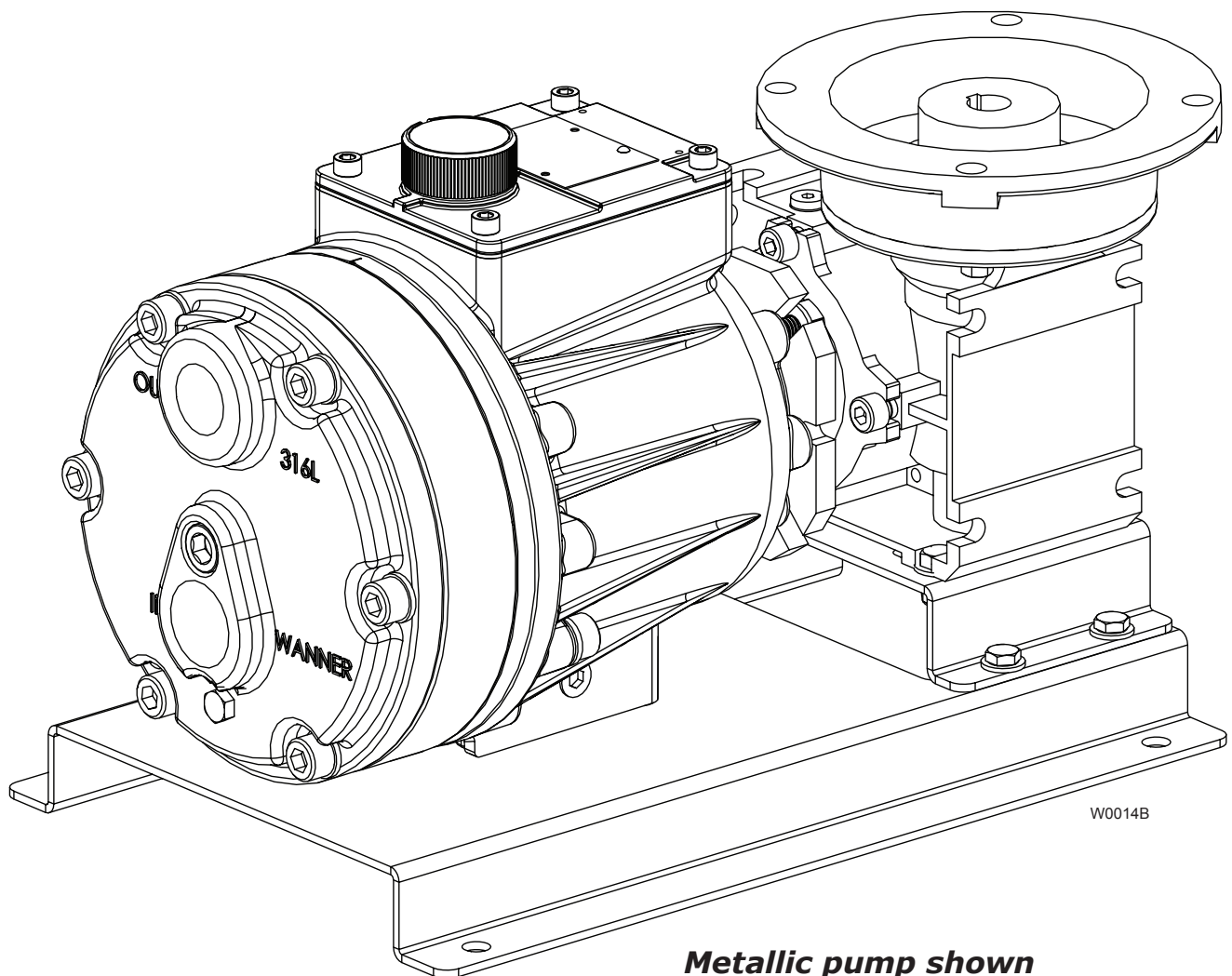


Hydra·Cell[®]
METERING SOLUTIONS™

P400 Metering Pump

Installation, Operation & Maintenance
P400-991-2400C



Wanner Engineering, Inc.

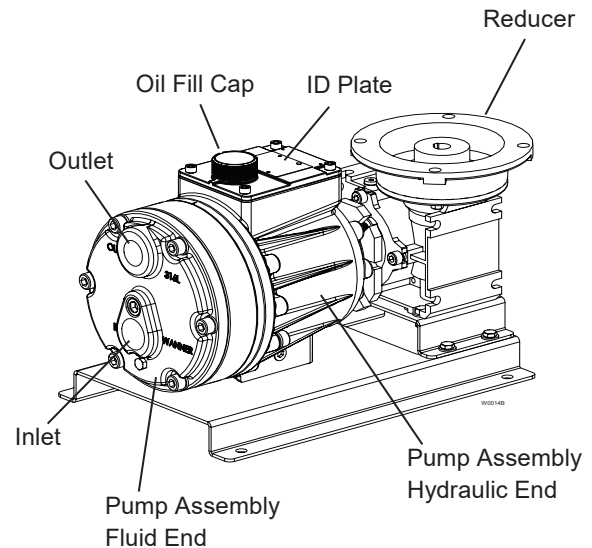
1204 Chestnut Avenue, Minneapolis, MN 55403
Tel: (612) 332-5681 Fax: (612) 332-6937
Toll-free fax [US only]: (800) 332-6812
www.hydra-cell.com/metering
email: sales@wannereng.com



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Component Identification



P400 Operation

Hydra-Cell Metering Solutions Pumps are hydraulically-actuated, hydraulically-balanced diaphragm metering pumps that exceed API 675 performance standards of $\pm 1\%$ steady state accuracy, $\pm 3\%$ linearity and $\pm 3\%$ repeatability.

Due to their multiple diaphragm design, the P Series metering pumps, with the exception of the P100, provide virtually “pulse-free” linear flow. Unlike conventional single diaphragm metering pumps, this linear flow reduces the need for pulsation dampeners and increases the reliability, performance, and safety of the metering pump system.

Pump operation and plunger activation are accomplished through a crankshaft (P100, P200 and P300) or wobble plate (P400, P500 and P600). Horizontal disk check valves allow for the pumping of particulates that ordinarily collect on vertical ball check valves common to conventional metering pumps.

P Series pumps utilize speed to adjust flow rate through a motor and variable-frequency drive (VFD), eliminating the need for mechanical adjustment.

P400 Specifications

Diaphragms per Liquid End	3 (Kel-Cell pistons)
Flow Control	Electronic variable speed drive
Steady State Accuracy	$\pm 1\%$
Linearity	$\pm 3\%$
Repeatability	$\pm 3\%$
Maximum Pressure	
Metallic Heads:	1000 psi (69 bar)
Non-Metallic Heads:	PVDF: 350 psi (24 bar)
	Polypropylene: 250 psi (17 bar)
Maximum Inlet Pressure	250 psi (17 bar)
Fluid Operating Temperatures*	
Metallic Head:	250°F (121°C)
Non-Metallic Head:	140°F (60°C)
* Consult factory for correct component selection for temperatures from 160°F (71°C) to 250°F (121°C).	
Inlet Port	1 inch NPT or BSPT
Discharge Port	3/4 inch NPT or BSPT
Maximum Solids	500 microns
Shaft Rotation	Bi-directional
Materials Used	See Replacement Parts Kits Section for individual pump materials.
Oil Capacity	1.35 US quart (1.27 liters)
Weight (less motor)	
Metallic Heads:	65.5 lbs (29.7 kg)
Non-Metallic Heads:	52.5 lbs (23.8kg)

P400 Specifications (Cont'd)

Performance Maximum Flow at Designated Pressure - Imperial *

All Pumps (gph)		Metallic Pump Heads Only (gph)		Pump rpm	Gear Ratio	Motor rpm
100 psi	250 psi	500 psi	1000 psi			
9.637 (¼)	9.280 (¼)	8.491 (¼)	6.464 (½)	30	60:1	1800
11.652 (¼)	11.283 (¼)	10.452 (½)	8.269 (½)	36	50:1	
14.66 (¼)	14.30 (¼)	13.37 (½)	11.21 (½)	45	40:1	
19.73 (¼)	19.31 (¼)	18.30 (½)	15.96 (¾)	60	30:1	
23.79 (¼)	23.32 (¼)	22.24 (½)	19.75 (¾)	72	25:1	
29.87 (¼)	29.34 (¼)	28.15 (½)	25.45 (¾)	90	20:1	
40.011 (¼)	39.375 (½)	38.00 (½)	34.94 (1)	120	15:1	
60.290 (¼)	59.438 (½)	57.70 (¾)	53.92 (1)	180	10:1	
80.569 (¼)	79.501 (½)	77.41 (¾)	72.90 (1½)	240	7.5:1	
121.1 (½)	119.6 (¾)	116.8 (1)	110.9 (2)	360	5:1	
161.69 (½)	159.75 (1)	156.22 (1½)	148.84 (3)	480	7.5:1	3600
242.80 (¾)	240.01 (1½)	235.03 (2.1)	224.77 (5)	720	5:1	

*Capacity data shown is for pumps with elastomeric diaphragms. Consult factory for performance characteristics of pumps with PTFE diaphragms.

() Required Motor hp

Performance Maximum Flow at Designated Pressure - Metric *

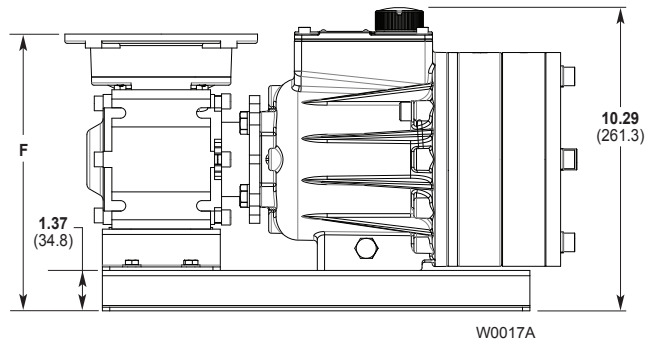
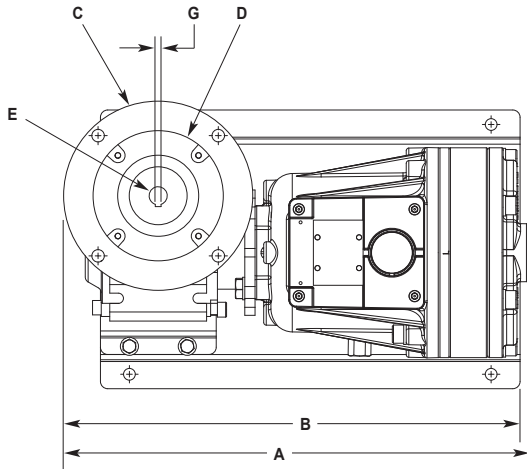
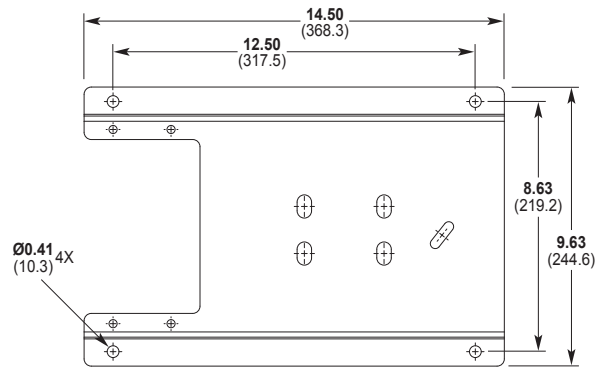
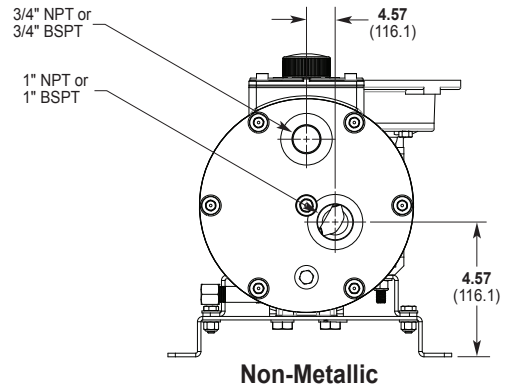
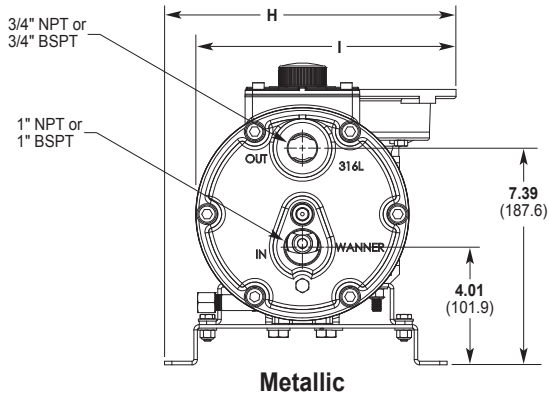
All Pumps (lph)		Metallic Pump Heads Only (lph)		Pump rpm	Gear Ratio	Motor rpm
7 bar	17 bar	34 bar	69 bar			
30.40 (0.18)	29.27 (0.18)	26.78 (0.25)	20.391 (0.37)	25	60:1	1500
36.76 (0.18)	35.59 (0.25)	32.97 (0.37)	26.09 (0.55)	30	50:1	
46.25 (0.18)	45.10 (0.25)	42.18 (0.37)	35.36 (0.55)	37.5	40:1	
62.24 (0.18)	60.92 (0.25)	57.72 (0.37)	50.33 (0.75)	50	30:1	
75.04 (0.18)	73.58 (0.25)	70.15 (0.37)	62.31 (0.75)	60	25:1	
94.23 (0.18)	92.56 (0.25)	88.80 (0.37)	80.27 (0.75)	75	20:1	
126.21 (0.25)	124.21 (0.37)	119.87 (0.55)	110.21 (1.1)	100	15:1	
190.19 (0.25)	187.50 (0.37)	182.03 (0.55)	170.09 (1.1)	150	10:1	
254.16 (0.25)	250.79 (0.55)	244.18 (0.75)	229.98 (1.1)	200	7.5:1	
382.1 (0.37)	377.4 (0.55)	368.5 (0.75)	349.7 (1.5)	300	5:1	
510.0 (0.55)	503.9 (0.75)	492.8 (1.5)	469.5 (1.5)	400	7.5:1	3000
765.9 (0.55)	757.1 (0.75)	741.4 (2.2)	709.0 (2.2)	600	5:1	

*Capacity data shown is for pumps with elastomeric diaphragms. Consult factory for performance characteristics of pumps with PTFE diaphragms.

() Required Motor kW

P400 Dimensions

P400 Models: Metallic and Non-Metallic



Dimensions in Inches (Millimeters)

Input Frame Size	A		B	C	D	E	F	G (Square Key)	H	I
	Metallic Pump Head	Plastic Pump Head								
NEMA 56C	16.12 (409.4)	17.29 (439.1)	15.77 (400.6)	Ø 6.54 (Ø 166)	Ø 4.50 (Ø 114.3)	Ø 0.62 (Ø 15.7)	9.39 (238.4)	0.187 (4.75)	9.94 (252.4)	8.86 (225.1)
NEMA 143/145 TC	16.12 (409.4)	17.29 (439.1)	15.77 (400.6)	Ø 6.54 (Ø 166)	Ø 4.50 (Ø 114.3)	Ø 0.87 (Ø 22.2)	9.86 (250.4)	0.187 (4.75)	9.94 (252.4)	8.86 (225.1)
IEC 63 B5	15.60 (396.2)	16.77 (426)	15.25 (387.4)	Ø 5.51 (Ø 140)	Ø 3.74 (Ø 95)	Ø 0.43 (Ø 11)	9.21 (233.9)	0.157 (4)	9.43 (239.5)	8.35 (212.2)
IEC 71 B5	16.00 (406.4)	17.17 (436.1)	15.65 (397.5)	Ø 6.30 (Ø 160)	Ø 4.33 (Ø 110)	Ø 0.55 (Ø 14)	9.21 (233.9)	0.196 (5)	9.82 (249.4)	8.74 (222.1)
IEC 80 B5	16.79 (426.5)	17.96 (456.2)	16.43 (417.32)	Ø 7.87 (Ø 200)	Ø 5.12 (Ø 130)	Ø 0.75 (Ø 19)	9.21 (233.9)	0.236 (6)	10.61 (269.5)	9.53 (242.2)
IEC 90 B5	16.79 (426.5)	17.96 (456.2)	16.43 (417.32)	Ø 7.87 (Ø 200)	Ø 5.12 (Ø 130)	Ø 0.94 (Ø 24)	9.69 (246.9)	0.315 (8)	10.61 (269.5)	9.53 (242.2)

P400 Installation

Location

Locate the pump as close to the supply source as possible.

Install the pump system in a lighted clean space where it will be easy to inspect and maintain.

Motor and Controller

The **P Series pump shaft** can rotate in either direction, therefore direction of motor shaft rotation is not critical.

Flow rate is determined by motor speed, which is controlled using an inverter duty constant torque motor and VFD. Flow rate functions can also be easily controlled using the Hydra-Cell Control Freak and appropriate motor.

Accessories

Consult installation drawing below for typical metering fluid system components. Contact Wanner Engineering or the distributor in your area for more details.

Important Precautions

Adequate Fluid Supply. To avoid cavitation and premature pump failure, be sure that the pump will have an adequate fluid supply and that the inlet line will not be obstructed. See **Inlet Piping**.

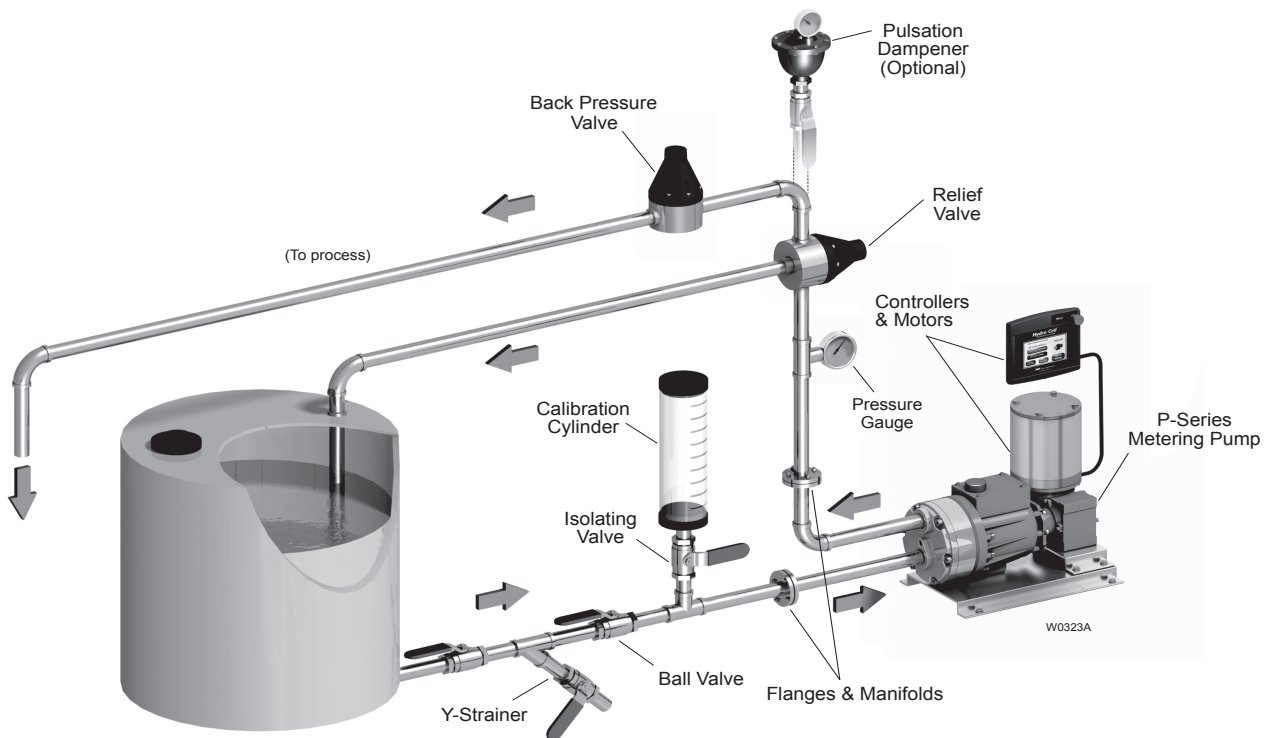
Positive Displacement. This is a positive-displacement pump. To avoid severe system damage if the discharge line ever becomes blocked, install a relief valve downstream from the pump. See **Discharge Piping**.

Safety Guards. Follow all codes and regulations regarding installation and operation of the pumping system.

Shut-Off Valves. Never install shut-off valves between the pump and relief valve, or in the regulator bypass line.

Consult the Factory for the following situations:

- Extreme temperature applications (above 160°F or below 40°F)
- Pressure feeding of pumps
- Viscous or abrasive fluid applications
- Chemical compatibility problems
- Hot ambient temperatures (above 110°F)



Typical Metering Installation

P400 Installation (Cont'd)

Safety Precautions

General remarks

These safety / installation instructions contain fundamental information and precautionary notes and must be kept available to all associated with the operation of the pump. Please read them thoroughly prior to installation, electrical connection and commissioning of the unit. It is imperative that all other operating instructions relating to the components of individual units are followed.

These safety / installation instructions do not take local regulations into account. The operator must ensure that such regulations are observed by all, including the personnel carrying out the installation.

Each pump must be labeled by the end user to warn of any hazards that the system process may produce; e.g. corrosive chemicals or hot process etc.

All personnel involved in the operation, maintenance, inspection and installation of the pump must be fully qualified to carry out the work. The personnel's responsibilities, competence and supervision must be clearly defined by the operator. To the extent that if the personnel in question is not already in possession of the requisite know how, appropriate training and instruction must be provided. In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by all the responsible personnel.

When installing a Hydra-Cell pump in conjunction with a motor or motor and frequency controller the relevant manuals must be referred to for electromagnetic compatibility. The installation should conform to EN 61800 and EN 60204 as applicable.

All safety instructions in this manual and all relevant local health and safety regulations must be followed.

Attention must be paid to the weight of the pump before attempting to lift either manually or selecting appropriate lifting equipment.

Inlet Piping

Provide for permanent or temporary installation of a compound pressure gauge to monitor the inlet pressure. To maintain maximum flow, the pump inlet should be under flooded suction conditions at all times. **Do not supply more than one pump from the same inlet line.**

Supply Tank

Use a supply tank that is large enough to provide time for any trapped air in the fluid to escape. The tank size should be at least twice the maximum pump flow rate.

Install a separate inlet line from the supply tank to each pump.

Place a cover over the supply tank, to prevent foreign objects from falling into it.

Hose Sizing and Routing

To minimize acceleration head and frictional losses, size the suction line at least one size larger than the pump inlet, and keep the suction line as short and direct as possible.

Recommendations:

- Keep inlet lines less than 3 ft. (1 m) long
- Use at least 5/8" (16 mm) I.D. inlet hose
- Minimize fittings (elbows, valves, tees, etc.)

Support the pump and piping independently.

Inlet Piping (Pressure Feed)

Provide for permanent or temporary installation of a pressure gauge to monitor the inlet pressure. Pressure at the pump inlet should not exceed 250 psi (17.3 bar). For higher pressures install a pressure reducing valve. **Do not supply more than one pump from the same inlet line.**

Note: System back pressure must exceed the pump inlet pressure by at least 15 psi (1 bar) in order to prevent flow thru.

Discharge Piping

Hose and Routing

Use the shortest, most-direct route for the discharge line.

Select pipe or hose with a **working pressure** rating of at least 1.5 times the maximum system pressure. Example: Select a 1500 psi (103 bar) W.P. rated hose for a system to be operated at 1000 psi (69 bar) gauge pressure.

Support the pump and piping independently.

Pressure Regulation

Install a pressure relief valve in the discharge line. Bypass pressure must not exceed the pressure limit of the pump.

Size the valve so that, when fully open, it will be large enough to relieve the full capacity of the pump without overpressurizing the system.

Locate the valve as close to the pump as possible and ahead of any other valves.

Adjust the pressure relief valve to no more than 10% over the maximum working pressure of the system. Do not exceed the manufacturer's pressure rating for the pump or valve.

Route the bypass line to the supply tank.

Caution: Never install shutoff valves in the bypass line or between the pump and pressure regulator or relief valve.

Provide for permanent or temporary installation of a pressure gauge to monitor the discharge pressure at the pump.

Minimum Discharge Pressure

To ensure proper capacity control, a minimum discharge pressure of 50 psi (3.5 bar) is recommended.

P400 Installation (Cont'd)

Initial Start-Up Procedure

Before starting the pump, be sure that:

1. All shut-off valves are open, and pump has adequate supply of fluid.
2. All connections are tight.
3. The oil level is 1/4 inch (6 mm) above the cast surface in the upper oil reservoir.
4. Open priming valve on system back pressure valve so pump starts under minimum pressure. See Typical Metering Installation drawing.

Turn on power to pump motor and:

1. Check inlet pressure or vacuum. To maintain maximum flow, pump inlet should be under flooded suction conditions at all times. Inlet pressure must not exceed 250 psi (17.3 bar).
2. Observe any erratic noise or flow.
3. Jog pump on and off until fluid coming from priming valve is air-free.
4. Close priming valve.
5. Perform pump calibration. See Calibration Procedure.

Calibration

Note: Each metering pump or pump system must be calibrated to determine the pump speed required for the desired flow rate.

Accurate calibration depends on pump discharge pressure and system conditions. When calibrating the pump or system, it is useful to plot capacity curves for future reference. Observe on the curve, that pump capacity decreases slightly as discharge pressure increases.

In order to achieve the best possible results, perform calibration under actual process conditions. Follow these steps:

1. Run pump for 20 minutes at actual process conditions. If process system cannot be used, circulate back to supply tank through pressure relief valve (see Typical Metering Installation drawing). If required system pressure is less than 50 psi (3.5 bar) back pressure valve must be installed and set to produce minimum of 50 psi (3.5 bar) pressure at pump head.
2. Determine maximum pump speed required for all system conditions that need to be satisfied. Measure pump delivery at this maximum speed using system calibration cylinder, flow meter, or similar container. This is the "rated capacity" for pump.
3. Measure pump delivery at 100%, 75%, 50%, 25%, and 10% of maximum speed just determined. Let pump run for 5 minutes at each speed setting before taking capacity measurement.

P400 Maintenance

Note: The numbers in parentheses are Reference Numbers located in the Parts List exploded views of this manual.

Periodically

CAUTION: Do not turn the drive shaft while the oil reservoir is empty.

CAUTION: Do not leave contaminated oil in the pump housing or leave the housing empty. Remove contaminated oil as soon as discovered and replace with clean oil.

1. Check inlet pressure periodically with gauge.
2. Change oil according to hours guidelines in table.
3. Change oil as follows:
 - a. Remove brass cap (34), and allow oil and contaminants to drain completely. Catch oil and dispose of properly.
 - b. Use suitable Hydra-Oil for the application and pump components.

Pump Operation Hours Between Oil Changes at Various Process Fluid Temperatures

Pressure	<90°F (32°C)	<139°F (60°C)	<180°F (82°C)
Metallic Pump Head			
<650 psi (45 bar)	6,000	4,500	3,000
<1000 psi (70 bar)	4,000	3,000	2,000
Non-Metallic Pump Head			
<250 psi (17 bar)	4,000	3,000	—

Note: Minimum oil viscosity for proper hydraulic end lubrication is 16-20 cST (80-100 SSU). P-Series replacement parts kits (complete kits and diaphragm kits) include suitable oil for each P Series pump configuration.

CAUTION: If you are losing oil but don't see any external leakage, or if the oil becomes discolored and contaminated, the diaphragm (20) may be damaged. Refer to the Fluid End Service and Troubleshooting Sections. Do not operate the pump with a damaged diaphragm.

P400 Fluid End Service

Note: The reference numbers in parentheses are shown in the Fluid End Parts List.

This section explains how to disassemble and inspect all easily-serviceable parts of the pump fluid end.

Caution: Disassembly of the hydraulic end of the pump should be performed only by a qualified technician. For assistance, contact Wanner Engineering (612-332-5681) or the distributor in your area.

1. Remove Manifold (6), Valve Plate (16)

a. Remove six bolts (4) and six washers (5) around manifold (6). Do not remove bolt (25) or bolt (29) installed through back of cylinder housing (24).

b. Use 3/8-in. (10-mm) hex Allen wrench to remove center bolt (1) and washer (2).

CAUTION: Do not turn the pump drive shaft while the manifold and valve plate are off the pump, except when removing diaphragms or repriming the hydraulic cells.

c. Remove manifold (6), and support plate (42) [Non-metallic pump head only.] Valve plate (16) will remain on cylinder housing (24).

d. Inspect manifold (6) for warping or wear around inlet and outlet ports. If wear is excessive, replace the manifold.

To check if manifold is warped, remove O-rings (7,8,9) and place straightedge across it. If warped, replace.

2. Inspect Valves (10-15, 39)

The three inlet and three outlet valve assemblies are identical but face opposite directions. Inspect each valve as follows:

a. Check the spring retainer (15), and replace if worn.

Note: if your pump has a non-metallic pump head there will be a plastic dampening washer (39) at the bottom of each seat. Inspect each one for wear or cracks and replace if necessary.

b. Check valve spring (13). If shorter than new spring, replace (**Do not stretch old spring.**)

c. Check valve (12). If worn excessively, replace.

Note: If your pump has plastic spring retainers, there is a tetra seal (flat O-ring, 14) between retainer (15) and valve seat (11).

d. Remove valve seat (11) and O-ring (10). A seat puller is included in Wanner Tool Kit. On cast iron valve plates, be careful not to break metal ridge around O-ring groove. Inspect valve seat for wear, and replace if necessary. A new O-ring should be installed.

e. Reinstall the inlet and outlet valve assemblies:

- Clean valve ports and shoulders with emery cloth, and lubricate with lubricating gel or petroleum jelly.

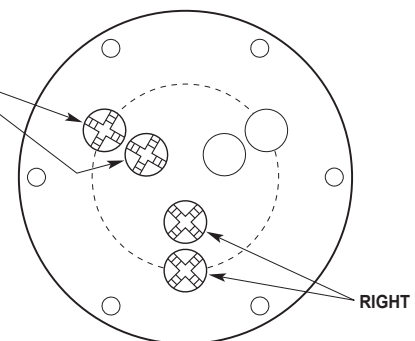
- Install O-ring (10) on valve seat (11).

- **Inlet Valves (3 center valves in illustration below).** Insert spring retainer (15) into valve plate (16). Then insert spring (13), valve (12), and valve seat (11). If pump has plastic spring retainers, install flat Tetra seal O-ring (14) between spring retainer and valve seat. Insert dampening washer (39), if included in your valve assembly.

- **Outlet Valves (3 outer valves in illustration below).** Insert dampening washer (39), if included in your valve assembly. Insert valve seat (11), valve (12), spring (13), and spring retainer (15). If the pump has **plastic** spring retainers, install flat Tetra seal O-ring (14) between spring retainer and valve seat. If the pump has **metal** spring retainers in outlet valves, position them so a leg does not point toward the center of the pump (See illustration below.)

Installing Valve Retainers in Valve Plate

WRONG: Retainer leg pointing toward center of pump.



W0020A

P400 Fluid End Service (Cont'd)

3. Inspect and Replace Diaphragms (20)

If necessary to service diaphragms, remove two socket-head cap screws (41) that secure valve plate (16) to cylinder casting (24). Inspect valve plate the same as manifold in Paragraph 1, step d.

- a. Lift diaphragm (20) by one edge, and turn pump shaft (**use the shaft rotator from the Wanner Tool Kit**) until diaphragm pulls up. This will expose machined cross-holes in plunger shaft behind diaphragm.
- b. Insert plunger holder (**from the Wanner Tool Kit**) through one of machined cross holes to hold diaphragm up. Don't remove tool until new diaphragm is installed in step f below.
- c. Remove the screw (17), O-ring (18), and follower (19) in center of diaphragm (20).
- d. Remove diaphragm (20), and inspect carefully. A damaged diaphragm generally indicates a pumping system problem. Replacing diaphragm only, will not solve the larger problem. Inspect diaphragm for following:
 - **Puncture.** Usually caused by sharp foreign object in fluid.
 - **Diaphragm pulled away** from center screw or from cylinder sides. Usually caused by fluid being frozen in pump, or by over-pressurization of pump.
 - **Diaphragm becoming stiff** and losing flexibility. Usually caused by pumping fluid that is incompatible with diaphragm material.
 - **Diaphragm edge chewed away.** Usually caused by over-pressurizing system.
- e. Inspect plunger (21) for any rough surfaces or edges. **Do not** remove plunger from plunger shaft. Smooth surfaces and edges as necessary with emery cloth or fine file.

CAUTION: If a diaphragm has ruptured and foreign material or water has entered the oil reservoir, do not operate the pump. Check all diaphragms, then flush the reservoir completely (as outlined below) and refill it with fresh oil. Never let the pump stand with foreign material or water in the reservoir, or with the reservoir empty.

- f. Install new diaphragm (20) (or old one, if not damaged), ridge side out.
- g. Clean screw (17) and remove any oil from it. Apply medium-strength thread locker to screw. Reinstall screw and follower (19), and new O-ring (18). Tighten to 18 in-lbs (2.0 N-m).
- h. Repeat above inspection procedure (and replacement, as necessary) with other two diaphragms.

4. Flush Contaminant from Hydraulic End

(only if a diaphragm has ruptured)

- a. Remove the brass cap (34) and allow all oil and contaminate to drain out.
- b. Fill reservoir with compatible solvent. Manually turn pump shaft to circulate compatible solvent and drain. Use the shaft rotator provided in Wanner Tool Kit (Part No. A03-175-1101). Dispose of contaminated fluid properly.

CAUTION: If you have an EPDM diaphragm, or if food grade oil is in the reservoir, do not use kerosene or solvents. Instead, flush with the same lubricant that is in the reservoir.
- c. Repeat step b. flushing procedure.
- d. Fill reservoir with fresh oil and manually turn pump shaft to circulate oil. Drain oil.

Note: P Series replacement parts kits (complete kits and diaphragm kits) include the correct oil for each specific P Series pump configuration.
- e. Refill reservoir with fresh oil. If oil appears milky, there is still contaminant in reservoir. Repeat steps c and d until oil appears clean.

P400 Fluid End Service (Cont'd)

5. Priming Hydraulic Cells

Note: Providing oil prime to fitted pumps requires pressure be applied to the diaphragms. This can be done manually, with the system head pressure, or with pressurized air if available. Review all methods below to determine the procedure most suitable.

Method 1 (system head pressure less than 2 psi)

- a. Install valve plate (16) but without the outlet valves installed (or else remove outlet valves; leave seats installed) onto cylinder housing (24). Tighten two socket-head screws (41).
- b. Fill reservoir with correct Hydra-oil to fill port.

Note: P Series replacement parts kits (complete kits and diaphragm kits) include the correct oil for each specific P Series pump configuration.

- c. With blunt pointer (eraser end of pencil), reach in through each outlet valve port and push diaphragm (20) backwards. Note air bubbles coming out at oil fill port. Now turn shaft about 1/2 turn.
- d. Repeat depressing diaphragms (20) and rotating shaft (approximately 4 to 6 times) until no more air bubbles escape and oil has dropped about 1 inch (25 mm) from top of fill port. Hydraulic cells are now primed. Replace oil fill cap (27) and O-ring (26).
- e. Install outlet valve assemblies in each outlet valve port. See Parts list for correct assembly order. If necessary, tip pump (head upward) to keep valve (12) centered on valve seat (11) and allow valve retainer (15) to fit into port flush.
- f. Install manifold (6) and complete installation.

Alternative Method 1 (system head pressure less than 2 psi)

- a. With pump horizontal, and the fluid-end head removed, fill reservoir with correct Hydra-oil to fill port.

Note: P Series replacement parts kits (complete kits and diaphragm kits) include the correct oil for each specific P Series pump configuration.

- b. Have catch basin for oil that leaks from behind diaphragms when priming. Catch oil and dispose of properly. **Do not reuse oil.**
- c. All air in oil within hydraulic piston behind diaphragms (20) must be forced out by turning shaft (and pumping piston). A shaft rotator is included in the Hydra-Cell Tool Kit. Keep pressure on diaphragms while turning shaft until bubble-free flow of oil comes from behind all diaphragms. Maintain oil level in reservoir. Do not allow oil level to be lower than reservoir.
- d. Before oil runs out past diaphragms (20), quickly attach loaded valve plate (16) with socket head screws (41). Do not tighten screws completely. Leave gap between valve plate and the cylinder housing (24). Turn shaft 2-3 turns to finish forcing out air behind diaphragms. Hydraulic cells are now primed. Finish tightening valve plate with two socket head screws (41) and add pump manifold (6).
- e. Wipe excess oil from around pump head.
- f. Check that oil level is 1 inch (25 mm) from top of fill port.
- g. Replace oil fill cap (27) and O-ring (26) and complete installation.

Method 2 (head pressure greater than 2 psi)

This simple and clean method of priming Hydra-cells requires an inlet head pressure of at least 5 feet (1.5 m) or 2 psi (.14 bar). The pressure source is required to hold the diaphragms back while the piston moves so as to force out the air.

- a. Completely assemble pump and fill reservoir with correct Hydra-oil to fill port.

Note: P Series replacement parts kits (complete kits and diaphragm kits) include the correct oil for each specific P Series pump configuration.

- b. **When tank head pressure is being used to prime**, install pump back into system and connect tank supply line to pump inlet. Pump discharge line may be connected at this time, but end of line must be open to allow air to pass out.
- c. Slowly turn pump shaft by hand and watch for bubbles exiting oil reservoir fill opening. This will take several rotations; when no more bubbles come out and reservoir level has dropped about 1" (25 mm), hydraulic cells are primed.
- d. Replace oil fill cap (27) and O-ring (26) and complete installation.
- e. **When compressed air is being used to prime**, insert clean air hose to pump inlet and restrict pump outlet. Turn shaft quarter turn and then apply air pressure into manifold to put pressure on diaphragms (20). This will force air out from inside pistons. Observe for bubbles at reservoir opening. Repeat for several rotations until no more air bubbles come out and reservoir level has dropped about 1" (25 mm). Hydraulic cells are now primed.
- f. Replace oil fill cap (27) and O-ring (26) and complete installation.

6. Reinstall Valve Plate (16), Manifold (6),

Note: Use the cap screw (29) protruding through the cylinder casting at the 10 o'clock position to locate the valve plate on the cylinder casting. Place the "blind hole" on the valve plate over this bolt.

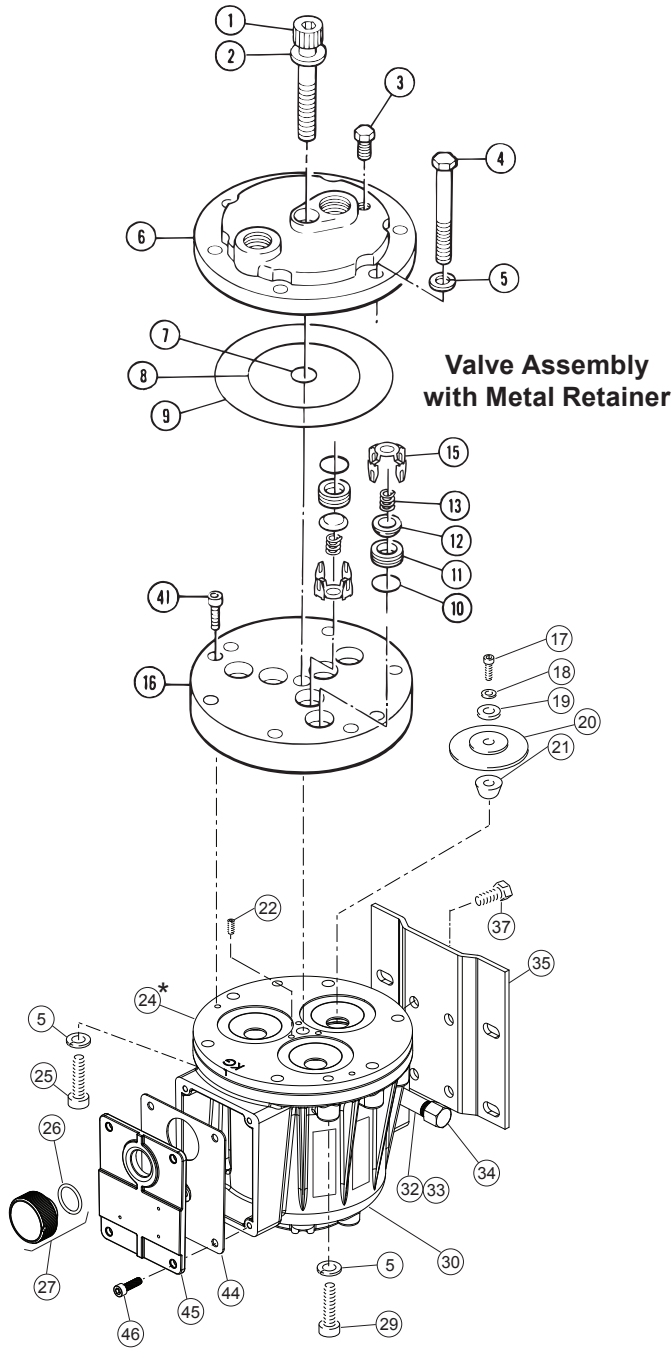
- a. With valve assemblies installed as outlined above, reinstall valve plate (16) onto cylinder housing (24). Recheck that blind hole is over protruding bolt at 10 o'clock position. Install two socket-head cap screws (41) and secure valve plate to cylinder casting.
- b. Reinstall O-rings (7,8,9) on rear side of the manifold (6). Use a compatible petroleum jelly or lubricating gel to hold them in place.
- c. Reinstall manifold (6) onto valve plate (16). Be sure drain plug (3) is installed in manifold.

Note: on pumps with non-metallic head, position support plate (42) onto manifold with ports and bolt holes aligned correctly.

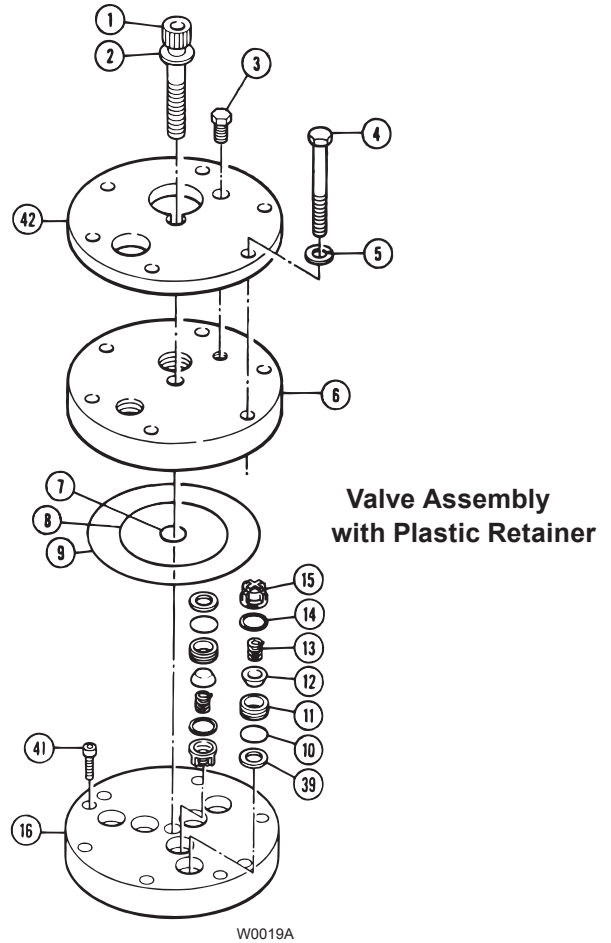
- d. Insert bolts (4) and washers (5). Hand tighten.
- e. Reinstall center bolt (1) with washer (2), and torque to 45 ft-lbs (60 N-m).
- f. Alternately tighten six perimeter bolts (4). Torque to 45 ft-lbs (60 N-m).
- g. Recheck all bolts for tightness.

P400 Fluid End Parts

**P400 with
Metallic Pump Head**



**P400 with
Non-Metallic Pump Head**



* Cylinder Housing Assembly includes: cylinder housing (24), bearing adjusting plate (61), O-ring (60), and set screws (22).

Ref No.	Part Number	Description	Quantity/ Pump
1	G10-081-2012	Screw, Cap, soc-hd, 70 mm, SST*	1
	G10-081-2020	Screw, Cap, soc-hd, 102 mm, SST**	1
2	G10-084-1010	Washer, Flat, SST	1
3	D10-038-2017	Plug, Hastelloy C , NPT	1
	D10-038-2210	Plug, Brass*	1
	D10-038-2211	Plug, 316 SST, NPT	1
	G10-038-2017	Plug, Hastelloy C, BSPT	1
	G10-038-2211	Plug, 316 SST, BSPT	1
4	G10-024-2020	Screw, Cap, soc-hd, 75 mm, SST*	6
	G25-024-2019	Screw, Cap, soc-hd, 120 mm, SST**	6
5	G25-048-2012	Washer, Split lock, SST	8

P400 Fluid End Parts List

Ref	No. Part Number	Description	Quantity/ Pump
6	D10-004-1002	Manifold, 316 SST, NPT*	1
	D10-004-1008	Manifold, Brass, NPT*	1
	D10-004-1017	Manifold, Hastelloy C, NPT*	1
	D10-004-1034	Manifold, Cast iron, NPT*	1
	D10-004-1050	Manifold, Polypropylene, NPT**	1
	D10-004-1053	Manifold, PVDF, NPT**	1
	G10-004-1002	Manifold, 316 SST, BSPT*	1
	G10-004-1008	Manifold, Brass, BSPT*	1
	G10-004-1017	Manifold, Hastelloy C, BSPT*	1
	G10-004-1034	Manifold, Cast iron, BSPT*	1
7	D10-083-2110	O-ring, Center bolt, Buna-N	1
	D10-083-2111	O-ring, Center bolt, FKM	1
	D10-083-2112	O-ring, Center bolt, Neoprene	1
	D10-083-2113	O-ring, Center bolt, EPDM	1
	D10-083-2118	O-ring, Center bolt, PTFE*	1
	8	D10-073-2118	O-ring, Inner manifold, PTFE
D11-073-2120		O-ring, Inner manifold, Buna-N	1
D11-073-2121		O-ring, Inner manifold, FKM	1
D11-073-2122		O-ring, Inner manifold, EPDM	1
D11-073-2123		O-ring, Inner manifold, Neoprene	1
9	D10-074-2118	O-ring, Outer manifold, PTFE*	1
	D10-109-2110	O-ring, Outer manifold, Buna-N**	1
	D10-109-2111	O-ring, Outer manifold, FKM**	1
	D10-109-2112	O-ring, Outer manifold, Neoprene**	1
	D10-109-2113	O-ring, Outer manifold, EPDM**	1
	D10-109-2118	O-ring, Outer manifold, PTFE**	1
	D11-074-2120	O-ring, Outer manifold, Buna-N*	1
	D11-074-2121	O-ring, Outer manifold, FKM*	1
	D11-074-2122	O-ring, Outer manifold, Neoprene*	1
D11-074-2123	O-ring, Outer manifold, EPDM*	1	
10	D10-035-2110	O-ring, Valve seat, Buna-N	6
	D10-035-2111	O-ring, Valve seat, FKM	6
	D10-035-2112	O-ring, Valve seat, Neoprene	6
	D10-035-2113	O-ring, Valve seat, EPDM	6
	D10-035-2118	O-ring, Valve seat, PTFE*	6
11	D10-020-1011	Valve seat, 316 SST	6
	D10-020-1016	Valve seat, Tungsten carbide	6
	D10-020-1017	Valve seat, Hastelloy C	6
	D10-020-3300	Valve seat, Ceramic	6
12	D10-021-1011	Valve, Nitronic	6
	D10-021-1016	Valve, Tungsten carbide	6
	D10-021-1017	Valve, Hastelloy C	6
	D10-021-3300	Valve, Ceramic	6
13	D10-022-3117	Valve Spring, Elgiloy	6
	D10-022-3123	Valve Spring, Hastelloy C	6
14	D10-092-2110	Tetra Seal, Buna-N	6
	D10-092-2111	Tetra Seal, FKM	6
	D10-092-2112	Tetra Seal, Neoprene	6
	D10-092-2113	Tetra Seal, EPDM	6
	D10-092-2118	Tetra Seal, PTFE*	6

Ref	No. Part Number	Description	Quantity/ Pump
15	D10-023-1017	Retainer, Valve spring, Hastelloy C*	6
	D10-023-2327	Retainer, Valve spring, Polypropylene	6
	D10-023-2328	Retainer, Valve spring, PVDF	6
16	D10-003-1032	Valve Plate, Brass*	1
	D10-003-1033	Valve Plate, 316, SST*	1
	D10-003-1036	Valve Plate, Cast iron*	1
	D10-003-1037	Valve Plate, Hastelloy C*	1
	D10-003-1060	Valve Plate, Polypropylene**	1
	D10-003-1063	Valve Plate, PVDF**	1
17	D10-030-2010	Screw, Flat-hd, SST	3
	D10-030-2011	Screw, Flat-hd, Hastelloy C	3
18	D10-047-2110	O-ring, Follower, Buna-N	3
	D10-047-2111	O-ring, Follower, FKM	3
	D10-047-2112	O-ring, Follower, Neoprene	3
	D10-047-2113	O-ring, Follower, EPDM	3
	D10-047-2118	O-ring, Follower, PTFE*	3
19	D10-017-1010	Follower, 316, SST	3
	D10-017-1011	Follower, Hastelloy C	3
20	D10-018-2312	Diaphragm, Neoprene	3
	D10-018-2313	Diaphragm, EPDM	3
	D10-018-2315	Diaphragm, FKM XT	3
	D10-018-2318	Diaphragm, PTFE*	3
	D10-018-2320	Diaphragm, Buna-N	3
	D10-018-2325	Diaphragm, Aflas	3
21	D10-016-1010	Plunger	3
22	D10-082-2010	Set Screw, 3/8 in.	3
	G10-082-2010	Set Screw, M6 x 11 x 10 mm	3
24	K10-002-1220	Cylinder Housing Assembly (1)	1
	K10-002-1242	Loaded Cylinder Housing, FKM (2)	1
	K10-002-1243	Loaded Cylinder Housing, EPDM (2)	1
	K10-002-1244	Loaded Cylinder Housing, Buna-N (2)	1
	K10-002-1245	Loaded Cylinder Housing, FXM-XT (2)	1
	K10-002-1246	Loaded Cylinder Housing, PTFE (2)	1
	K10-002-1020	Cylinder Housing, Metric	1
25	G10-089-2012	Screw, Cap, hex-hd, 38 mm, SST	1
26	D03-080-2110	O-ring, Buna-N	1
27	D03-039-1030	Cap with O-ring, Oil fill	1
29	G10-087-2012	Screw, Cap, soc-hd, 45 mm", SST	1
30	G10-001-1258	Pump Housing Assembly	1
31	G10-001-1158	Pump Housing, Metric	1
32	D10-076-2250	Plug, Soc-hd, 1/4"	2
33	D10-077-2250	Nipple, Brass, 1/4"	1
34	D10-078-2250	Cap, Brass, 1/4"	1

* For use with Metallic Pump Head models only.

** For use with Non-Metallic Pump Head models only.

(1) A Cylinder Housing Assembly includes: cylinder housing (24), bearing adjusting plate (61), O-ring (60), and set screws (22).

(2) A Loaded Cylinder Housing includes items: 17, 18, 19, 20, 22, 24, 50, 51, 53, 54, 55, 56, 57, 59, and 60.

P400 Fluid End Parts List (Cont'd)

Ref No.	Part Number	Description	Quantity/ Pump
35	D10-025-1010	Base	1
37	G10-029-2010	Screw, Cap, hex-hd, 25 mm.....	4
39	D10-125-2327	Washer, Dampening, Polypropylene**	.6
	D10-125-2328	Washer, Dampening, PVDF**	6
41	G10-088-2010	Screw, Cap, soc-hd, 30 mm.....	2
44	G10-106-2350	Gasket, Cover	1
45	G10-105-1050	Cover/Nameplate	1
46	G03-088-2010	Screw, 20 mm.....	4

** For use with Non-Metallic Pump Head models only.

P400 Hydraulic End Parts List

Ref No.	Part Number	Description	Quantity/ Pump
50	D10-019-3110	Spring, Piston return	3
51	K10-042-1010	Retainer, Spring	3
52	C23-009-2110	O-ring, Valve cylinder, Buna-N	3
53	K10-045-3110	Spring, Sleeve valve	3
54	K10-044-1010	Valve Spool	3
55	K10-043-1010	Cylinder, Valve	3
56	D10-034-2110	O-ring, Buna-N.....	3
57	D10-041-1010	Washer, Ball retainer.....	3
58	D10-015-3010	Ball	12
59	D10-014-1209	Piston with foot and retainer	3
	K10-014-1210	Piston Assembly (1)	1
60	D25-035-2110	O-ring, Bearing adjusting plate, Buna-N ..	1
61	D10-012-1010	Bearing Adjusting Plate.....	1

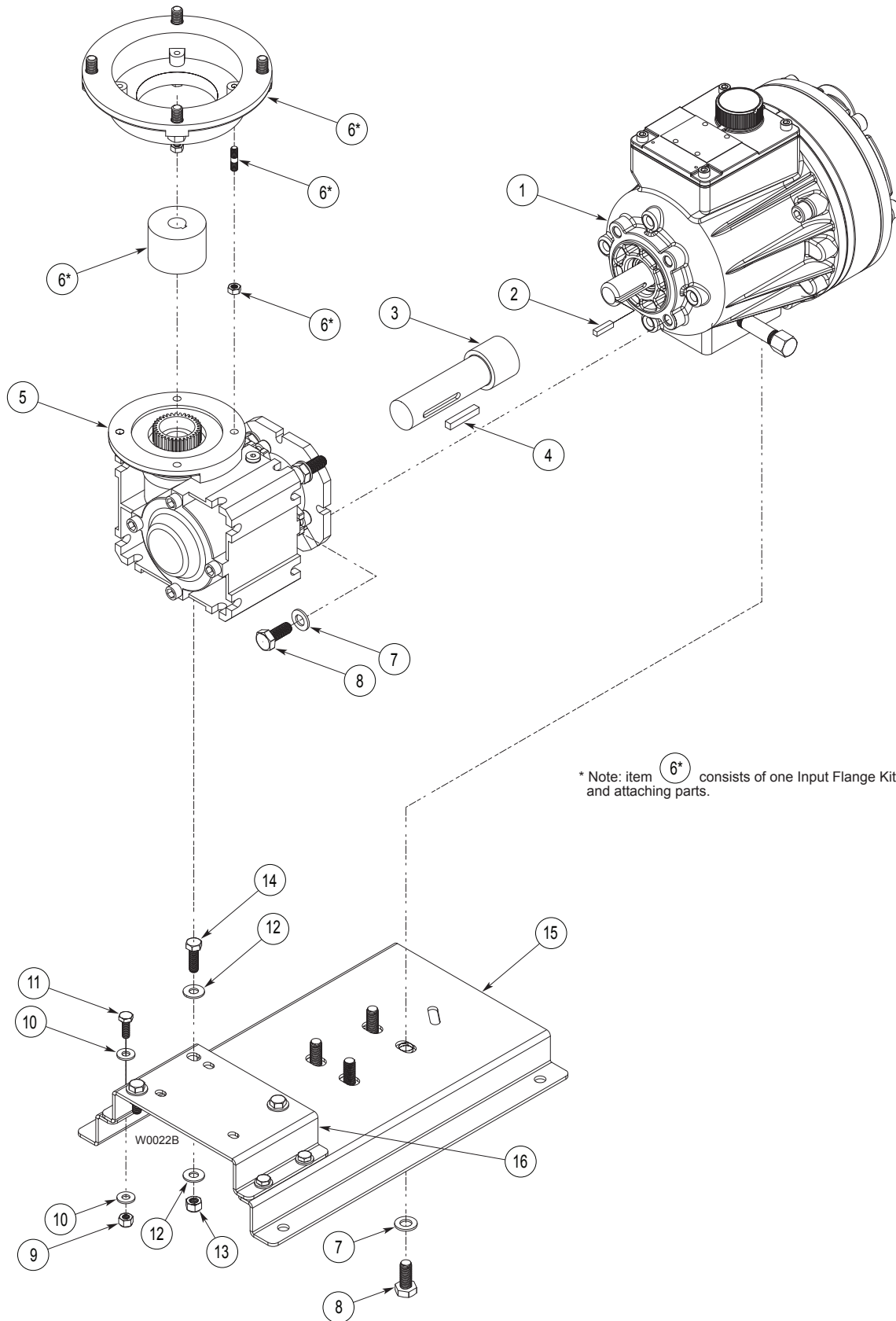
(1) Piston Assembly includes cylinder, foot, valve plunger, O-rings, spring retainer, and springs (50-59).

Ref No.	Part Number	Description	Quantity/ Pump
62	D10-007-1210	(X) Cam Assembly, 8 gpm @ 1450 rpm	1
63	D10-085-2210	Key, Shaft.....	1
64	D10-031-2110	Seal , Buna-N.....	2
65	D10-037-2110	O-ring, Pump housing, Buna-N.....	1

Hydraulic End Service

CAUTION: Disassembly of the hydraulic end of the pump should be performed only by a qualified technician. For assistance, contact Wanner Engineering (612-332-5681) or the distributor in your area.

P400 Reducer Parts



* Note: item 6* consists of one Input Flange Kit and attaching parts.

P400 Reducer Parts List

Ref No.	Part Number	Description	Quantity/ Pump
1	P4-M-PUMP	P400 Pump Assembly, BSPT	
	P4-N-PUMP	P400 Pump Assembly, NPT	
2	112-044	Key, 3/16" x 3/16" x 0.8 in.....	1
3	112-581-01	Shaft, P300/P400.....	1
4	D25-085-2210	Key, 1/4" SQ x 1.40 in. lg.....	1
5	112-414	Reducer, 60:1 ratio	1
	112-415	Reducer, 50:1 ratio	1
	112-416	Reducer, 40:1 ratio	1
	112-417	Reducer, 30:1 ratio	1
	112-418	Reducer, 25:1 ratio	1
	112-419	Reducer, 20:1 ratio	1
	112-420	Reducer, 15:1 ratio	1
	112-421	Reducer, 10:1 ratio	1
	112-422	Reducer, 7.5:1 ratio	1
	112-423	Reducer, 5:1 ratio	1
	6	- Adapters for use with Pump M -	
112-558		Input Flange Kit, IEC 63 B5.....	1
112-559		Input Flange Kit, IEC 71 B5.....	1
112-560		Input Flange Kit, IEC 80 B5.....	1
112-563		Input Flange Kit, IEC 90 B5	1
- Adapters for use with Pump N -			
112-555	Input Flange Kit, NEMA 56C.....	1	
112-556	Input Flange Kit, NEMA 143/145TC....	1	
7	112-526	Washer, Flat, M10, SST	8
8	G25-029-2011	Screw, M10 x 1.5 x 25 mm, SST	8
9	100-063	Locknut, 1/4-20, SST	4
10	100-663	Washer, Flat, 1/4, SST	8
11	100-062	Screw, 1/4-20 UNC-2A x .75 HHCS, SST...8	
12	100-915	Washer, Flat, 5/16 special.....	6
13	100-938	Locknut, 5/16-18.....	3
14	100-948	Screw, 5/16-18 x 1.00 HHCS	3
15	112-016	Baseplate, Pump	1
	112-012	Baseplate, Pump, SST	1
16	112-017	Baseplate, Gearbox	1
	112-013	Baseplate, Gearbox, SST	1

P400 Troubleshooting

Problem	Probable Cause	Solution
Motor/Pump Does Not Operate:	No power.	Supply correct power according to motor requirements.
	Blown fuse/tripped circuit breaker.	Replace/reset, eliminate circuit overload.
	Shaft coupling to pump not in place.	Install proper coupling hardware (see parts list).
	Current overload - motor.	Motor not rated for pump operating conditions - install proper motor.
	Thermal overload - motor.	Motor not rated for pump and/or ambient operating conditions - supply cooling or install proper motor.
	Faulty motor drive/controller.	Repair/replace.
	Faulty motor.	Repair/replace.
	Low liquid level in supply tank (if low-level shut-off is used).	Fill tank.
No Delivery	Supply tank empty.	Fill tank.
	Loss of prime	Re-prime using Initial Start-Up Procedure.
	Inlet line or strainer clogged.	Clear debris and flush, or replace.
	Inadequate supply pressure at pump inlet.	Increase supply pressure by raising fluid level in tank, raising tank, or pressurizing suction tank.
	Inlet line too restrictive.	Increase inlet line diameter and/or decrease inlet line length.
	Fluid viscosity too high.	Reduce viscosity if possible (by heat or some other means). Increase inlet line diameter and/or decrease inlet line length. Increase supply pressure.
	Vapor lock/cavitation.	Increase inlet pressure. Decrease fluid temperature.
	Pump valves held open or worn out.	Clear debris and flush, or replace (see Fluid End Service)
	System relief valve actuating.	Adjust relief valve, or repair, clean, or replace with new relief valve.
Delivery Too Low and/or Erratic	Review all Probable Causes and Solutions in Problem 2 No Delivery above.	
	Air leak(s) in inlet line.	Locate all leaks and repair.
	System back pressure too low.	Adjust back pressure valve to higher setting. Install back pressure valve if none in system.
	Pumped fluid characteristics changed.	Monitor supply tank temperature to determine if fluid is too hot (leading to cavitation) or too cold (increasing fluid viscosity). Stabilize temperature at suitable level to resolve problem. Check for entrapped air in the fluid supply system.
	Inlet supply pressure changed.	Monitor inlet supply pressure (at the pump) to determine if it is too low, causing a starved condition/cavitation. Stabilize pressure at suitable level to resolve problem.
	Pump OK - Calibration system or flow meter error.	Evaluate components and repair/correct problem(s).
	Oil condition in pump hydraulic end changed.	Check oil level - if low evaluate for source of leakage. Consult factory for hydraulic end service.
		Change oil per recommended guidelines in maintenance section.
Delivery Too High and/or Erratic.	System back pressure too low.	Adjust back pressure valve to higher setting. Install back pressure valve if none in system.
	Inlet supply pressure changed.	Monitor inlet supply pressure (at the pump) to determine if it is too high, causing a "flow-through" condition. Stabilize pressure at suitable level to resolve problem.
	Pump OK - Calibration system or flow meter error.	Evaluate components and repair/correct problem(s).

P400 Replacement Parts Kits

TO ORDER REPLACEMENT PARTS KIT: A Replacement Parts Kit contains 9 digits corresponding to customer-specified design options.

1	2	3	4	5	6	7	8	9
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Digit	Order Code	Description
1-2	P4	Pump Configuration For all P400 Pumps
3	K	Kit Designator Complete Fluid End Kit*
	D	Diaphragm Kit*
	V	Valve Kit (diaphragm not included)
4-5	52	Pump Head Version Metallic Pump Head
	55	Non-Metallic Pump Head
6	B	Spring Retainers/Dampening Washers For Brass (Hastelloy C)
	C	For Cast Iron pump head
	M	For PVDF pump head
	P	For Polypropylene pump head
	R	For 316L SST ANSI Flange pump head
	S	For 316L SST pump head
	T	For Hastelloy® C pump head
	X	Not included in Diaphragm Kit
7	A	Diaphragm & O-ring Material Aflas (Synthetic Oil)
	E	EPDM
	G	FKM
	S	FKM (Food Contact Oil)
	X	FKM (Synthetic Oil)
	J	PTFE (Food Contact Oil)
	W	PTFE (Synthetic Oil)
	P	Neoprene
	R	Neoprene (Food Contact Oil)
	Z	Neoprene (Synthetic Oil)
	T	Buna-N
	F	Buna-N (Food Contact Oil)
	Y	Buna-N (Synthetic Oil)
8-9	SS	Check Valve Material (Spring / Valve & Seat / Valve) 316 SST / 316 SST / Nitronic 50
	TT	Hastelloy® C / Hastelloy® C / Hastelloy® C
	SC	316 SST / Ceramic / Ceramic
	TC	Hastelloy® C / Ceramic / Ceramic
	SD	Elgiloy / Tungsten Carbide /Tungsten Carbide
	TD	Hastelloy® C / Tungsten Carbide /Tungsten Carbide
	XX	Not included in Diaphragm Kit

* Includes Hydraulic End Oil

P400 Tool Kit

The P400 Tool Kit (Part No. A03-175-1101) contains the tools listed below. These tools are used to assist in the repair and maintenance of the P400. See the maintenance sections of this manual for specific application.

Ref. P400 No.	Tool Part No.	Tool Description	Quantity/Kit
1	A03-125-1010	Holder, Plunger.....	1

Ref. P400 No.	Tool Part No.	Tool Description	Quantity/Kit
2	A03-195-1200	Rotator	1
3	A03-162-1200	Lifter, Plunger guide	1
4	A03-124-1200	Lever Assembly	1
5	A03-118-1000	Seat Puller, D/G10	1
6	A03-157-1000	Seal Protector, D/G10	1
7	A03-126-1500	Tool Box	1
8	A03-159-1200	Insertor/Rotator	1

Metallic Pump Head

Kit Contents

Part Number*	Description	Qty	Kit Designator		
			K	D	V
D10-018-___	Diaphragm	3	•	•	
D10-047-___	O-ring, follower	3	•	•	
D10-074-___	O-ring, outer manifold	1	•	•	•
D10-073-___	O-ring, inner manifold	1	•	•	•
D10-083-___	O-ring, center bolt	1	•	•	•
D10-035-___	O-ring, valve seat	6	•		•
D10-020-___	Valve seat	6	•		•
D10-021-___	Valve	6	•		•
D10-022-___	Valve spring	6	•		•
D10-023-___	Retainer, valve spring	6	•		•
A01-113-3400	Thread locker	1	•		•
	Hydraulic End Oil (1.5 qt)		•		•

* Last four digits of part numbers with ___ refer to specific material of construction.

Non-Metallic Pump Head

Kit Contents

Part Number*	Description	Qty	Kit Designator		
			K	D	V
D10-018-___	Diaphragm	3	•	•	
D10-047-___	O-ring, follower	3	•	•	
D10-109-___	O-ring, outer manifold	1	•	•	•
D10-073-___	O-ring, inner manifold	1	•	•	•
D10-083-___	O-ring, center bolt	1	•	•	•
D10-035-___	O-ring, valve seat	6	•		•
D10-020-___	Valve seat	6	•		•
D10-021-___	Valve	6	•		•
D10-022-___	Valve spring	6	•		•
D10-092-___	Tetra seal	6	•		•
D10-023-___	Retainer, valve spring	6	•		•
D10-125-___	Washer, dampening	6	•		•
A01-113-3400	Thread locker	1	•		•
	Hydraulic End Oil (1.5 qt)		•		•

* Last four digits of part numbers with ___ refer to specific material of construction.

P400 Warranty

Limited Warranty

Wanner Engineering, Inc. extends to the original purchaser of equipment manufactured by it and bearing its name, a limited one-year warranty from the date of purchase against defects in material or workmanship, provided that the equipment is installed and operated in accordance with the recommendations and instructions of Wanner Engineering, Inc. Wanner Engineering, Inc. will repair or replace, at its option, defective parts without charge if such parts are returned with transportation charges prepaid to Wanner Engineering, Inc., 1204 Chestnut Avenue, Minneapolis, Minnesota 55403.

This warranty does not cover:

1. The electric motors (if any), which are covered by the separate warranties of the manufacturers of these components.
2. Normal wear and/or damage caused by or related to abrasion, corrosion, abuse, negligence, accident, faulty installation or tampering in a manner which impairs normal operation.
3. Transportation costs.

This limited warranty is exclusive, and is in lieu of any other warranties (express or implied) including warranty of merchantability or warranty of fitness for a particular purpose and of any non-contractual liabilities including product liabilities based on negligence or strict liability. Every form of liability for direct, special, incidental or consequential damages or loss is expressly excluded and denied.



World Headquarters & Manufacturing

Wanner Engineering, Inc
1204 Chestnut Avenue,
Minneapolis, MN 55403 USA
Phone: 612-332-5681 • Fax: 612-332-6937
Toll-Free Fax (USA): 800-332-6812
Email: sales@wannereng.com
www.Hydra-Cell.com

207 US Highway 281
Wichita Falls, TX 76310 USA
Phone: 940-322-7111
Toll-Free Fax: 800-234-1384
Email: sales@wannereng.com
www.Hydra-Cell.com

Latin American Office

São Paulo, Brazil
Phone: +55 (11) 4081-7098
Email: sales@wannereng.com
www.Hydra-Cell.com



Wanner International Ltd
Hampshire - United Kingdom
Phone: +44 (0) 1252 816847
Email: sales@wannerint.com
www.Hydra-Cell.eu



Wanner Pumps Ltd.
Kowloon - Hong Kong
Phone: +852 3428 6534
Email: sales@wannerpumps.com
www.WannerPumps.com

Shanghai - China
Phone: +86-21-6876 3700
Email: sales@wannerpumps.com
www.WannerPumps.com