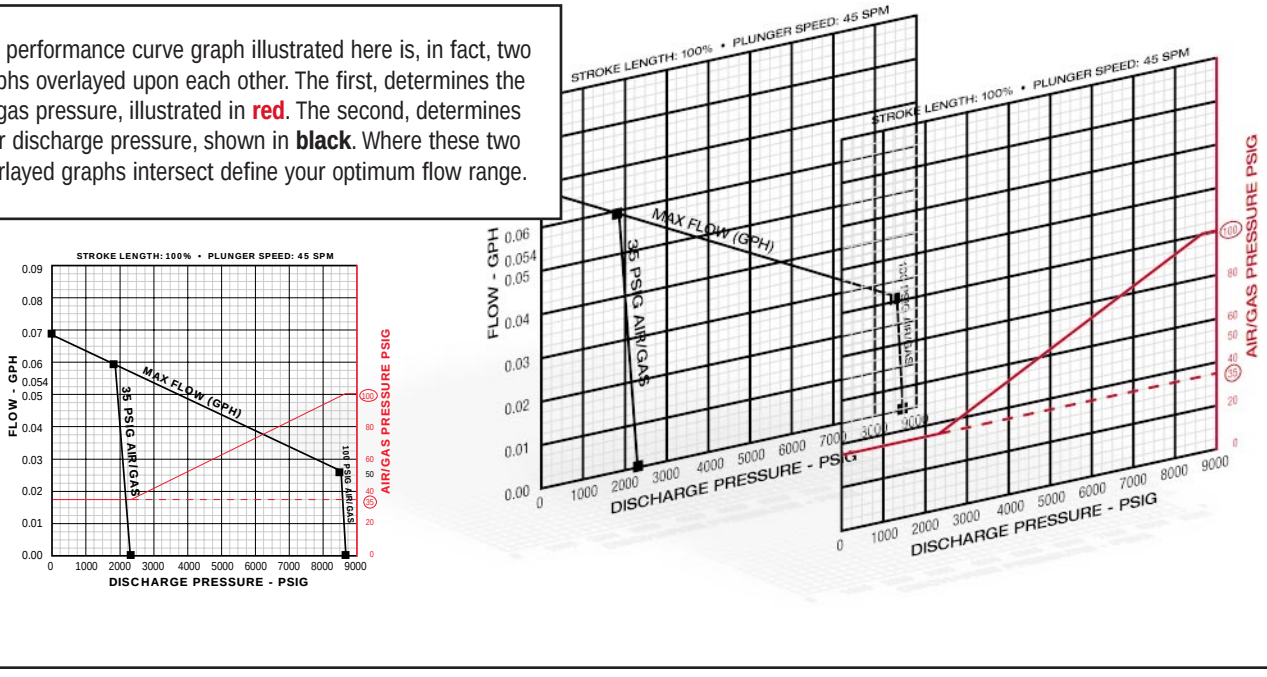
A) The flow curves show the maximum flow/pressure limit of the pumps. The upper near horizontal line represents the maximum flow capability (45 SPM @ 100% stroke). The near vertical lines represent the maximum discharge pressure at the corresponding air/gas pressure. The area under the curve represents the entire flow/pressure range for the pumps.

B) THE RED CURVE defines the relationship between air/gas supply pressure and discharge pressure. For each discharge pressure there is a minimum air/gas supply pressure required. **Always add 200 PSI to your discharge pressure in order to ensure positive injection.** Find the discharge pressure on the horizontal axis and follow it up to the red curve. At that point, read your air/gas pressure requirements on the right axis in PSIG. The minimum air/gas supply pressure will produce discharge pressures found to the left of the 35 PSIG limit line.

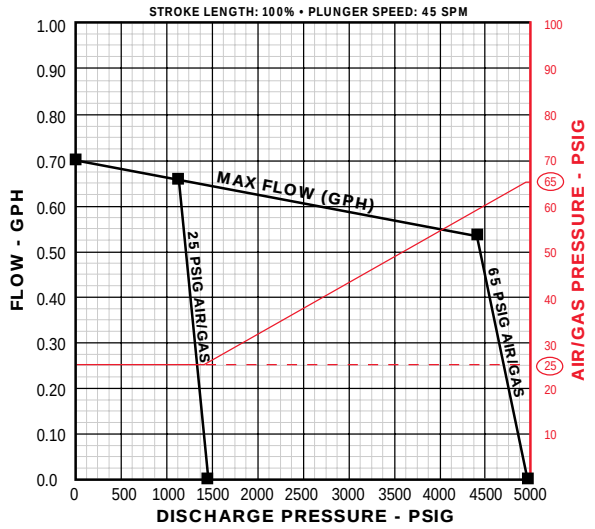
The required air/gas supply pressure can be read off the graph by first adding 200 psi to the discharge pressure. Then locate the psi on the discharge pressure axis and follow it up until it intersects the red line. Follow this point to the air/gas supply pressure axis on the right and you will find the appropriate air/gas pressure necessary to operate the pump.

Reading The Graphs

The performance curve graph illustrated here is, in fact, two graphs overlayed upon each other. The first, determines the air/gas pressure, illustrated in **red**. The second, determines your discharge pressure, shown in **black**. Where these two overlayed graphs intersect define your optimum flow range.

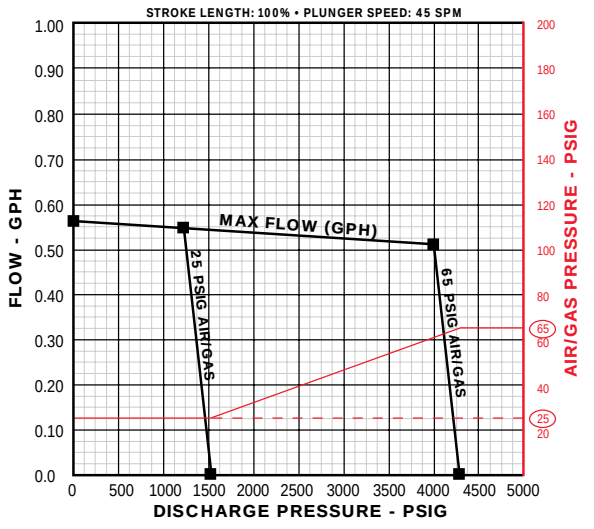


PERFORMANCE



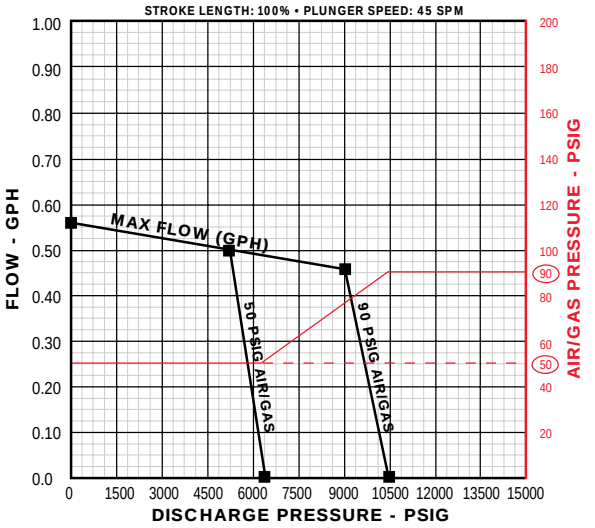
CP125X125 with MK II

Discharge Pressure PSI	0	500	1100	2500	4400	5000
Gph	0.07	0.068	0.065	0.061	0.052	0
Air Pressure PSI	25	25	25	38	55	65



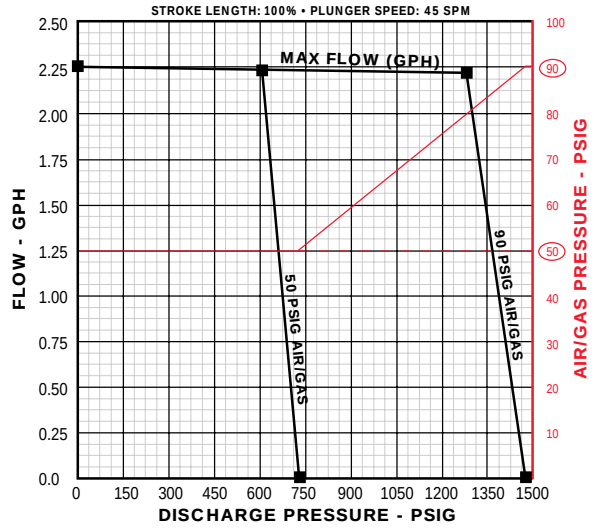
CP250X225 with MK II

Discharge Pressure PSI	0	500	1500	2500	4000	4100
Gph	0.57	0.56	0.55	0.55	0.54	0
Air Pressure PSI	25	25	27	40	60	65



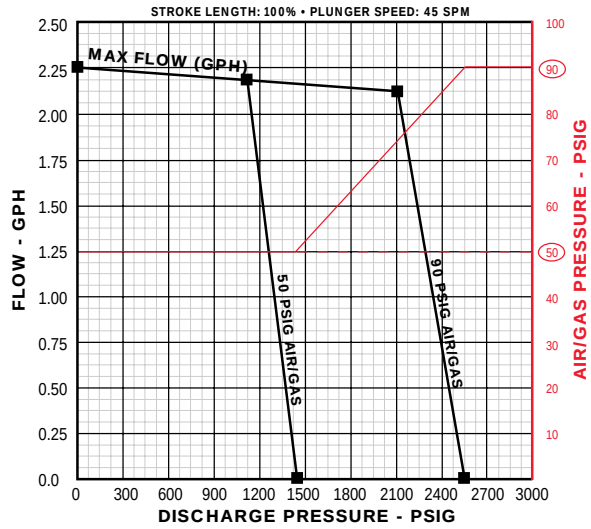
CP250X300 with MK VII

Discharge Pressure PSI	0	1500	4500	7500	9000	10500
Gph	0.57	0.55	0.51	0.5	0.45	0
Air Pressure PSI	50	50	50	65	75	90



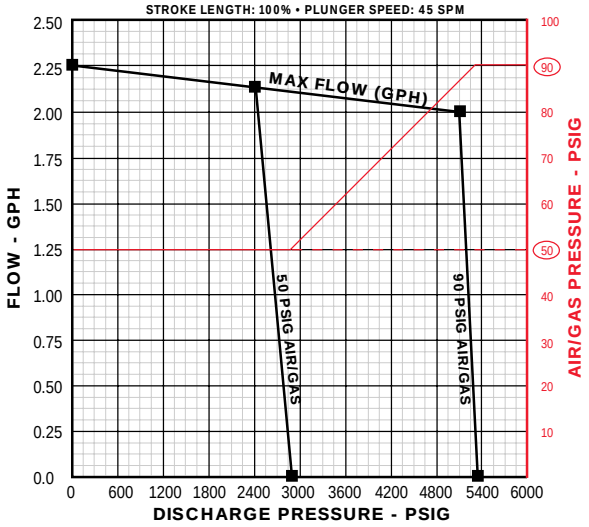
CP500X225 with MK VII

Discharge Pressure PSI	0	450	750	1050	1300	1500
Gph	2.26	2.24	2.24	2.23	2.22	0
Air Pressure PSI	50	50	50	68	80	90



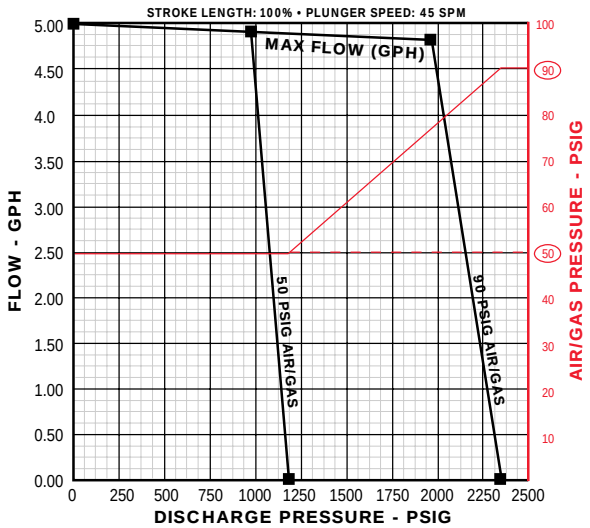
CP500X300 with MK VII

Discharge Pressure PSI	0	500	900	1500	2100	2550
Gph	2.26	2.2	2.16	2.08	2.15	0
Air Pressure PSI	50	50	50	54	74	90



CRP500X400 with MK II & PO3-6A

Discharge Pressure PSI	0	1200	2900	3600	5100	5400
Gph	2.26	2.24	2.2	2.11	2	0
Air Pressure PSI	50	50	50	63	85	90

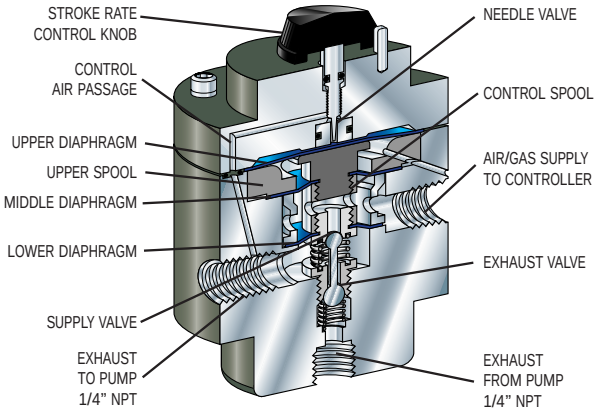


CRP750X400 with MK II & PO3-6A

Discharge Pressure PSI	0	500	1150	1500	2000	2300
Gph	5	4.96	4.95	4.8	4.7	0
Air Pressure PSI	50	50	50	60	80	90

CONTROL METHODS FOR THE PUMP

MK II & MK VII OSCILLAMATIC® CONTROLLER

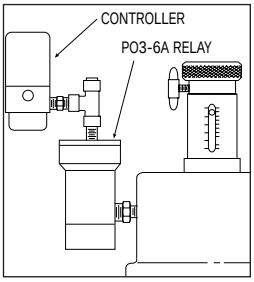


The MK II and MK VII Controllers operate on the same operating principal as the MK X Controller. The MK II and MK VII have the same upper and lower chambers, but are separated with flexible diaphragms rather than sliding seals. A capillary tube, controlled by a needle valve, transfers the air/gas supply to the pump from the lower to the upper chamber.

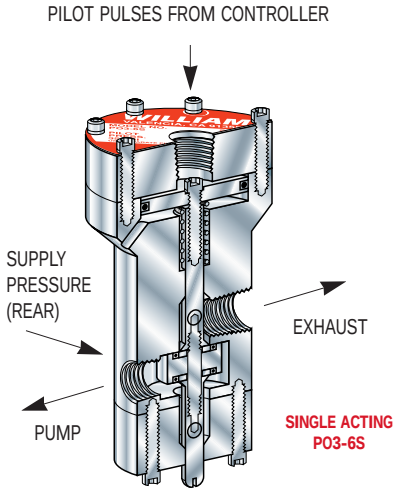
When the spool is in the highest position, a pilot plug closes a vent and opens the supply air/gas to the pump. When the spool is in its lowest position, the pilot plug prevents the supply air/gas from entering the pump, and opens the air/gas vent to let it exhaust the pump. The spool then returns to its highest position to repeat the process.

CONTROLLER - PNEUMATIC RELAY COMBINATION

The PNEUMATIC RELAY is a pilot operated valve designed to provide the higher air or gas flow rates necessary for PNEUMATIC DRIVE CYLINDER diameters greater than 3 inches. The PNEUMATIC RELAY is actuated by the pulses produced by the CONTROLLER. A single acting PNEUMATIC RELAY is used with pumps that have return springs such as the CRP500X400.

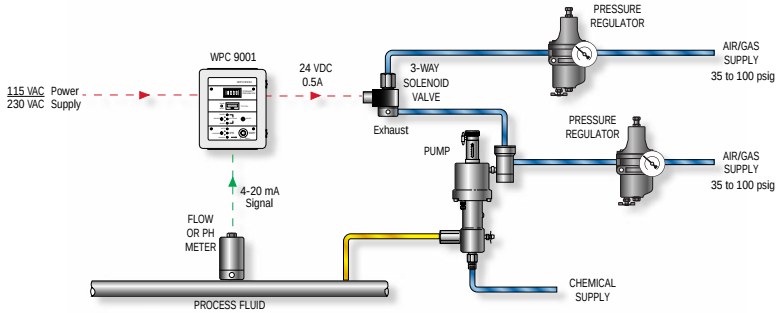


PUMP INSTALLATION
CRP500X400 OR CRP750X400



SOLENOID VALVES

The pumps can be automated by replacing the CONTROLLER with a 3-way electro-pneumatic SOLENOID VALVE. The SOLENOID VALVE can be cycled in order to achieve the desired pump output. Flow tracking can be accomplished by having a FLOWMETER or PH METER signal interpreted by our WPC9001 or a PLC. The typical arrangement for a WPC-9001 installation is shown at right.



PLUNGER MATERIAL SELECTION

The materials available vary in hardness and chemical compatibility. We offer three materials based on our many years of industry experience with various chemicals. Hardness is a key property when selecting the proper plunger material. Our experience has shown that the harder plunger materials not only provide longer plunger life, they also provide greater seal life. A hard plunger is a must when pumping a chemical that is prone to crystallization or if the chemical is contaminated. Of course both of the above conditions will affect seal life. Below is a table that compares the chemical compatibility and hardness properties of each material.

DESIGNATION	MATERIAL	HARDNESS	CHEMICAL COMPATIBILITY
CR	Ceramic	Between Sapphire and Diamond on the Mohs' Scale	Excellent Chemical Inertness in all Acids, Bases, Solvents
A	17-4 ph	40 Rc	General Corrosion-resistant Stainless Steel Limited Acid Resistance
B	316 SS	28 Rc	Excellent Corrosion-resistant Stainless Steel Limited Acid Resistance

We recommend the use of ceramic because of its extreme hardness and excellent chemical inertness.

SEAL MATERIAL SELECTION

The seal material must be chosen to satisfy both the chemical compatibility and the pressures/temperatures at which you are operating. Below is a general guideline for seal material selection.

MATERIAL	SEAL TYPE	TEMP RANGE	SUGGESTED PRESSURE RANGE	COMMENTS
TG Teflon® Graphite	Mechanical (Spring Loaded)	-30 to 180°F -34 to 82°C	3000 to 10,000 psi 207 to 690 bar (High Pressure)	Tough material with excellent wear resistance. Excellent chemical inertness. Good for all types of chemicals, acids, bases or solvents. Recommended for use with the harder ceramic plunger and higher pressures.
TC Teflon® Composite	Mechanical (Spring Loaded)	-30 to 180°F -34 to 82°C	100 to 5000 psi 6.9 to 344 bar (Low Pressure)	Tough material with excellent wear resistance. Excellent chemical inertness. Good for all types of chemicals, acids, bases or solvents.
PE UHMW Polyethylene	Mechanical (Spring Loaded)	-30 to 180°F -34 to 82°C	100 to 3000 psi 6.9 to 207 bar	Tough material with excellent wear resistance. Good for water and alcohol based chemicals. Not recommended for solvents.
V Viton®	O-ring	-10 to 200°F -23 to 93°C	100 to 750 psi 6.9 to 52 bar	Soft material with fair wear resistance. Broad chemical compatibility but its not to be used with ethyl or methyl alcohols. Suggested only for hard to seal fluids in low pressure applications when PE or TC will not seal.
BR Buna N	O-ring	-40 to 200°F -40 to 93°C	100 to 750 psi 6.9 to 52 bar	Soft material with fair wear resistance. Limited chemical compatibility. Used mainly in Methanol pumping at low pressure.
K Kalrez®	O-ring	32 to 200°F 0 to 93°C	100 to 750 psi 6.9 to 52 bar	Soft material with fair wear resistance. Excellent chemical compatibility. Used when Viton® is not compatible and PE or TC will not seal.
EPR Ethylene Propylene	O-ring	-40 to 200°F -40 to 93°C	100 to 750 psi 6.9 to 52 bar	Material has very good abrasion resistance. Excellent chemical resistance to phosphate esters, good to excellent to mild acids, alkalis, silicone oils and greases, ketones and alcohols. Not recommended for petroleum oils or di-esters.

Selecting the proper seal material for your application is important. We suggest using the harder plastic seals (PE, TC or TG) whenever possible because they provide excellent wear life. The elastomers (V, BR,K or EPR) offer enhanced sealing at low pressure because they are soft and more compliant than the plastics. However, the elastomers do not provide the same toughness or wear resistance.

PART NUMBERING SYSTEM

CR P750X400 A PE

Control Method
- **C**: Controller
- **CR**: Controller - Relay
- **S**: Solenoid Valve
- **SR**: Solenoid Valve - Relay

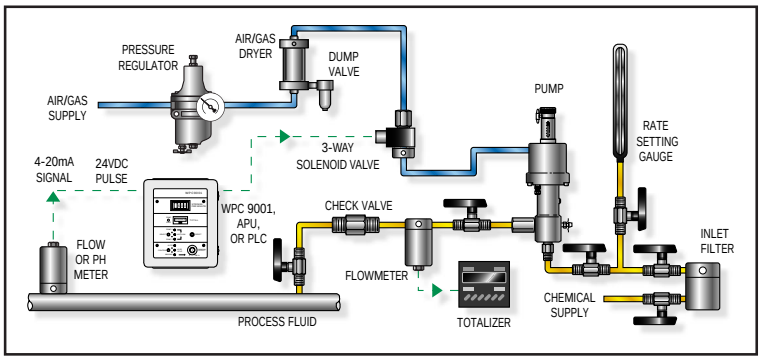
Basic Model
- **P125X125**
- **P250X225**
- **P250X300**
- **P500X225**
- **P500X300**
- **P500X400**[1]
- **P750X400**[1]

Plunger Material
- **A**: 17-4 ph
- **B**: 316 SS
- **CR**: Ceramic

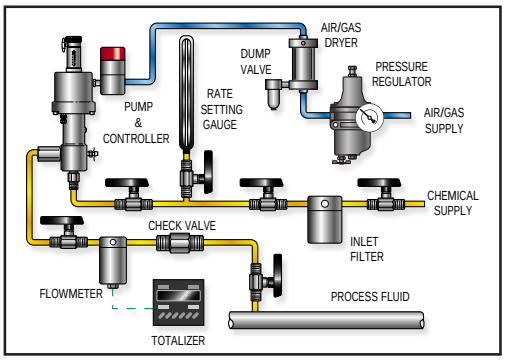
Seal Material
- **PE**: Polyethylene (UHMW)
- **TC**: Teflon® Composite
- **TG**: Teflon® Graphite
- **V**: Viton®
- **BR**: Buna N
- **K**: Kalrez®
- **EPR**: Ethylene Propylene

NOTE: [1] The 400 motor cylinders are only available with the CR (controller-relay) or SR (solenoid-relay) control methods.

TYPICAL INSTALLATION

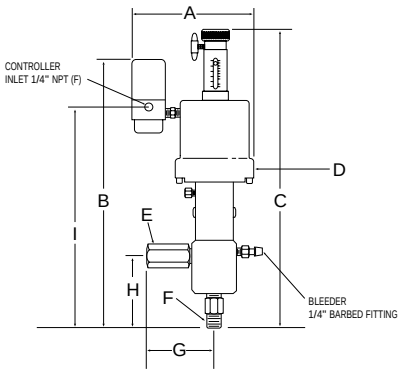


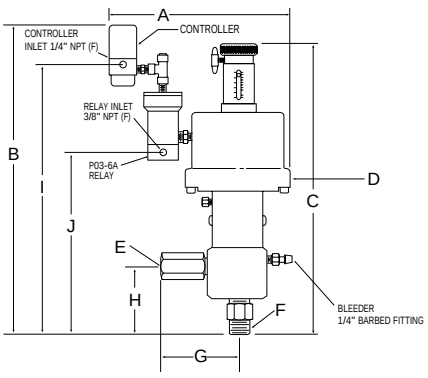
Flow Tracking Controller Configuration



Standard Pneumatic Controller Configuration

DIMENSIONS & PHYSICAL SPECIFICATIONS





Model	Plunger Diameter (In.)	Piston Diameter (In.)
CP125X125	1/8	1 1/4
CP250X225	1/4	2 1/4
CP250X300	1/4	3
CP500X225	1/2	2 1/4
CP500X300	1/2	3
CRP500X400	1/2	4
CRP750X400	3/4	4

Model	A Inch/mm	B Inch/mm	C Inch/mm	D Diameter (IN)	E Connector	F Connector	G Inch/mm	H Inch/mm	I Inch/mm	J Inch/mm	WT LBS/KG
CP125X125	5.25/133.4	9.00/228.6	8.12/206.2	1 7/8"47mm	1/4" NPT (F)	1/4" NPT (M)	1 3/4"45mm	1 3/4"45mm	6 1/4"159mm	n/a	7.0/3.2
CP250X225	6.50/165.1	11.43/290.3	11.00/279.4	2 1/2"63.5mm	1/4" NPT (F)	1/4" NPT (M)	2 9/16"65mm	2 11/16"68mm	8 7/8"214mm	n/a	9.0/4.1
CP250X300	7.25/184.2	11.43/290.3	11.00/279.4	3 1/4"82.5mm	1/4" NPT (F)	1/4" NPT (M)	2 9/16"65mm	2 11/16"68mm	8 7/8"214mm	n/a	9.0/4.1
CP500X225	6.50/165.1	11.75/298.5	11.00/279.4	2 1/2"63.5mm	1/4" NPT (F)	1/2" NPT (M)	2 5/8"67mm	2 13/16"69mm	8 9/16"217mm	n/a	10.0/4.5
CP500X300	7.25/184.2	11.75/298.5	11.00/279.4	3 1/4"82.5mm	1/4" NPT (F)	1/2" NPT (M)	2 5/8"67mm	2 13/16"69mm	8 9/16"217mm	n/a	10.0/4.5
CRP500X400	9.75/247.7	15.75/400	11.00/279.4	4 1/4"108mm	1/4" NPT (F)	1/2" NPT (M)	2 5/8"67mm	2 13/16"69mm	12 3/4"324mm	9 7/16"240mm	15.0/6.8
CRP750X400	9.75/247.7	16.00/406.4	11.31/287.2	4 9/16"116mm	1/2" NPT (F)	3/4" NPT (M)	3 5/8"92mm	3"76.2mm	13"331.7mm	7 9/16"240mm	16.7/7.5

PUMP ACCESSORIES

WFS6704 Micro Flow Switch
For Detecting Changes in Flow Rate

SENSITIVITY	OPERATING TEMP	OPERATING PRESSURE
0.1 PSI	-40° to +300° F	3000 PSI
0.689kPa	-40° to +150° C	207 Bar

AUTOMATIC DUMP VALVES
Used with the Air or Gas Dryer-Filters

MODELS	BOWL	MAX. PRESSURE
ADV-150-A	Plastic	150 PSI
ADV-250-A	Steel	250 PSI

DRUM GAUGES [2]
Liquid Level/Injection Rate Gauge

MODELS	MATERIALS
C779WS	Carbon Steel
C779WS-V	Carbon Steel - Vented
C779WS/SS	Stainless Steel
C779WS/SS-V	Stainless Steel - Vented
30216-CS-V-GPD-S	Carbon Steel
30216-S6-V-GPD-S	Stainless Steel

PCV125 AL
Pressure Regulator

SENSITIVITY	FLOW RATES	MAX. PRESSURE
0.1 PSI	20SCFM	250 PSI
0.689kPa	.566m3/min	1724 kPa

LIQUID CHEMICAL FILTERS [1]
316 Stainless Steel

MODELS	CONNECTION FILTER ELEMENT	OPTIONAL FILTER ELEMENT
LCF10-25	1/4" NPT 25 micron, Std	1, 2, 8 microns or 100 mesh stainless steel screen
LCF15-25	1/2" NPT 25 micron, Std	

AIR OR GAS DRYER-FILTERS
Complete with Manual Drain Valve

MODELS	FLOW RATES	MAX. PRESSURE
J150	40SCFM	150 PSI
J500	40SCFM	500 PSI

APU-XP
Automatic Processing Unit

FREQUENCY	ACCURACY
0-45 SPM	± 0.25% of span

WPC9001
Electronic Pump Controller

MODEL	NEMA CLASS	MAX. TEMP.		OPERATING MODES
WPC9001-GP	4X	140° F	60° C	Auto
WPC9001-XP	7			Manual
				Switching

NOTES: [1] Use only with all models of P125X, P250X and P500X pumps.
[2] Use the C779 with all models of P125X, P250X and P500X; use the 30216 with all models of P750X.

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INSTRUMENT INCORPORATED
MILTON ROY

(800) 235-3421
(661) 257-2250 • Fax: (661) 257-7963

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