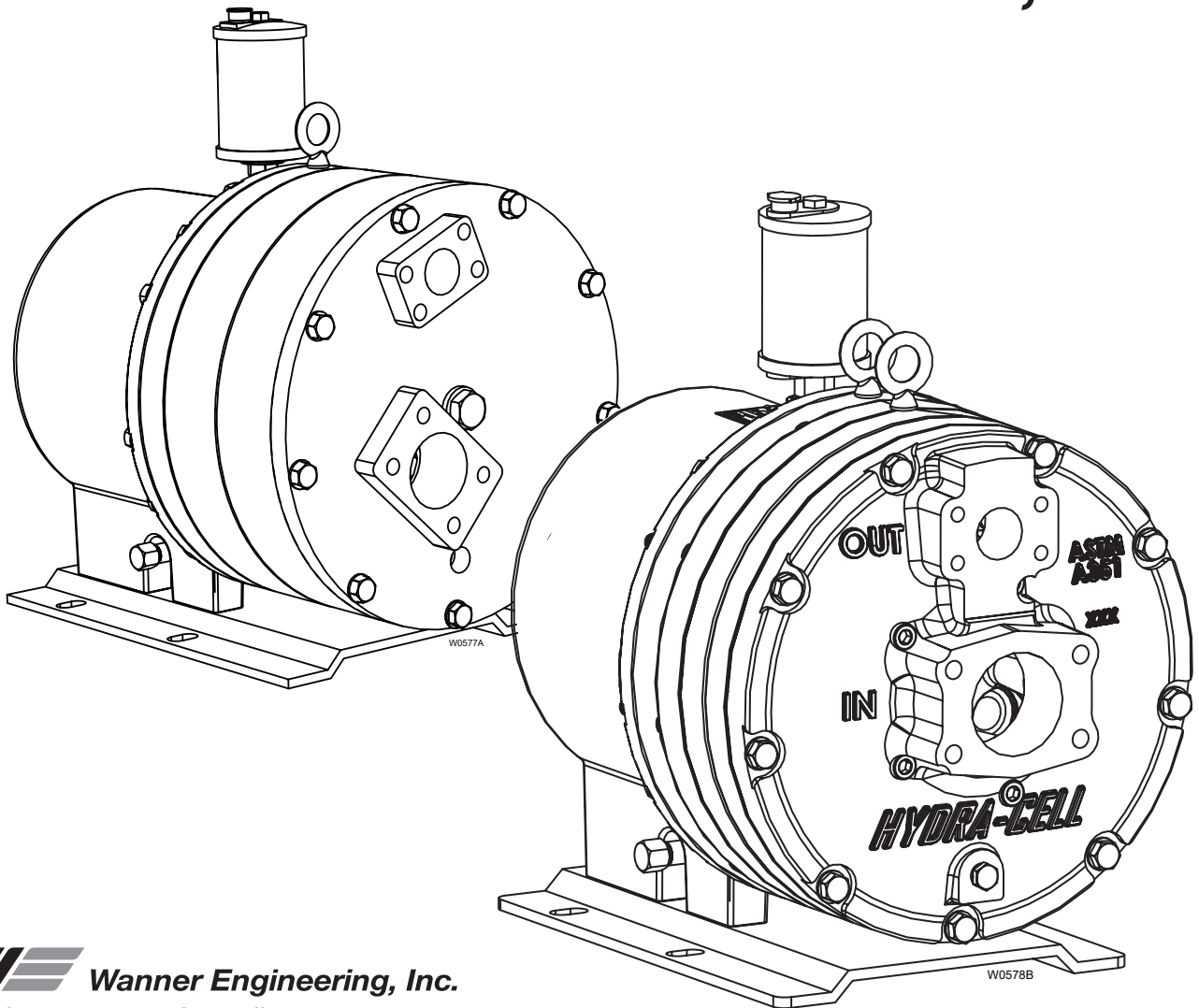


Installation, Operation & Maintenance
D66-991-2400 Rev G

Hydra-Cell[®]

Seal-less Pumps

Models: D66, G66



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D/G-66 Specifications

Maximum Flow Rate	65.7 gpm (248.7 l/min)
Maximum Pressure	Metallic: 700 psi (48 bar) Non-Metallic: 250 psi (17 bar)

Flow Capacities @ 200 psi (14 bar)			
Model	rpm	gpm	l/min
Metallic	1000	67.8	256

Flow Capacities @ 250 psi (17 bar)			
Model	rpm	gpm	l/min
Non-Metallic	1000	67.5	255

Flow Capacities @ 700 psi (48 bar)			
Model	rpm	gpm	l/min
Metallic	1000	65.7	248

Delivery @ 200 psi (14 bar)		
Model	gal/rev	liters/rev
Metallic	0.0678	0.256

Delivery @ 250 psi (17 bar)		
Model	gal/rev	liters/rev
Non-Metallic	0.0675	0.255

Delivery @ 700 psi (48 bar)		
Model	gal/rev	liters/rev
Metallic	0.0657	0.248

Maximum Discharge Pressure	
Metallic Heads:	700 psi (48 bar)
Non-Metallic Heads:	250 psi (17 bar)

Maximum Inlet Pressure	
Metallic:	250 psi (17 bar)
Non-Metallic:	50 psi (3.5 bar)

Maximum Operating Temperature	
Metallic Heads:	200°F (93°C) - consult factory for correct component selection for temperatures from 160°F (71°C) to 200°F (93°C)
Non-Metallic Heads:	120°F (49°C) - consult factory for temperatures above 120°F (49°C)

Maximum Solids Size	800 microns
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Inlet Port	
Metallic Heads:	
D66:	3 inch NPT or 3 inch SAE J518 Flange
G66:	3 inch BSPT
Non-Metallic Heads:	
	2-1/2 inch SAE J518 Flange

Discharge Port	
Metallic Heads:	
D66:	1-1/2 inch NPT or 1-1/2 inch SAE J518 Flange
G66:	1-1/2 inch BSPT
Non-Metallic Heads:	
	1-1/2 inch SAE J518 Flange

Shaft Diameter	2 inches (50.8 mm)
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Shaft Rotation	Reverse (bi-directional)
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Bearings	Tapered roller bearings
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Oil Capacity	8 US quarts (7.5 liters)
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Weight	Metallic Heads: 500 lbs (226 kg) Non-Metallic Heads: 295 lbs (133 kg)
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Calculating Required Power

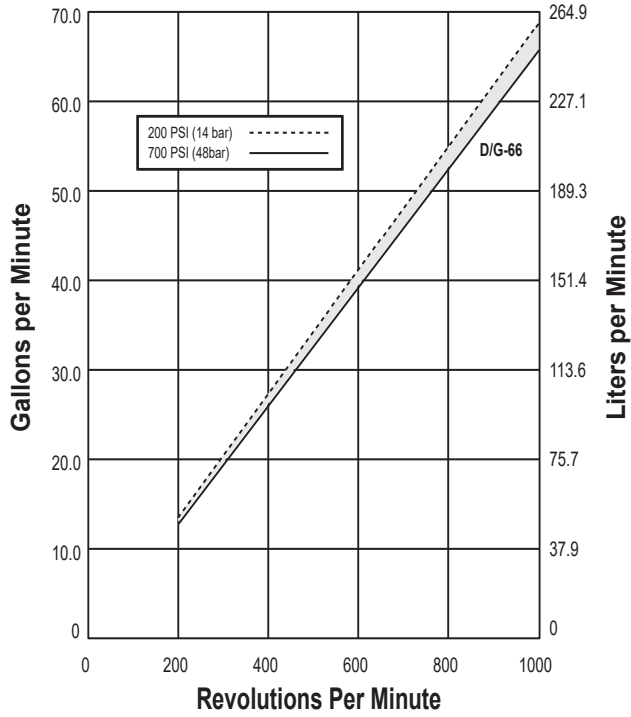
$$\frac{100 \times \text{rpm}}{63,000} + \frac{\text{gpm} \times \text{psi}}{1,460} = \text{electric motor hp}$$

$$\frac{100 \times \text{rpm}}{84,428} + \frac{\text{l/min} \times \text{bar}}{511} = \text{electric motor kW}$$

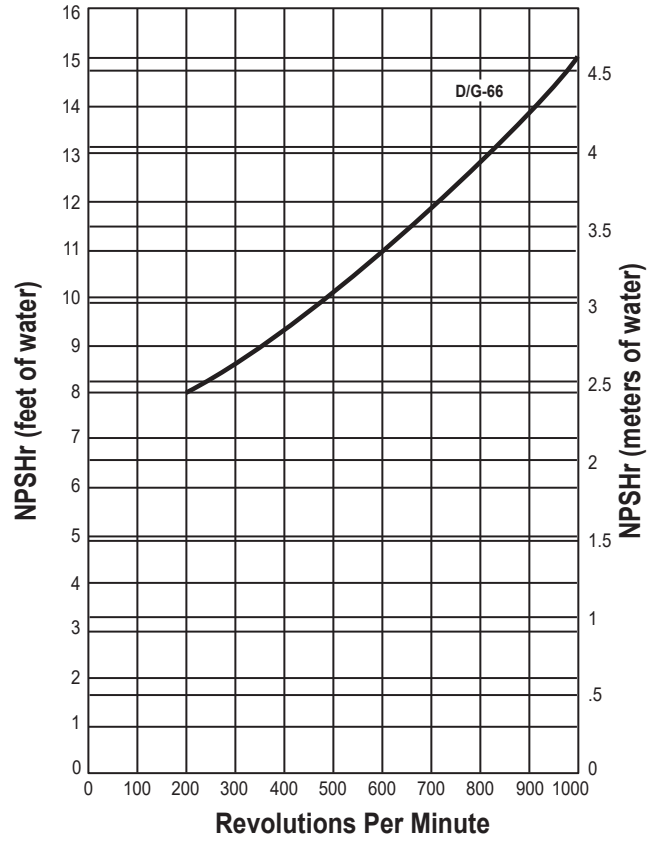
When using a variable frequency drive (VFD) controller calculate the hp or kW at minimum and maximum pump speed to ensure the correct hp or kW motor is selected. Note that motor manufacturers typically de-rate the service factor to 1.0 when operating with a VFD.

D/G-66 Specifications

Performance



Net Positive Suction Head – NPSHr



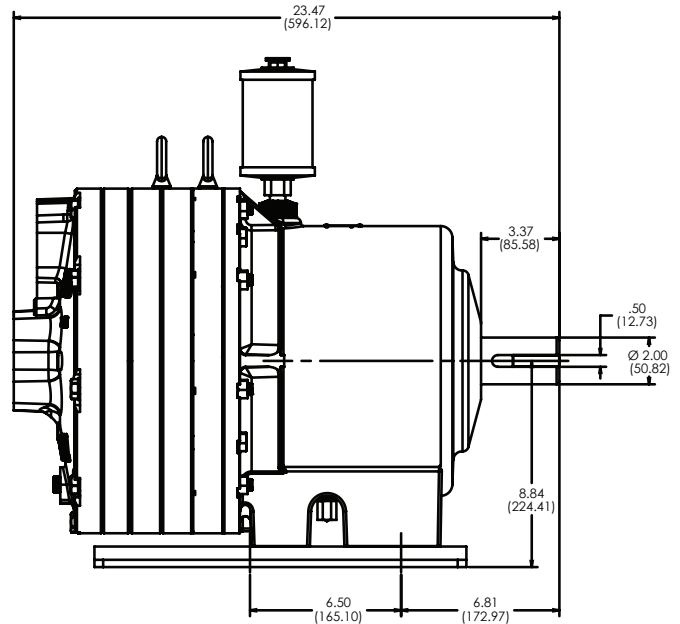
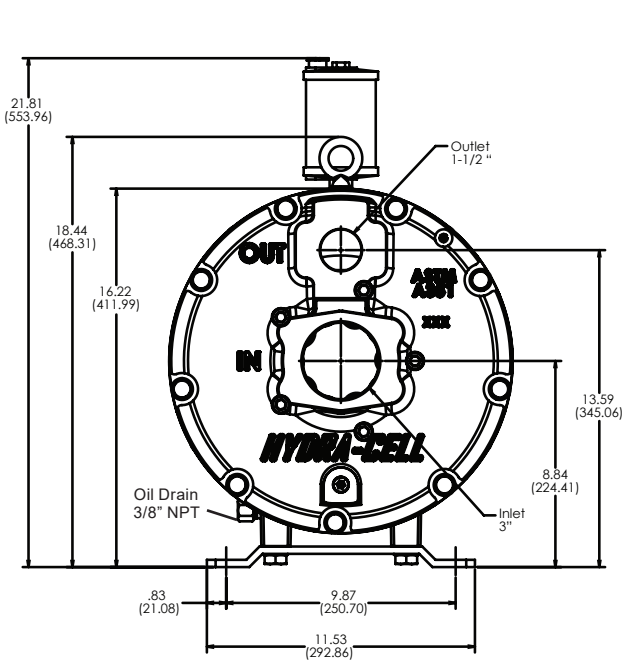
D/G-66 Representative Drawings

Models with Metallic Pump Head Inches (mm) (NPT, BSPT, and SAE)

Brass

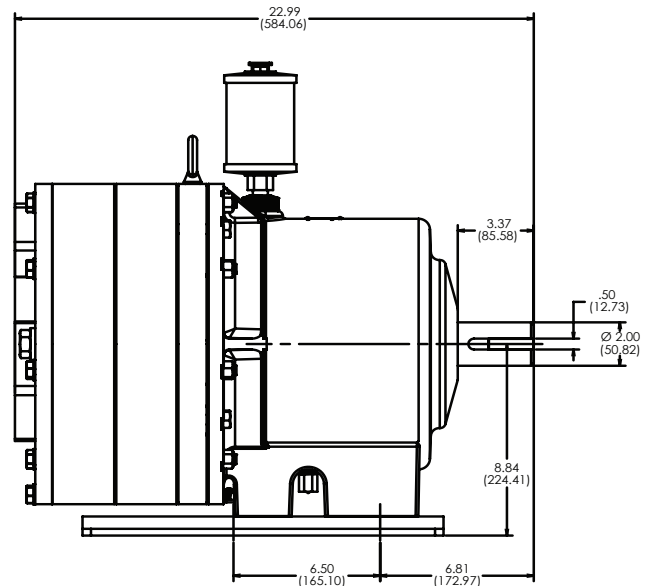
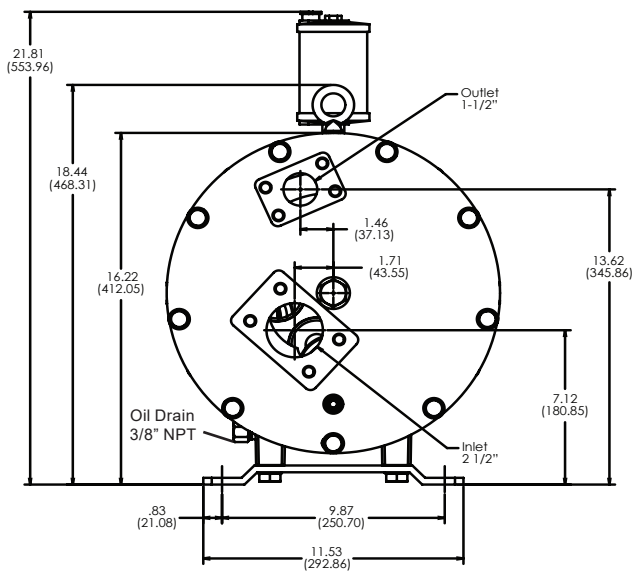
Ductile Iron

316 Stainless Steel



Models with Non-Metallic Pump Head Inches (mm) (SAE)

Polypropylene



D/G-66 Installation

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 either lifting it manually or by selecting appropriate lifting equipment.

D/G-66 Installation

Equipment 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". A suitable and calibrated pressure gauge should be installed in the discharge line close to the pump head.

Safety Guards. Install adequate safety guards over all pulleys, belts, and couplings. 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 discharge pressure regulator, or in the regulator bypass line.

Freezing Conditions. Protect the pump from freezing. See also the Maintenance Section.

Working Pump. The pump body will become hot during operation even if the liquid being pumped is cold.

Consult the Factory for the following situations:

- Extreme temperature applications – above 160° F (71°C) or below 40° F (4.4°C)
- Pressure feeding of pumps
- Viscous or abrasive fluid applications
- Chemical compatibility problems
- Hot ambient temperatures – above 110° F (43°C)
- Conditions where pump oil may exceed 200° F (93°C) because of a combination of hot ambient temperatures, hot fluid temperature, and full horsepower load — an oil cooler may be required

Location

Locate the pump as close to the supply source as possible. Install it in a lighted clean space where it will be easy to inspect and maintain. Allow room for checking the oil level, changing the oil, and removing the pump head (manifold, valve plate and related items).

Mounting

The pump shaft can rotate in either direction. To prevent vibration, mount the pump and motor securely on a level rigid base.

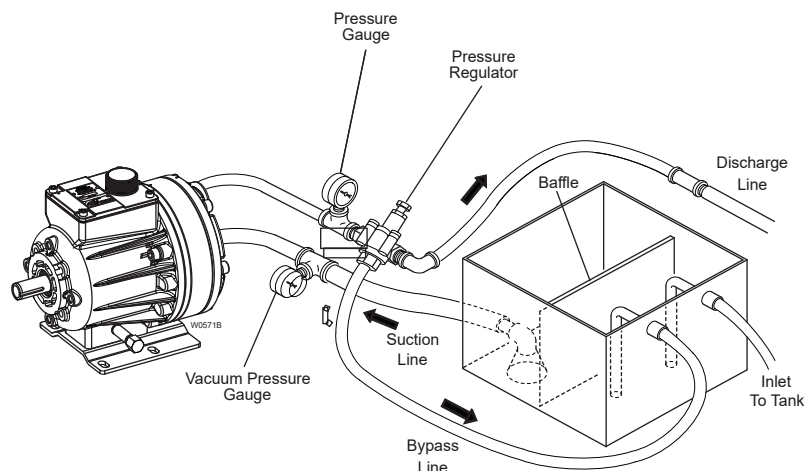
On a belt-drive system, align the sheaves accurately; poor alignment wastes horsepower and shortens the belt and bearing life. Make sure the belts are properly tightened as specified by the belt manufacturer.

On a direct-drive system, align the shafts accurately. Unless otherwise specified by the coupling manufacturer, maximum parallel misalignment should not exceed 0.015 in. (0.4 mm) and angular misalignment should be held to 1° maximum. Careful alignment extends life of the coupling, pump, shafts, and support bearings. Consult coupling manufacturer for exact alignment tolerances.

Drive couplings, belts and pulleys must be of suitable design, correctly sized, fitted, and rated for the maximum load required.

On a close-coupled system, coat the motor shaft liberally with anti-seize.

The pump, motor and related components must be adequately grounded.



D/G-66 Installation

Inlet Piping (Suction Feed)

CAUTION: When pumping at temperatures above 160° F (71°C), attention must be paid to the vapor pressure curve of the liquid. A pressure-feed system may be required.

Do not supply more than one pump from the same inlet line.

Install drain cocks at any low points of the suction line, to permit draining in freezing conditions.

Provide for permanent or temporary installation of a vacuum gauge to monitor the inlet suction. To maintain maximum flow, insure the system NPSHa exceeds the NPSHr of the pump.

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.

Isolate the pump and motor stand from the supply tank and support them separately.

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

Install the inlet and bypass lines so they empty into the supply tank below the lowest water level on the opposite side of the baffle from the pump suction line.

Do not use a line strainer or filter in the suction line unless regular maintenance is assured. If a line strainer is used in the system, install it in the inlet line to the supply tank. It should have a free-flow area of at least three times the free-flow area of the inlet.

To reduce aeration and turbulence, install a completely submerged baffle plate to separate the incoming and outgoing liquids.

Install a vortex breaker in the supply tank, over the outlet port to the pump.

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

Hose and Routing

Size the suction line at least one size larger than the pump inlet, and so that the velocity will not exceed 1-3 ft/sec (0.3 to 0.9 m/s):

For pipe in mm: Velocity (m/sec) = 21.2 x LPM/Pipe ID²

For pipe in inches: Velocity (ft/sec) = 0.408 x GPM/Pipe ID²

Keep the suction line as short and direct as possible. A maximum of 1m (3 feet) is recommended.

Use flexible hose and/or expansion joints to absorb vibration, expansion, or contraction.

If possible, keep the suction line level. Do not have any high points to collect vapor unless these high points are vented.

To reduce turbulence and resistance, do not use 90° elbows. If turns are necessary in the suction line, use 45° elbows or arrange sweeping curves in the flexible inlet hose.

If a block valve is used, be sure it is fully opened so that the flow to the pump is not restricted. The opening should be at least the same diameter as the inlet plumbing ID.

Install piping supports where necessary to relieve strain on the inlet line and to minimize vibration.

Inlet Piping (Pressure Feed)

Provide for permanent or temporary installation of a vacuum/pressure gauge to monitor the inlet vacuum or pressure. Pressure at the pump inlet should not exceed 250 psi (17 bar); if it does get higher, install an inlet pressure reducing regulator. Do not supply more than one pump from the same inlet line.

Inlet Calculations

Acceleration Head

Calculating the Acceleration Head

Use the following formula to calculate acceleration head losses. Subtract this figure from the NPSHa, and compare the result to the NPSHr of the Hydra-Cell pump.

$$Ha = (L \times V \times N \times C) \div (K \times G)$$

where:

Ha = Acceleration head (ft of liquid)

L = Actual length of suction line (ft) — not equivalent length

V = Velocity of liquid in suction line (ft/sec)

$$\text{or } V = \text{GPM} \left(\frac{0.408}{\text{Pipe ID}^2} \right)$$

N = RPM of crank shaft

C = Constant determined by type of pump — Use 0.066 for D/G03, M03, M23, G13, D/G10, D/G04 and H/G25 pumps. Use 0.04 for D/G15, D/G35, and D/G-66 pumps. Use 0.628 for F/G20/21/22 pumps.

K = Constant to compensate for compressibility of the fluid — use: 1.4 for de-aerated or hot water; 1.5 for most liquids; 2.5 for hydrocarbons with high compressibility

G = Gravitational constant (32.2 ft/sec²)

D/G-66 Installation

Friction Losses

Calculating Friction Losses in Suction Piping

When following the above recommendations (under “Inlet Piping”) for minimum hose/pipe I.D. and maximum length, frictional losses in the suction piping are negligible (i.e., $H_f = 0$) if you are pumping a water-like fluid.

When pumping more viscous fluids such as lubricating oils, sealants, adhesives, syrups, varnishes, etc., frictional losses in the suction piping may become significant. As H_f increases, the available NPSH (NPSHa) will decrease, and cavitation will occur.

In general, frictional losses increase with increasing viscosity, increasing suction line length, increasing pump flow rate, and decreasing suction line diameter. Changes in suction line diameter have the greatest impact on frictional losses: a 25% increase in suction line diameter cuts losses by more than two times, and a 50% increase cuts losses by a factor of five times.

Consult the factory before pumping viscous fluids.

Minimizing Acceleration Head and Frictional Losses

To minimize the acceleration head and frictional losses:

- Keep inlet lines less than 1 m (3 ft) long.
- Use inlet hose at least one size larger than the size of the inlet port of the pump.
- Use flexible, non-collapsible suction hose and/or expansion joints to absorb vibrations, expansions and contractions.
- Minimize fittings (elbows, valves, tees, etc.)
- **Use a suction stabilizer on the inlet.**

Net Positive Suction Head

NPSHa must be equal to or greater than NPSHr. If not, the pressure in the pump inlet will be lower than the vapor pressure of the fluid—and cavitation will occur.

Calculating the NPSHa

Use the following formula to calculate the NPSHa:

$$NPSHa = P_t + H_z - H_f - H_a - P_{vp}$$

where:

P_t = Atmospheric pressure

H_z = Vertical distance from surface liquid to pump center line (if liquid is below pump center line, the H_z is negative)

H_f = Friction losses in suction piping

H_a = Acceleration head at pump suction

P_{vp} = Absolute vapor pressure of liquid at pumping temperature

Notes:

- In good practice, NPSHa should be 2 ft (0.6 m) greater than NPSHr.
- All values must be expressed in feet of liquid.

Atmospheric Pressure at Various Altitudes

Altitude (ft)	Pressure (ft of H ₂ O)	Altitude (ft)	Pressure (ft of H ₂ O)
0	33.9	1500	32.1
500	33.3	2000	31.5
1000	32.8	5000	28.2

Discharge Piping

Note: Consult the Factory before manifolding two or more pumps together.

Hose and Routing

Use shortest, most-direct route for discharge line.

Select pipe or hose with **working pressure** rating of at least 1.5 times maximum system pressure. EXAMPLE: Select a 1500 psi W. P.-rated hose for systems to be operated at 1000 psi gauge pressure.

Use about 6 ft (1.8 m) of flexible hose between pump and rigid piping to absorb vibration, expansion or contraction.

Support pump and piping independently. Size discharge line so that velocity of fluid will not exceed 2-3 m/sec (8-10 ft/sec):

For pipe in mm: Velocity (m/sec) = $21.2 \times \text{LPM}/\text{Pipe ID}^2$

For pipe in inches: Velocity (ft/sec)

$$\text{or } V = 0.408 \left(\frac{\text{GPM}}{\text{Pipe ID}^2} \right)$$

Note: Pumps with a non-metallic pumping head are limited to 250 psi (17 bar) maximum working pressure rating.

Pressure Regulation

Install pressure regulator or unloader in discharge line. Bypass pressure must not exceed pressure limit of pump.

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

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

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

Route the bypass line to the supply tank, not to the suction line (to reduce the chance of turbulence and cavitation within the pump).

If the pump may be run for a long time with the discharge closed and fluid bypassing, install a thermal protector in the bypass line (to prevent severe temperature buildup in the bypassed fluid).

The safety pressure regulating valve must be checked for correct operation on a regular basis.

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 pressure gauge to monitor discharge pressure at pump.

For additional system protection install safety relief valve in discharge line downstream from pressure regulator.

D/G-66 Installation

Before Initial Start-Up

Before you start the pump, be sure that:

- All shut-off valves are open, and pump has adequate supply of fluid.
- All connections are tight.
- There is oil in the oil reservoir bottle. Cold oil level should be less than one inch. The oil level will drop when the pump is started as the oil fills behind the diaphragms but will gradually rise as the oil warms to operating temperature. Overfilling with cold oil can cause overflow of the oil bottle as the oil warms during operation.
- The relief valve on the pump outlet is adjusted so the pump starts under minimum pressure.
- All pulleys and belts are properly aligned, and belts are tensioned according to specification.
- All pulleys and belts have adequate safety guards.
- Ensure that the materials of construction of the pump are compatible with the liquid being pumped.

Initial Start-Up Procedure

1. Turn on power to pump motor.
2. Check inlet pressure or vacuum. To maintain maximum flow, inlet vacuum must not exceed 180 mm Hg at 21°C (7 in. Hg at 70° F). Inlet pressure must not exceed 250 psi (17 bar).
3. Listen for any erratic noise and look for unsteady flow.
4. If system has airlock and pump fails to prime:
 - a. Turn off power.
 - b. Remove pressure gauge or plug from tee fitting at pump outlet (refer to illustration drawing at the front of this section).

Note: Fluid may come out of this port when the plug is removed. Provide an adequate catch basin for fluid spillage, if required. Fluid will come out of this port when the pump is started, so we recommend that you attach adequate plumbing from this port so fluid will not be sprayed or lost. Use high-pressure rated hose and fittings from this port. Take all safety precautions to assure safe handling of the fluid being pumped.
 - c. Jog system on and off until fluid coming from this port is air-free.
 - d. Turn off power.
 - e. Remove plumbing that was temporarily installed, and reinstall pressure gauge or plug.
5. Adjust discharge pressure regulator to desired operating and bypass pressures. Do not exceed maximum pressure rating of pump.
6. After pressure regulator is adjusted, set safety relief valve at 100 psi (7 bar) higher than desired operating pressure. To verify this setting, adjust discharge pressure regulator upward until relief valve opens. Follow recommendations in **Step 4b Note** for handling fluid that will come from relief valve.
7. Reset discharge pressure regulator to desired system pressure.
8. Provide return line from relief valve to supply tank, similar to bypass line from pressure regulator, never back to suction line.

D/G-66 Maintenance

Note: The numbers in parentheses are the Reference Numbers on the exploded view illustrations found in this manual and in the Parts Section.

Daily

Check oil level and condition of oil. The oil is at the correct level for the model of pump;

D/G-66 - ¼ in. (6mm) above the cast surface in the upper oil reservoir. Use the appropriate Hydra-Oil for the application (contact Wanner Engineering if in doubt).

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

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

Periodically

Change the oil after the first 100 hours of operation, and then according to the guidelines below.

Hours Between Oil Changes @ Various Process Fluid Temperatures

Pressure	RPM	<90°F (32°C)	<139°F (60°C)	<180°F (82°C)
Metallic Pump Head				
<500 psi (35 bar)	<600	6,000	4,500	3,000
	<1000	4,000	3,000	2,000
<700 psi (48 bar)	<600	4,000	3,000	2,000
	<1000	2,000	1,500	1,000
Non-Metallic Pump Head				
<250 psi (17 bar)	<600	4,000	3,000	—
	<1000	2,000	1,500	—

Note: Minimum oil viscosity for proper hydraulic end lubrication is 16-20 cST (80-100 SSU).

Note: Use of an oil cooler is recommended when process fluid and/or hydraulic end oil exceeds 180°F (82°C) for Metallic Pump Head models or when hydraulic end oil exceeds 180°F (82°C) for Non-Metallic Pump Head models.

When changing, remove the drain plug cap (34) at the bottom of the pump so all oil and accumulated sediment will drain out.

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

Check the inlet pressure or vacuum periodically with a gauge. If vacuum at the pump inlet exceeds 7 in. Hg (180 mm Hg), check the inlet piping system for blockages. If the pump inlet is located above the supply tank, check the fluid supply level and replenish if too low.

CAUTION: Protect the pump from freezing. Refer also to the "Shutdown Procedure".

D/G-66 Maintenance

Shutdown Procedure During Freezing Temperatures

Take all safety precautions to assure safe handling of the fluid being pumped. Provide adequate catch basins for fluid drainage and use appropriate plumbing from drain ports, etc., when flushing the pump and system with a compatible antifreeze.

1. Adjust discharge pressure regulating valve so pump runs under minimum pressure. Stop pump.
2. Drain supply tank; open any draincocks in system piping and collect drainage; remove plug (1) from manifold and collect drainage.
3. Close draincocks in system piping and replace manifold plug.
4. Fill supply tank with enough antifreeze to fill system piping and pump.

Note: Disconnect the system return line from the supply tank and connect it to a separate reservoir.

5. Start pump and allow it to run until system is filled with antifreeze.

Note: If the system has an air lock and the pump fails to prime, follow step 4 of the Initial Start-up Procedure to clear the air.

6. When mostly antifreeze is flowing from system return line, stop pump. Connect system return line back to supply tank and circulate antifreeze for short period.
7. It is also good practice to change oil in hydraulic end before storage for an extended period. This will remove any accumulated condensation and sediment from oil reservoir. Drain and refill hydraulic end with appropriate Hydra-Oil and operate pump for short period to assure smooth performance.

Service (Fluid End)

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.

CAUTION: Do not remove the four HHCS (34) that go through the back of the pump housing (35) and thread into the cylinder housing (25), unless you are repairing the hydraulic end of the pump.

Tools and Supplies

The following tools and supplies are recommended for servicing the fluid end of the pump:

- Wanner D66/G66 Tool Kit, P/N A03-191-1100
- 3/4-in box end wrench
- 3/4-in, and 1 1/8-in (non-metallic only) hex socket
- 7/32-in, 3/8-in, and 5/8-in (non-metallic only) hex bit socket
- Large and small flat head screw drivers
- Mallet
- O-ring Pick
- Small Plyers
- Required Torque Wrenches: 12 ft-lbs (16 N-m), 65 ft-lbs (88 N-m), 90 ft-lbs (122 N-m, metallic only), 180 ft-lbs (244 N-m, metallic only), 150 ft-lbs (203 N-m non-metallic only), and 20 ft-lbs (27 N-m, metallic only).
- New Hydra oil
- Lubricating gel
- Fine emery cloth

The following additional supplies are recommended for servicing the hydraulic end of the pump:

- 17-mm hex socket or box-end wrench
- Grease
- Anaerobic seal sealant

D/G-66 Service (Fluid End)

1. Remove Manifold (4) and Valve Plate (8)

- a. All Head Materials: Using 3/4-in hex socket and 3/4-in box end wrench remove nine HHCS (2), eight hex nuts (33) and seventeen washers (3) around manifold (4) and pump housing (35). Do not remove four HHCS (34) that are installed through back of pump housing (35).
- b. Metallic Head: Using 3/8-in hex bit socket remove the five SHCS (37) around the manifold inlet.
- c. Non-Metallic Head: Using 1 1/8-in hex socket remove the one HHCS center bolt (5) from the manifold center.

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

- d. Remove manifold (4) and support plate (43, used on non-metallic pump only).
- e. Inspect manifold for warping or wear around inlet and outlet ports. If wear is excessive, replace manifold. To check for warped manifold, remove O-rings and place straightedge across it. If warped replace.
- f. Metallic Head: Using 3/8-in hex bit socket remove nine SHCS (7) from valve plate. Using 5/8-in hex bit socket remove the one SHCS (5) from valve plate center.
- g. Non-Metallic Head: Using 3/8-in hex bit socket remove four SHCS (7) from valve plate.
- h. Inspect valve plate (8) for warping as in step e for manifold. If warped replace.

NOTE: Plastic valve plates and manifolds should also be inspected for cracks and replaced as necessary.

2. Inspect Valve Assemblies (parts 9-16)

NOTE: The five inlet and five outlet valve assemblies in the pump are identical (but face in opposite directions).

Inspect each valve assembly as follows:

- a. Remove the five inlet valve assemblies using the valve puller tool supplied in the Wanner Tool Kit. Be careful not to break the metal ridge around O-ring groove.
- b. Remove tetra seal, O-ring (13), between valve retainer (9) and valve seat (15) using a flat head screwdriver.
- c. Insert flat head screw driver in the gap created by the removal of O-ring (13). Using the screw driver pop apart the valve retainer (9) and valve seat (15). Collect the remaining parts of the five valve assemblies (9-16) for inspection.
- d. With pliers grip one discharge retainer (9) leg and firmly pull away from the valve plate. Remove five discharge retainers (9) from the discharge valve assemblies.
- e. Once valve retainers are removed collect valve spring washer (10), valve spring (11), valve disc (12), O-ring (13) for inspection. **Caution springs are under slight load. Parts may fall out of valve during disassembly.**
- f. Remove five discharge valve seats (15) using the valve puller tool supplied in the Wanner Tool Kit. Be careful not to break metal ridge around O-ring groove.
- g. Check 10 valve springs (11). If shorter than new spring, replace. (Don't stretch old spring.)
- h. Check 10 valve poppets (12). If worn, replace. Inspect valve seats (15) for wear. If worn, replace and install new O-ring (14).
- i. Place retainer (9) with the small side down. Put the parts back into the retainer in the following order. Valve spring washer (10), valve spring (11), valve poppet (12), valve seat (15). Press the valve retainer and poppet to snap the valve assembly back together.
- j. Grease up tetra seal O-ring (13), and push into the gap between the valve retainer (9) and valve seat (15). Make sure tetra seal is fully installed.
- k. Reinstall valve assemblies:
 - Clean valve ports and valve shoulders with emery cloth, and grease with lubricating gel or petroleum jelly.
 - **Inlet (5 center valves).** Insert inlet valve assembly into valve plate (8) retainer (9) side first. Use a dead blow mallet to tap the valves back into the valve plate until they bottom out. Grease and place the dampening washer (16) on top of the valve seat (15).
 - **Outlet (5 outer valves).** Grease and place the dampening washer (16) on bottom of the discharge valve bores in the valve plate (8). Place valve assembly on the discharge ports of the valve plate (8), valve seat toward the valve plate. Place 1 3/4-in hex socket or 2" schedule 40 pipe onto legs of the valve retainer. Tap the tool until the valve retainer bottoms out.

D/G-66 Service (Fluid End)

3. Inspect and Replace Diaphragms (20)

- a. Lift diaphragm (20) by one edge and turn pump shaft until diaphragm pulls up. This will expose machined cross holes in valve plunger shaft behind diaphragm.
- b. Insert 1/8-in Allen wrench or diaphragm tool through one of cross holes to hold diaphragm up. (The proper size diaphragm tool is included in the Wanner Tool Kit.)
- c. With a 7/32-in hex bit socket remove FHCS (17). Make sure to hold Allen wrench/diaphragm tool to prevent diaphragm rotation. Next remove follower (19), and O-ring (18) in center of diaphragm.
- d. Remove diaphragm and inspect carefully.

NOTE: A ruptured diaphragm indicates a pumping system problem, and replacing only the diaphragm will not solve the larger problem.

Inspect diaphragm (20) for following:

- **Half-moon marks.** Usually caused by cavitation of pump (See Troubleshooting section).
 - **Concentric circular marks.** Usually caused by cavitation of pump (See Troubleshooting section).
 - **Small puncture.** Usually caused by sharp foreign object in fluid, or by ice particle.
 - **Diaphragm pulled away** from center screw or from cylinder sides. Usually caused by fluid being frozen in pump, or by overpressurization of pump.
 - **Diaphragm stiff and inflexible.** Usually caused by pumping fluid incompatible with diaphragm material, or diaphragm operated at temperatures below rated capability.
 - **Diaphragm edge chewed away.** Usually caused by overpressurizing system.
- e. Inspect plunger (21) for any rough surfaces or edges. Do not remove plunger from valve plunger (61). 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. Reinstall O-ring (18) into center of follower (19). Insert follower (19) back into the diaphragm (20). Use new diaphragm (20) or reuse old diaphragm (if good).
 - g. Clean FHCS (17) including any oil and old thread locker. Apply activator and medium-strength thread locker to screw.
 - h. Clean valve plunger (61) female threads. Apply medium strength thread-locker to female threads.
 - i. Reinstall diaphragm (20), follower (19), O-ring (18) and FHCS (17) into valve plunger (61). Tighten FHCS to 144 in.-lbs (16 N-m). **Warning do not overtighten as this can cause damage to valve plunger (61).**
 - j. Repeat steps a. thru i. for all five diaphragms (20).

4. Flush Contaminant from Hydraulic End (use if diaphragm has ruptured)

- a. Remove oil drain cap (24) and allow all oil and contaminants to drain out. Replace oil drain cap.
- b. Remove oil reservoir (30) and fill reservoir with kerosene or solvent, manually turn pump shaft to circulate kerosene, and drain.

CAUTION: If you have EPDM diaphragms, or if food grade oil is in the reservoir, do not use kerosene or solvents. Instead, flush with the same lubricant used in the reservoir. Pumps with EPDM diaphragms have an "E" as the 7th digit of the Model No.
- c. Repeat step b.
- d. Fill reservoir with fresh oil, manually turn pump shaft to circulate oil, and drain once again.
- e. Refill reservoir. If oil appears milky, there is still contaminant in reservoir. Repeat flushing procedure until oil appears clean.
- f. Replace oil reservoir (30).

D/G-66 Service (Fluid End)

5. Prime Hydraulic Cells on Kel-Cell Pumps

Method #1 (with system head pressure less than 2 psi)

- With pump horizontal, and fluid-end head removed, remove reservoir (30) and fill reservoir with correct Hydra-oil. Have catch basin for oil leaks from behind diaphragms when priming. Catch oil and dispose of properly. **Do not reuse.**
- Force air out of oil in hydraulic cell (behind diaphragms) by turning shaft and pumping piston. (A shaft rotator is included in the Wanner Tool Kit.) Keep pressure on diaphragms while turning shaft until bubble-free flow of oil comes from behind all diaphragms. Watch oil level in reservoir. If oil gets too low during priming, air will be drawn into pistons (inside hydraulic end) and cause pump to run rough.
- Quickly attach assembled valve plate (8) (before oil runs out past diaphragms) with center bolt socket head screw (5) for metallic head, or four SHCS (7) for non-metallic head. Do not tighten screw completely. Leave gap between valve plate and cylinder housing (25). Turn shaft 2-3 turns to force out any remaining air behind diaphragms. Hydraulic cells are now primed.
- Metallic Head: Using 5/8-in hex bit socket hand tighten SHCS Center Bolt (5). Using 3/8-in hex bit socket hand tighten nine SHCS (7).
- Non-Metallic Head: Using 3/8-in hex bit socket hand tighten four SHCS (7).
- Wipe off excess oil from around pump head.
- Check that oil level is 1 inch (25 mm) from top of fill port.
- Replace reservoir (30) and complete installation.

Method #2 (with system head pressure greater than 2 psi)

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

- Completely assemble pump.
- Remove reservoir (30) and fill reservoir with correct Hydra-oil to top of fill port.
When tank head pressure is being used to prime, use the following steps:
- Install pump in system and connect tank supply line to pump inlet. Connect pump discharge line. Leave end of line open to allow air to pass out.
- Slowly turn pump shaft by hand and watch for bubbles at 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.
- Replace reservoir (30) and complete installation.

When compressed air is being used to prime, use the following steps:

- Insert clean air hose to pump inlet and restrict pump outlet. Turn shaft quarter turn and apply air pressure into manifold to put pressure on diaphragms. Note air 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.
- Replace reservoir (30) and complete installation.

6. Reinstall Valve Plate (8), and Manifold (4)

- Install valve assemblies in valve plate (8) as outlined in paragraph 2, step k.
- Metallic Head: Using 5/8-in hex bit socket hand tighten, then torque, SHCS Center Bolt (5) to 180 ft-lbs (244 N-m). Using 3/8-in hex bit socket hand tighten, then torque, nine SHCS (7) to 65 ft-lbs (88 N-m).
- Non-Metallic Head: Using 3/8-in hex bit socket hand tighten, then torque, four SHCS (7) to 20 ft-lbs (27 N-m).
Warning do not overtighten as this can cause damage to the valve plate.
- Metallic Head: Reinstall ten O-rings (36) between valve plate (8) and manifold (4). Use petroleum jelly or lubricating gel to hold them in place.
- Non-Metallic Head: Reinstall three O-rings (36, 37, 38) between valve plate and manifold. Use petroleum jelly or lubricating gel to hold them in place.
- Reinstall manifold (4) onto valve plate (8). Be sure drain plug (1) is at bottom of manifold. If pumping head is non-metallic, support plate (43) is also used.
- Metallic Head: Insert all nine bolts (2), seventeen washers (3), and eight nuts (33) around edge of manifold. Using 3/4-in hex socket and 3/4-in box-end wrench hand tighten, then torque nine HHCS to 90 ft-lbs (122 N-m). Install all five SHCS (37). Using 3/8-in hex bit socket, hand tighten, then torque five SHCS to 65 ft-lbs (88 N-m).
- Non-Metallic Head: Insert all nine bolts (2), seventeen washers (3), and eight nuts (33) around edge of manifold. Using 3/4-in hex socket and 3/4-in box-end wrench hand tighten, then torque nine HHCS to 65 ft-lbs (88 N-m). Install one HHCS (5). Using 1-1/4 inch socket, hand tighten, then torque to 150 ft-lbs (203 N-m).
Warning do not overtighten as this can cause damage to pump head.

D/G-66 Service (Hydraulic End)

NOTE: The numbers in parentheses are the Reference Numbers on the exploded view illustrations found in the Parts Section.

Caution: Do not disassemble the hydraulic end of the pump unless you are a skilled mechanic. For assistance, contact Wanner Engineering (TEL 612-332-5681 or FAX 612-332-6937) or the distributor in your area.

Caution: The four socket head cap screws (34) that screw through the back of the pump housing (35) into the cylinder housing (25) hold these parts together. Do not remove these four screws except when repairing the hydraulic end.

NOTE: The following service procedures refer several times to the Wanner D/G-66 Tool Kit. We strongly urge you not to try to repair the hydraulic end of the pump without using the tools in this kit (available from Wanner or your local distributor). Refer also to the list of tools and supplies in the Fluid-End Service Section.

1. Remove Pump Housing

- Remove manifold (4), valve plate (8), and diaphragms (20), from pump housing (35). Refer to Fluid-End Service Section.
- Drain oil from pump housing by removing drain plug (24). Dispose of oil properly.
- Check shaft assembly (51) for sharp burrs. Smooth any burrs, to prevent scarring seals (54) when removing shaft assembly.
- Reinsert two cap screws (2) through pump housing (35) and cylinder housing (25) from shaft assembly end (at 10 and 2 o'clock positions) to support parts as pump is being disassembled. Install shaft rotator (from D/G-66 Tool Kit) over shaft assembly. Push shaft rotator on all the way, so front of shaft rotator touches pump housing. Tighten shaft rotator set screw into keyway. This keeps shaft assembly (51) attached to pump housing (35) when cylinder housing (25) is removed.
- Insert three assembly studs from the (from D/G-66 Tool Kit), (equally spaced) through pump housing flange (35) and cylinder housing (25). Tighten nuts to within 3/4 in. (17 mm) from cylinder housing.
NOTE: The assembly studs will catch the cylinder housing as it is unbolted and allow the cylinder housing to be removed slowly under spring tension.
- Remove four cap screws (34) from cylinder housing (25). Slide cylinder housing out on two cap screws (2) that were inserted for support in Step d above.
NOTE: The preload on the piston return springs will push the cylinder housing out of the pump housing. Remove the cylinder housing assembly.
- Remove cam assembly (51) by loosening set screw in the shaft rotator and sliding the shaft assembly out of seals (54). After removal from housing (35) inspect cam assembly.
CAUTION: These parts are heavy and may need a second person or a lifting device to remove them.
- Remove bearing adjustment plate (48) from the cylinder housing (23) and inspect the bearing cup (51A). Inspect all parts for wear and replace if necessary.

- Inspect Housing Bearing (51B) after removal of the cam assembly (51) from the pump housing (35).

NOTE: If the bearings are pitted or binding, or if the bearing cup in the housing is worn, contact Wanner Engineering.

CAUTION: If a bearing cup or bearing cone is replaced, they must be replaced as a pair or premature failure will result.

2. Disassemble Pistons

- Place cylinder housing assembly (25) on clean flat surface, with piston-*feet* side down.
- With diaphragms (20) removed (see the Fluid-End Service Section), thread 3/8-in x 3" SHCS screw approximately three turns into one of valve plungers (61). Tap screw lightly with hammer, and plunger (21) should slip off the valve plunger. Remove 3/8-in x 3" SHCS screw. Piston assembly (69) can then be removed. Repeat for remaining cylinders.
- Inspect and clean all parts of piston assembly (69). Replace O-rings and any other parts that are worn or damaged. Repeat on remaining piston assemblies.

3. Reassemble Pistons

NOTE: When reassembling the hydraulic pistons, use new plungers (21). They are press-fit onto the valve plungers (61) and are not reusable.

- Drop two steel balls (65) into bottom of piston assembly (70). **NOTE: Using grease on the O-rings, and lubricating the parts, will aid in assembly.**
- Insert retaining washer (64) to hold steel balls in place.
- Insert valve plunger (61) into valve cylinder (63). Slide bias spring (60), separator (59), spring (58) over valve plunger (61) inside valve cylinder (63). The long bias springs goes first, followed by the separator, and finally the shorter stiffer spring (58).
- Insert one O-ring into the bottom of spring retainer (56).
- Install one O-ring (62) onto valve cylinder (63).
- Install two O-rings (57) onto spring retainer (56). Use grease to hold O-rings in place.
- Slide assembled valve cylinder (63), valve plunger (61), bias spring (60), separator (59), spring (58) into spring retainer (56).
- Slide complete cylinder-and-retainer assembly into piston assembly (66).
- Insert piston return spring (55) into piston assembly (66).
- Repeat steps a. through i. for remaining four piston assemblies.

4. Remove Shaft Seals (54)

Inspect shaft seals (54). Replace if they look damaged in any way. Remove shaft seals by pounding out from inside pump housing (35). Replace both shaft seals. Clean bore of pump housing with emery cloth.

D/G-66 Service (Hydraulic End)

5. Reassemble Pump Housing, Shaft Assembly, and Cylinder Housing

- a. With pump housing (35) horizontal and mounted on baseplate (28), insert cam assembly (51) into pump housing. If shaft seals (54) are still in pump housing, cover shaft keyway with masking tape and slide it through seals. Remove tape. Place shaft rotator (from D/G-66 Tool Kit) over end of cam assembly shaft and slide it up tight against pump housing. Keep cam assembly (51) horizontal and tight against pump housing bearing. Tighten shaft rotator set screw to shaft keyway. This will hold the cam assembly horizontal and aid in assembly.
- b. Install O-ring (53) into pump housing (35) O-ring groove. Use grease to hold O-ring in groove.
- c. Place cylinder housing (25) face-down on clean surface.
- d. Insert bearing adjustment plate (48), with bearing cup (51A), dowel pin (50), and key (49), into cylinder housing (25).
- e. Insert five piston assemblies into cylinder housing (25).
- f. To aid in assembly, insert two cap screws (2) through pump housing from shaft side (at 10 and 2 o'clock positions).
- g. Pick up cylinder housing assembly (25) and slide onto two cap screws (2) that are in pump housing (35). It will slide on until piston feet contact cam assembly (51). Insert up to eight more cap screws (2) through pump housing and cylinder housing to aid in alignment.
- h. Using 17-mm box-end wrench, install four 10-mm x 100-mm fully-threaded HHCS (from D/G-66 Tool Kit) through pump housing (35) where four socket head cap screws (34) were fastened. Tighten HHCS evenly. Cylinder housing assembly (25) will pull tight against pump housing (35). One at a time, remove fully-threaded HHCS and replace with cap screws (34). Tighten four cap screws to 65 ft-lbs (88 N-m).
- i. Remove shaft rotator.

6. Install Shaft Seals

- a. Cover cam assembly shaft keyway (51) with masking tape to protect inside diameter of seals. Grease shaft and slide on one shaft seal (54) up to pump housing (35). Pack inside (spring side) of second shaft seal (54) half-full of grease. Slide shaft seal on and flush against first shaft seal. Make sure outside diameters of two shaft seals are clean and free of grease. Remove protective tape from cam assembly shaft.
- b. Apply an anaerobic seal sealant or bearing retaining compound to outside diameter of shaft seals (54). Install shaft rotator/seal inserter (from the D/G-66 Tool Kit) over the cam assembly shaft. Using mallet, tap shaft rotator/seal inserter to push two seals into the pump housing (35). Wipe off excess sealant.

7. Reinstall Plungers

NOTE: If the plungers (21) have been removed from the valve plungers (61), do not reuse them. Install new ones.

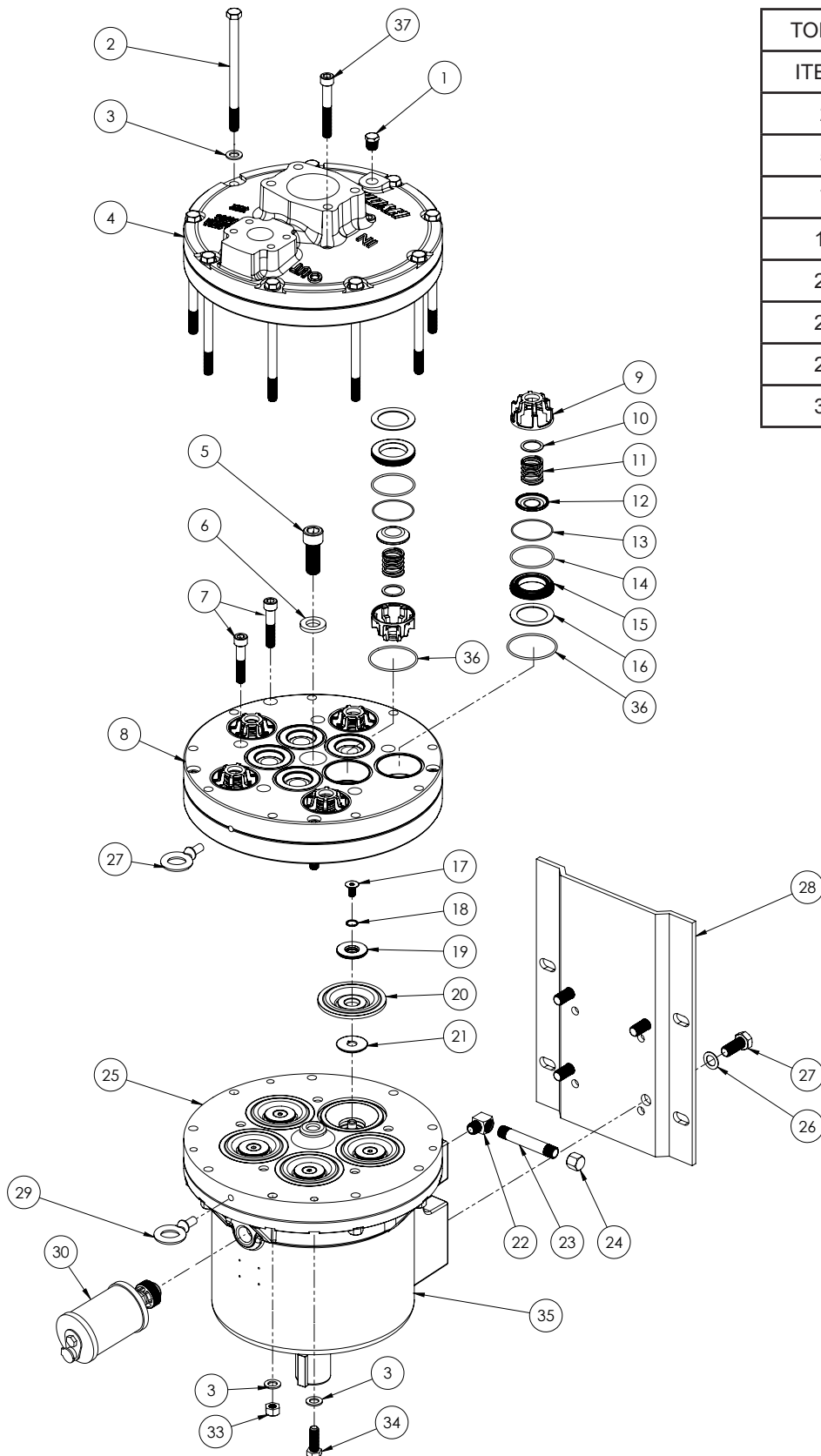
- a. Place plunger (21) onto exposed screw end of plunger guide lifter tool (from D/G-66 Tool Kit). The flat side of plunger should face plunger guide lifter tool.
- b. Screw plunger guide lifter tool (with plunger) into valve plunger (61) until tight.
- c. Pull valve plunger (61) up until its cross holes are exposed. Insert valve plunger holder (from D/G-66 Tool Kit) through top cross hole.
- d. Hold hex bolt with wrench. At the same time, tighten the hex nut against the plunger (21) with another wrench.
- e. Remove the plunger guide tool.
NOTE: Before removing the valve plunger holder tool, install new diaphragm. See Reinstall Diaphragms below.
- f. Repeat procedure for remaining cylinders.

8. Reinstall Diaphragm

NOTE: Keep the valve plunger holder tool installed in valve plunger (61) (as explained in Reinstall Plungers above).

- a. Clean female threads on valve plunger (61), then apply small amount of thread locker to female threads.
- b. Place O-ring (18) into follower (19).
- c. Place diaphragm (20) onto plunger (21), ridge side out.
- d. Center follower (19) on diaphragm.
- e. Clean threads on screw (17), then apply small amount of activator and thread locker to the screw.
- f. Insert follower screw (17), with O-ring (18), through follower (19) and diaphragm (20). Screw into valve plunger (61).
- g. Hold valve plunger holder tool and tighten screw (17) to 12 ft-lbs (16 N-m).
- h. Repeat above procedure for remaining cylinders.
- i. Fill reservoir with fresh oil and prime pump (See Fluid End Service Section).

D/G-66 Fluid End Parts - Metallic

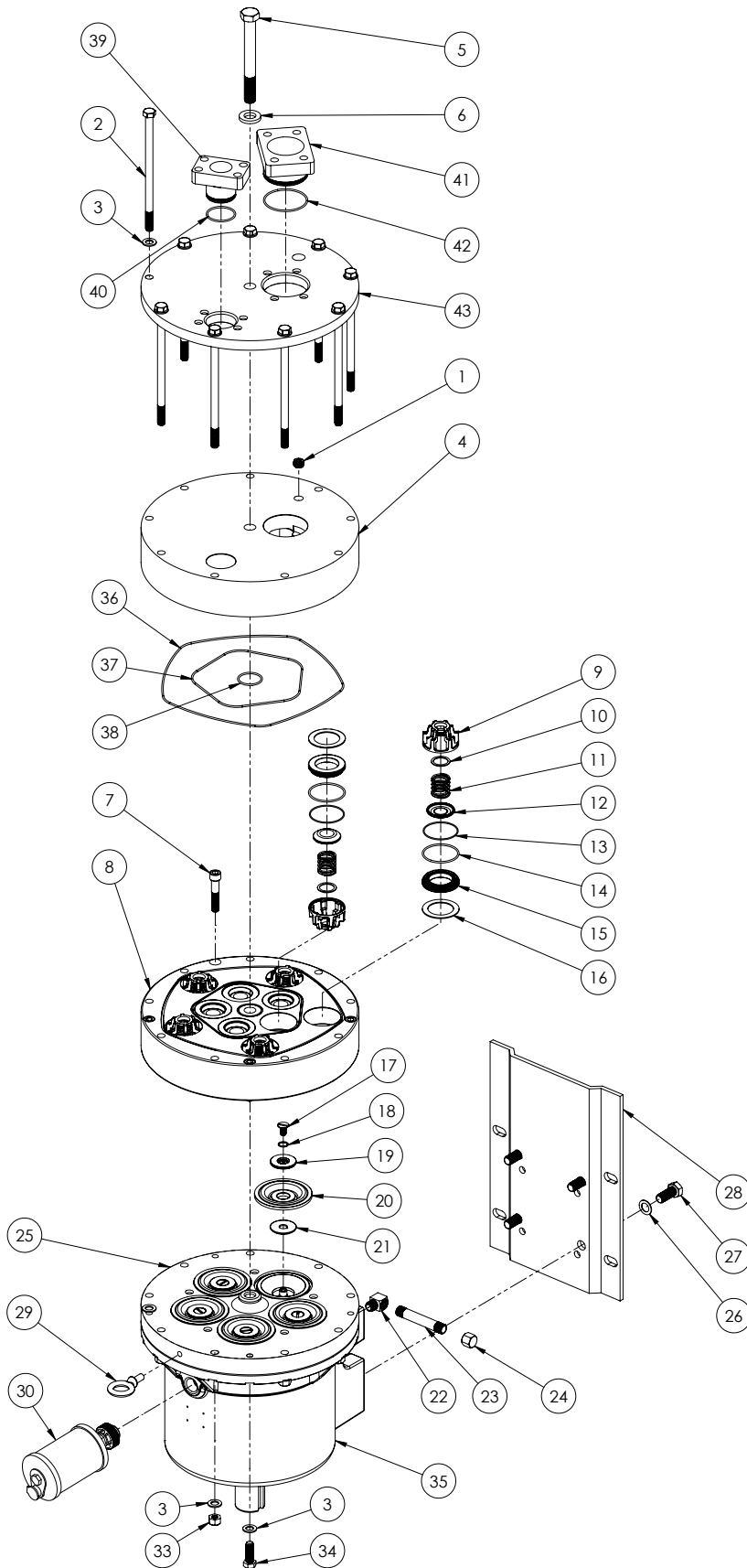


TORQUE/LOCTITE REQUIREMENTS		
ITEM#	TORQUE	LOCTITE#
2	90 FT-LBS	--
5	180 FT-LBS	--
7	65 FT-LBS	--
17	12 FT-LBS	242
22	--	567
23	--	609, 567
27	--	609
37	65 FT-LBS	--

D/G-66 Fluid End Parts - Metallic

Ref. No.	Part Number	Description	Quantity/ Pump	Ref. No.	Part Number	Description	Quantity/ Pump
1	D25-038-2210	Fitting, Plug Pipe, 3/8 NPT, Brass.....	1	21	D66-016-1010	Plunger	5
	D25-038-2211	Fitting, Plug Pipe, 3/8 NPT, 316 SST ..	1	22	D25-076-2210	Street Elbow, 3/8 NPT Brass	1
2	D66-048-2014	Screw, 1/2 HHCS	9	23	D25-077-2210	Pipe, Nipple, 3/8 NPT.....	1
3	D40-048-2010	Hardened Washer, 1/2"	21	24	D25-078-2210	Pipe, Cap, 3/8 NPT	1
4	D66-004-1029	Manifold, Ductile Iron, SAE.....	1	25	D66-002-1020	Cylinder Housing.....	1
	D66-004-1030	Manifold, Ductile Iron, NPT	1	26	D40-054-2010	Lockwasher, 5/8	4
	G66-004-1030	Manifold, Ductile Iron, BSPT.....	1	27	D40-087-2010	Screw, 5/8 HHCS	4
	D66-004-1032	Manifold, SS 316, SAE	1	28	D40-025-1010	Baseplate	1
	D66-004-1033	Manifold, SS 316, NPT	1	29	D40-102-2000	Eyebolt, 7/16, Wanner Blue	2
	G66-004-1033	Manifold, SS 316, BSPT.....	1	30	A01-116-3400	Assembly, Oil Reservoir, 12 oz	1
	D66-004-1038	Manifold, Manganese Bronze, SAE	1	33	D40-028-2010	Nut, 1/2 Hex.....	8
	D66-004-1039	Manifold, Manganese Bronze, NPT	1	34	D40-029-2010	Screw, 1/2 HHCS	4
	G66-004-1039	Manifold, Manganese Bronze, BSPT	1	35	D40-001-1010	Housing	1
5	D66-081-2026	Screw, 3/4 SHCS	1	36	D66-085-2110	O-Ring, Buna-N.....	10
6	D66-048-2024	Washer, 3/4"	1		D66-085-2111	O-Ring, FKM.....	10
7	D40-101-2010	Screw, 1/2 SHCS	9		D66-085-2113	O-Ring, EPDM	10
8	D66-003-1007	Valve Plate, Iron	1	37	D66-029-2019	Screw, 1/2" SHCS	5
	D66-003-1002	Valve Plate, SS 316.....	1				
	D66-003-1003	Valve Plate, Brass	1				
9	D66-023-2310	Valve Spring Retainer, Celcon	10				
	D66-023-2328	Valve Spring Retainer, PVDF	10				
10	D40-123-1010	Washer, Valve Spring, SS 316	10				
	D40-123-1017	Washer, Valve Spring, Hastelloy	10				
11	D40-022-3110	Spring, 17-7 PH	10				
	D40-022-3118	Spring Elgiloy	10				
	D40-022-3119	Spring, Hastelloy	10				
12	D66-021-1015	Disc, Valve, 17-4 PH.....	10				
	D66-021-1011	Disc, Valve, Nitronic 50.....	10				
	D66-021-1017	Disc, Valve, Hastelloy C276.....	10				
13	D40-092-2110	O-Ring, Buna-N	10				
	D40-092-2111	O-Ring, FKM.....	10				
	D40-092-2113	O-Ring, EPDM	10				
14	D40-035-2110	O-Ring, Buna-N.....	10				
	D40-035-2111	O-Ring, FKM	10				
	D40-035-2113	O-Ring, EPDM	10				
15	D66-020-1010	Valve Seat, 17-4 PH	10				
	D66-020-1011	Valve Seat, Nitronic 50.....	10				
	D66-020-1017	Valve Seat, Hastelloy C276.....	10				
16	D40-125-2310	Washer, Dampening, Celcon	10				
	D40-125-2318	Washer, Dampening, PVDF	10				
17	D40-030-2010	Screw, 3/8 SHCS, SST.....	5				
	D40-030-2017	Screw, 3/8 SHCS, T40, Hastelloy	5				
18	D40-047-2110	O-Ring, Buna-N.....	5				
	D40-047-2111	O-Ring, FKM	5				
	D40-047-2113	O-Ring, EPDM	5				
19	D66-017-1010	Follower, SS 316	5				
	D66-017-1011	Follower, Hastelloy C276.....	5				
20	D66-018-2320	Diaphragm, Buna-N, 4"	5				
	D66-018-2315	Diaphragm, FKM, 4".....	5				
	D66-018-2313	Diaphragm, EPDM, 4"	5				

D/G-66 Fluid End Parts - Non-Metallic



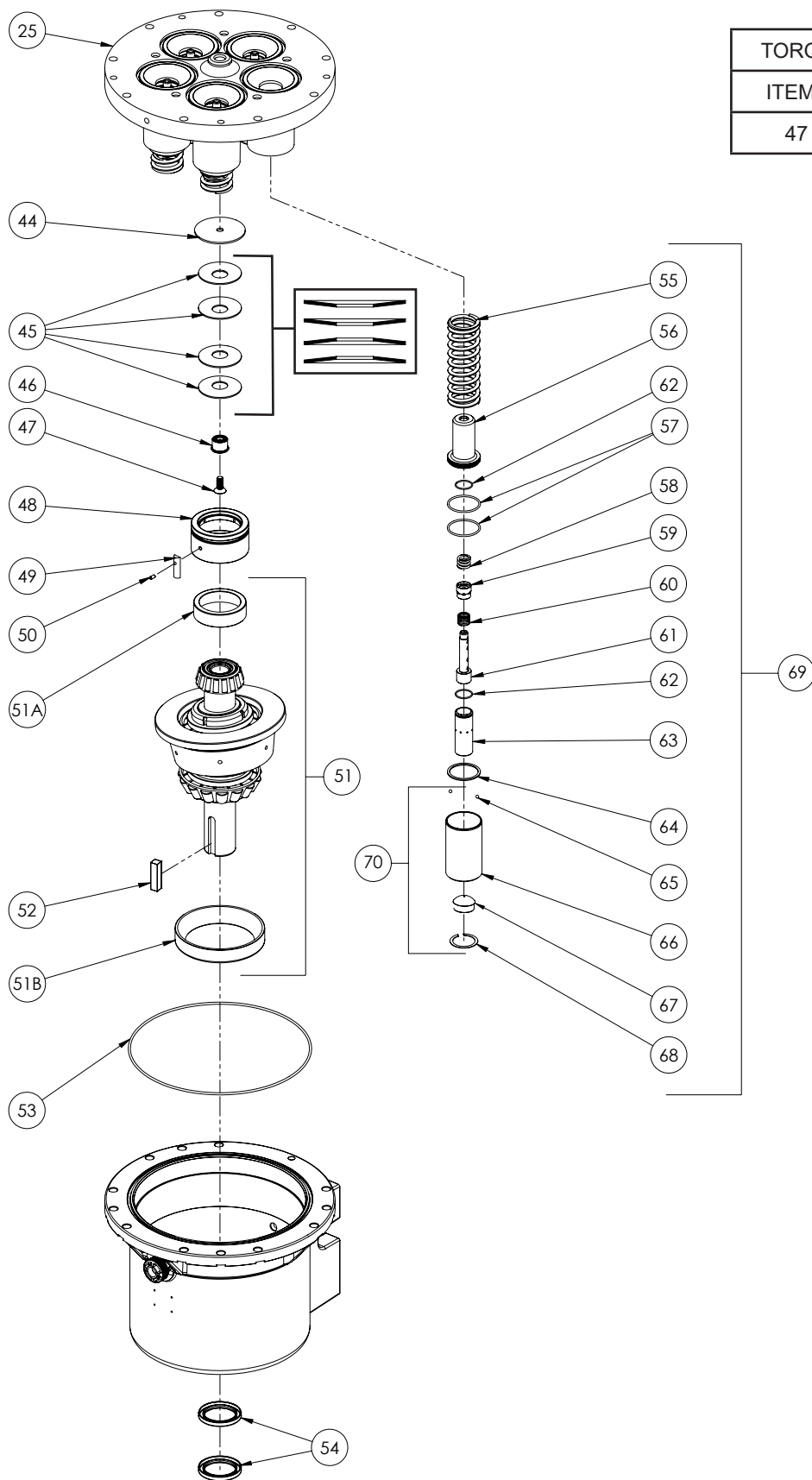
TORQUE/LOCTITE REQUIREMENTS		
ITEM#	TORQUE	LOCTITE#
2	65 FT-LBS	--
5	150 FT-LBS	--
7	20 FT-LBS	--
17	12 FT-LBS	242
22	--	567
23	--	609, 567
27	--	609

D/G-66 Fluid End Parts - Non-Metallic

Ref. No.	Part Number	Description	Quantity/ Pump
1	D66-038-2015	Pipe Plug, 3/8-18, Polypropylene.....	1
2	D66-029-2020	Screw, 1/2 HHCS	9
3	D40-048-2010	Hardened Washer, 1/2"	21
4	D66-004-1050	Manifold, Polypropylene.....	1
5	D66-031-2020	Screw, 3/4 HHCS	1
6	D66-048-2024	Washer, 3/4"	1
7	D40-101-2010	Screw, 1/2 SHCS	4
8	D66-003-1050	Valve Plate, Polypropylene	1
9	D66-023-2310	Valve Spring Retainer, Celcon	10
	D66-023-2328	Valve Spring Retainer, PVDF.....	10
10	D40-123-1010	Washer, Valve Spring, SS316	10
	D40-123-1017	Washer, Valve Spring, Hastelloy.....	10
11	D40-022-3110	Spring, 17-7 PH	10
	D40-022-3118	Spring Elgiloy	10
	D40-022-3119	Spring, Hastelloy	10
12	D66-021-1015	Disc, Valve, 17-4 PH.....	10
	D66-021-1011	Disc, Valve, Nitronic-50.....	10
	D66-021-1017	Disc, Valve, Hastelloy C276	10
13	D40-092-2110	O-Ring, Buna-N	10
	D40-092-2111	O-Ring, FKM.....	10
	D40-092-2113	O-Ring, EPDM.....	10
14	D40-035-2110	O-Ring, Buna-N	10
	D40-035-2111	O-Ring, FKM	10
	D40-035-2113	O-Ring, EPDM.....	10
15	D66-020-1010	Valve Seat, 17-4 PH	10
	D66-020-1011	Valve Seat, Nitronic 50.....	10
	D66-020-1017	Valve Seat, Hastelloy C276.....	10
16	D40-125-2310	Washer, Dampening, Celcon	10
	D40-125-2318	Washer, Dampening, PVDF	10
17	D40-030-2010	Screw, 3/8-16, FHMS, SS316	5
	D40-030-2017	Screw, 3/8-16, FHMS, Hastelloy	5
18	D40-047-2110	O-Ring, Buna-N	5
	D40-047-2111	O-Ring, FKM	5
	D40-047-2113	O-Ring, EPDM.....	5
19	D66-017-1010	Follower, SS316	5
	D66-017-1011	Follower, Hastelloy C276.....	5
20	D66-018-2320	Diaphragm, Buna-N, 4"	5
	D66-018-2315	Diaphragm, FKM, 4".....	5
	D66-018-2313	Diaphragm, EPDM, 4"	5
21	D66-016-1010	Plunger	5
22	D25-076-2210	Street Elbow, 3/8 NPT Brass	1
23	D25-077-2210	Pipe, Nipple, 3/8 NPT	1
24	D25-078-2210	Pipe, Cap, 3/8 NPT	1
25	D66-002-1020	Cylinder Housing.....	1
26	D40-054-2010	Lockwasher, 5/8	4

Ref. No.	Part Number	Description	Quantity/ Pump
27	D40-087-2010	Screw, 5/8 HHCS	4
28	D40-025-1010	Baseplate	1
29	D40-102-2000	Eyebolt, 7/16, Wanner Blue.....	1
30	A01-116-3400	Assembly, Oil Reservoir, 12 oz	1
33	D40-028-2010	Nut, 1/2 Hex.....	8
34	D40-029-2010	Screw, 1/2 HHCS.....	4
35	D40-001-1010	Housing	1
36	D66-081-2110	O-Ring, Buna-N	1
	D66-081-2111	O-Ring, FKM.....	1
	D66-081-2113	O-Ring, EPDM.....	1
37	D66-080-2110	O-Ring, Buna-N	1
	D66-080-2111	O-Ring, FKM	1
	D66-080-2113	O-Ring, EPDM.....	1
38	D66-084-2110	O-Ring, Buna-N	1
	D66-084-2111	O-Ring, FKM.....	1
	D66-084-2113	O-Ring, EPDM.....	1
39	D66-200-0107	Adapter, SAE Outlet	1
40	D66-083-2110	O-Ring, Buna-N	1
	D66-083-2111	O-Ring, FKM.....	1
	D66-083-2113	O-Ring, EPDM.....	1
41	D66-200-0106	Adapter, SAE Inlet.....	1
42	D66-082-2110	O-Ring, Buna-N	1
	D66-082-2111	O-Ring, FKM.....	1
	D66-082-2113	O-Ring, EPDM.....	1
43	D66-100-1011	Support Plate	1

D/G-66 Hydraulic End Parts



TORQUE/LOCTITE REQUIREMENTS		
ITEM#	TORQUE	LOCTITE#
47	--	242

D/G-66 Hydraulic End Parts

Ref. No.	Part Number	Description	Quantity/ Pump
25	D66-002-1020	Cylinder Housing.....	1
44	D35-116-1010	Backup Washer	1
45	D40-075-3110	Spring Disc Adjusting Plate.....	4
46	D35-112-1011	Guide, Disc Spring	1
47	G35-115-2011	Screw, M10 SFHC.....	1
48	D35-012-1011	Bearing Carrier.....	1
49	D35-113-1010	Key, Round Radius.....	1
50	D35-110-2011	Pin Dowel, 3/16"	1
51	D66-007-1210	Cam Assembly	1
52	D40-085-2210	Shaft Key.....	1
53	D40-037-2110	O-Ring, Buna-N	1
54	D40-031-2110	Shaft Seal.....	2
55	D40-019-3112	Spring, Piston Return	5
56	D66-042-1010	Retainer, Return Spring.....	5
57	D40-034-2110	O-Ring, Buna-N.....	10
58	D66-019-3112	Spring.....	5
59	D66-005-1000	Separator, Kel-Cell.....	5
60	D66-019-3110	Spring, Low Pressure Bias.....	5
61	D40-044-1010	Valve Plunger	5
62	D10-034-2110	O-Ring, Buna-N	10
63	D66-043-1010	Valve Cylinder	5
64	D40-041-1010	Retainer, Ball	5
65	D10-015-3010	Ball, .1875 Dia	10
66	D66-014-1010	Piston	5
67	D40-013-1010	Foot	5
68	D40-050-1010	Retainer, Foot.....	5
69	D66-014-1210	Piston Assembly.....	5
70	D66-014-1209	Foot Piston Assembly	5

D/G-66 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.
	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.

D/G-66 Replacement Parts Kits

TO ORDER REPLACEMENT PARTS KIT: A Replacement Parts Kit contains 11 digits corresponding to customer-specified design options.

1	2	3	4	5	6	7	8	9	10	11
---	---	---	---	---	---	---	---	---	----	----

Digit	Code	Order Description
1-3		Pump Configuration
	D66	For all D66 Pumps
	G66	For all G66 Pumps
4		Kit Designator
	K	Complete Fluid End Kit
	D	Diaphragm Kit
	V	Valve Kit (diaphragms not included)
5-6		Pump Head Material
	52	Metallic Pump Head Version
	55	Non-metallic Pump Head Version
7		Diaphragm & O-ring Material
	E	EPDM Metallic Pump Head
	G	FKM Metallic Pump Head
	H	FKM Non-metallic Pump Head
	R	EPDM Non-metallic Pump Head
	T	Buna-N Metallic Pump Head
	U	Buna-N Non-metallic Pump Head
8		Valve Seat Material
	H	17-4 Stainless Steel
	N	Nitronic® 50
	T	Hastelloy® C
	X	Not included in Diaphragm Kit
9		Valve Material
	F	17-4 Stainless Steel
	N	Nitronic® 50
	T	Hastelloy® C
	X	Not included in Diaphragm Kit
10		Valve Springs
	E	Elgiloy® (Exceeds SST grade 316L)
	H	17-7 Stainless Steel
	T	Hastelloy® C
	X	Not included in Diaphragm Kit
11		Valve Spring Retainers
	C	Celcon®
	M	PVDF
	X	Not included in Diaphragm Kit

Kit Contents			Kit Designator		
Part Number*	Description	QTY	K	D	V
D66-018-__	Diaphragm	5	•	•	
D40-047-__	O-ring, follower	5	•	•	
D66-085-__	O-ring, manifold ^{1,3}	10	•	•	•
D66-084-__	O-ring, Center bolt manifold ²	1	•	•	•
D66-080-__	O-ring, Inner manifold ²	1	•	•	•
D66-081-__	O-ring, Outer manifold ²	1	•	•	•
D40-035-__	O-ring, valve seat	10	•		•
D66-020-__	Valve seat	10	•		•
D66-021-__	Valve	10	•		•
D40-022-__	Valve spring	10	•		•
D40-092-__	Tetra seal	10	•		•
D66-023-__	Retainer, Valve	10	•		•
D40-123-__	Washer, valve spring	10	•		•
D40-125-__	Washer, Dampening	10	•		•
A01-113-3400	Threadlocker	1	•	•	

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

Hydra-Cell® is a registered trademark of Wanner Engineering, Inc.
 Kel-Cell® is a registered trademark of Wanner Engineering, Inc.
 Celcon® is a registered trademark of the Celanese Company.
 Elgiloy® is a registered trademark of Elgiloy Limited Partnership
 Hastelloy® C is a registered trademark of Haynes International, Inc.
 Nitronic® 50 is a registered trademark of AK Steel Corporation

¹ D66 Metallic.

³ G66 Metallic.

² D66 Non-metallic.

D/G-66 Warranty

Limited Warranty

Wanner Engineering, Inc. ("Wanner") extends to the original purchaser of equipment supplied or manufactured by Wanner and bearing its name, a limited one-year warranty from the date of purchase against defects in material or workmanship, under normal use and service, and provided the equipment is installed, operated and maintained in accordance with instructions supplied by Wanner. Wanner will repair or replace, at its option, defective parts without charge if: (a) you provide written notice of any defect within thirty (30) days from the discovery of the defect; (b) the claim is received by Wanner before the expiration of the warranty period; and (c) such parts are returned with transportation charges prepaid to Wanner Engineering, Inc., 1204 Chestnut Avenue, Minneapolis, Minnesota 55403. A return goods authorization must be received prior to the return of the defective part. No allowance will be made for repairs undertaken without Wanner written consent or approval.

Notwithstanding anything to the contrary, this warranty does not cover:

1. Electric motors (if applicable) not manufactured by Wanner. The warranties, if any, on such equipment are assigned to you by Wanner (without recourse) at the time of purchase.
2. Normal wear and/or damage caused by or related to abrasion, corrosion, abuse, negligence, accident, faulty installation or tampering which impairs normal operation.
3. Transportation costs.

This limited warranty is exclusive, and is in lieu of any other warranties (oral, express, implied or statutory) including, but not limited to, implied warranties of merchantability and fitness for a particular purpose; warranties of non-infringement; warranties arising from course of dealing or usage of trade or any other matter. Any descriptions of the equipment, drawings, specifications, and any samples, models, bulletins, or similar material used in connection with the sale of equipment are for the sole purpose of identifying the equipment and are not to be construed as an express warranty that the equipment will conform to such description. Any field advisory or installation support is advisory only. Every form of liability for direct, special, incidental or consequential damages or loss is expressly excluded and denied. All liability of Wanner shall terminate one (1) year from the date of purchase of the equipment.



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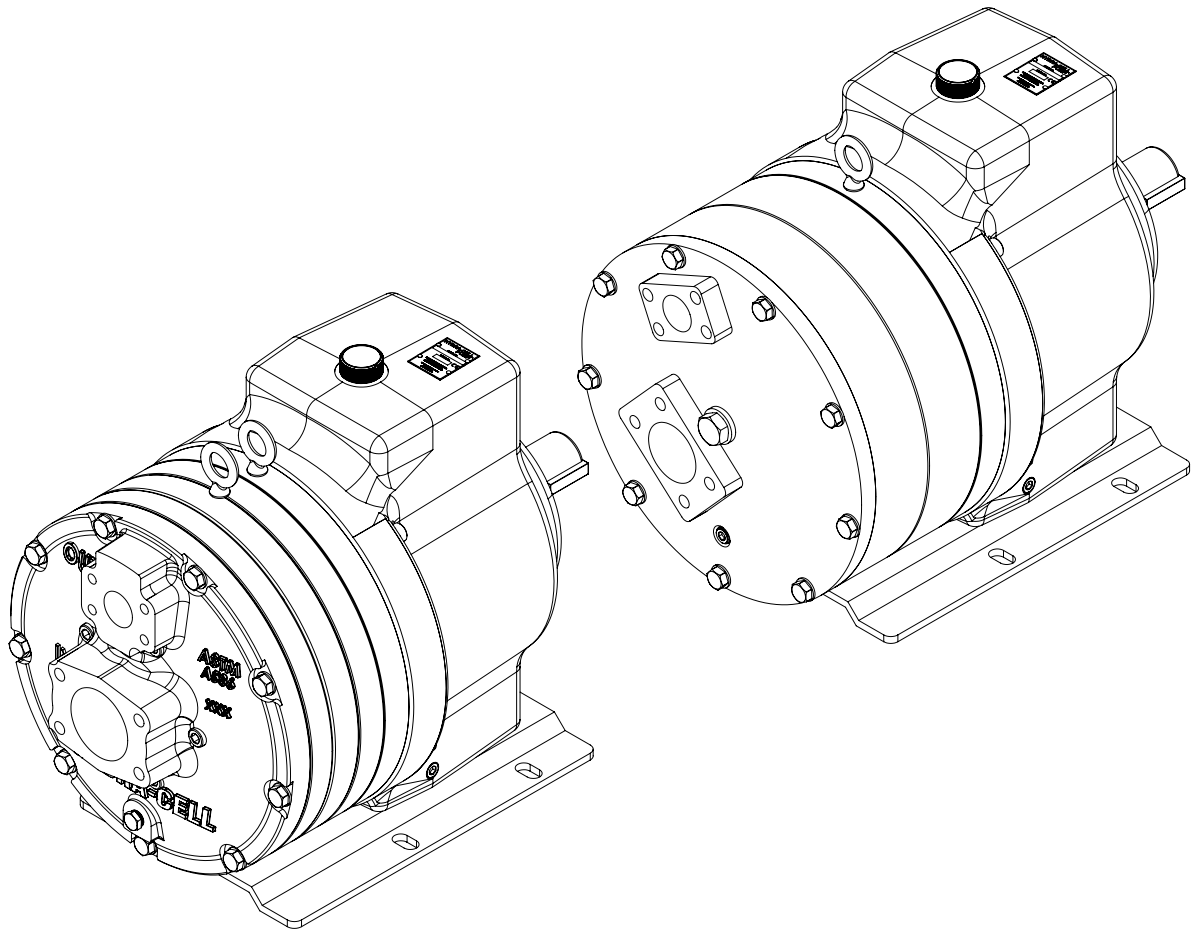
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Installation, Operation & Maintenance
D66-991-2410 Rev A

Hydra-Cell®

Seal-less Pumps

Models: D66, G66
Serial Number 455218 and Above



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D/G-66 Contents

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D/G-66 Specifications

Maximum Flow Rate	62.5 gpm (236.6 l/min)
Maximum Pressure	Metallic: 1000 psi (69 bar) Non-Metallic: 250 psi (17 bar)

Flow Capacities @ 250 psi (17 bar)			
Model	rpm	gpm	l/min
Non-Metallic	1000	66.9	253

Flow Capacities @ 500 psi (35 bar)			
Model	rpm	gpm	l/min
Metallic	1000	65.0	246

Flow Capacities @ 1000 psi (69 bar)			
Model	rpm	gpm	l/min
Metallic	1000	62.5	237

Delivery @ 250 psi (17 bar)		
Model	gal/rev	liters/rev
Non-Metallic	0.0669	0.253

Delivery @ 500 psi (35 bar)		
Model	gal/rev	liters/rev
Metallic	0.0650	0.246

Delivery @ 1000 psi (69 bar)		
Model	gal/rev	liters/rev
Metallic	0.0625	0.237

Maximum Discharge Pressure	
Metallic Heads:	1000 psi (69 bar)
Non-Metallic Heads:	250 psi (17 bar)

Maximum Inlet Pressure	
Metallic:	250 psi (17 bar)
Non-Metallic:	50 psi (3.5 bar)

Maximum Operating Temperature	
Metallic Heads:	200°F (93°C) - consult factory for correct component selection for temperatures from 160°F (71°C) to 200°F (93°C)
Non-Metallic Heads:	120°F (49°C) - consult factory for temperatures above 120°F (49°C)

Maximum Solids Size	800 microns
----------------------------	-------------

Inlet Port	
Metallic Heads:	
D66:	3 inch NPT or 3 inch SAE J518 Flange
G66:	3 inch BSPT
Non-Metallic Heads:	
	2-1/2 inch SAE J518 Flange

Discharge Port	
Metallic Heads:	
D66:	1-1/2 inch NPT or 1-1/2 inch SAE J518 Flange
G66:	1-1/2 inch BSPT
Non-Metallic Heads:	
	1-1/2 inch SAE J518 Flange

Shaft Diameter	2 inches (50.8 mm)
-----------------------	--------------------

Shaft Rotation	Reverse (bi-directional)
-----------------------	--------------------------

Bearings	Tapered roller bearings
-----------------	-------------------------

Oil Capacity	11 US quarts (10.4 liters)
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Weight	Metallic Heads: 400 lbs (181 kg) Non-Metallic Heads: 275 lbs (125 kg)
---------------	--

Calculating Required Power

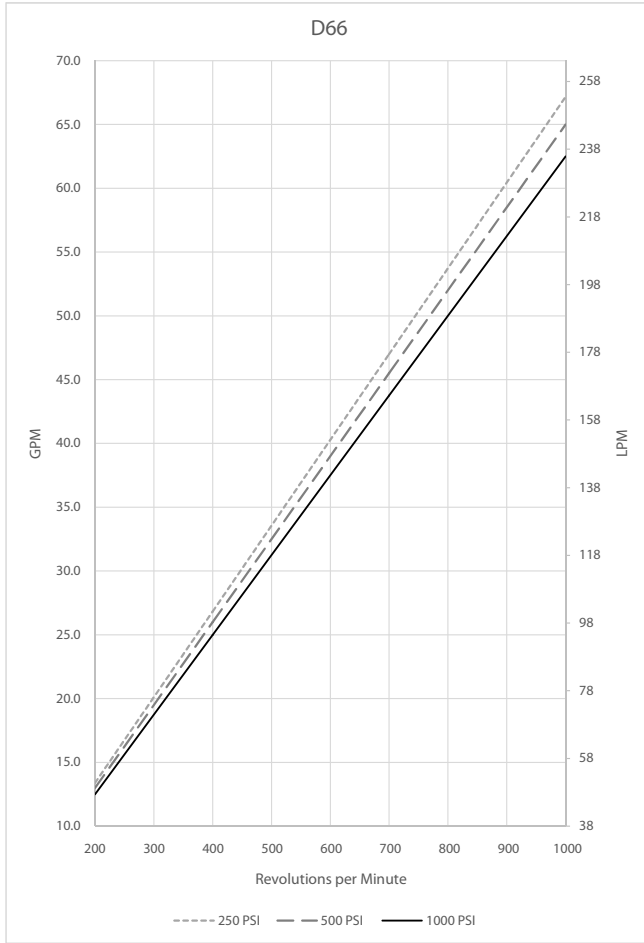
$$\frac{100 \times \text{rpm}}{63,000} + \frac{\text{gpm} \times \text{psi}}{1,460} = \text{electric motor hp}$$

$$\frac{100 \times \text{rpm}}{84,428} + \frac{\text{l/min} \times \text{bar}}{511} = \text{electric motor kW}$$

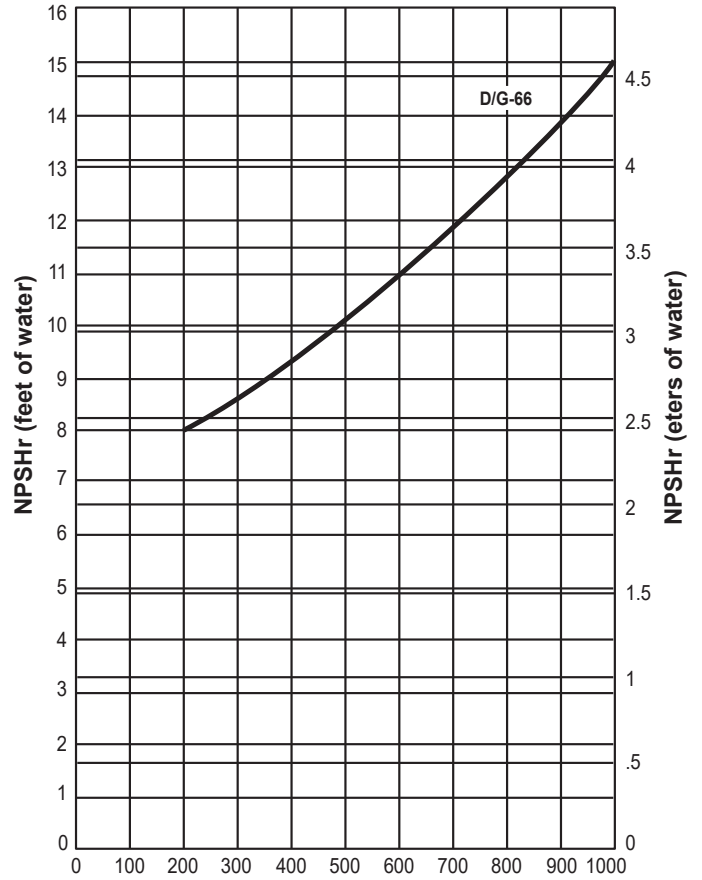
When using a variable frequency drive (VFD) controller calculate the hp or kW at minimum and maximum pump speed to ensure the correct hp or kW motor is selected. Note that motor manufacturers typically de-rate the service factor to 1.0 when operating with a VFD.

D/G-66 Specifications

Performance



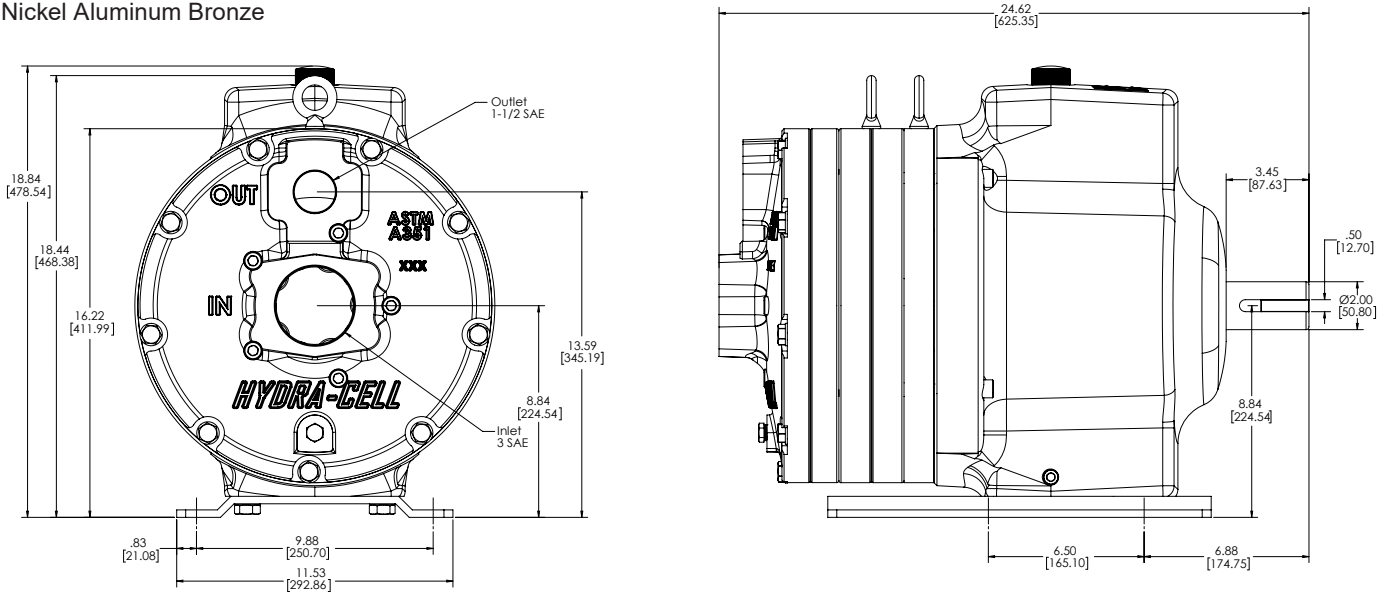
Net Positive Suction Head – NPSHr



D/G-66 Representative Drawings

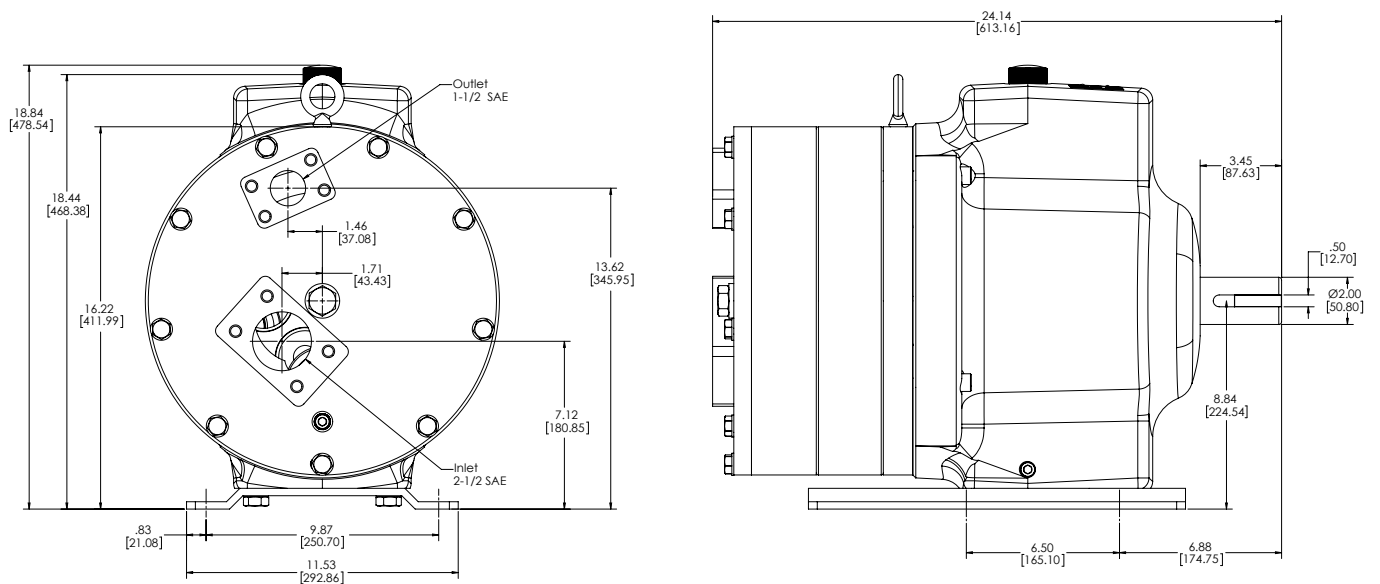
Models with Metallic Pump Head Inches (mm) (NPT, BSPT, and SAE)

- Brass
- Ductile Iron
- 316 Stainless Steel
- 2205 Duplex
- Nickel Aluminum Bronze



Models with Non-Metallic Pump Head Inches (mm) (SAE)

- Polypropylene



D/G-66 Installation

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 either lifting it manually or by selecting appropriate lifting equipment.

D/G-66 Installation

Equipment 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". A suitable and calibrated pressure gauge should be installed in the discharge line close to the pump head.

Safety Guards. Install adequate safety guards over all pulleys, belts, and couplings. 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 discharge pressure regulator, or in the regulator bypass line.

Freezing Conditions. Protect the pump from freezing. See also the Maintenance Section.

Working Pump. The pump body will become hot during operation even if the liquid being pumped is cold.

Consult the Factory for the following situations:

- Extreme temperature applications – above 160° F (71°C) or below 40° F (4.4°C)
- Pressure feeding of pumps
- Viscous or abrasive fluid applications
- Chemical compatibility problems
- Hot ambient temperatures – above 110° F (43°C)
- Conditions where pump oil may exceed 200° F (93°C) because of a combination of hot ambient temperatures, hot fluid temperature, and full horsepower load — an oil cooler may be required

Location

Locate the pump as close to the supply source as possible. Install it in a lighted clean space where it will be easy to inspect and maintain. Allow room for checking the oil level, changing the oil, and removing the pump head (manifold, valve plate and related items).

Mounting

The pump shaft can rotate in either direction. To prevent vibration, mount the pump and motor securely on a level rigid base.

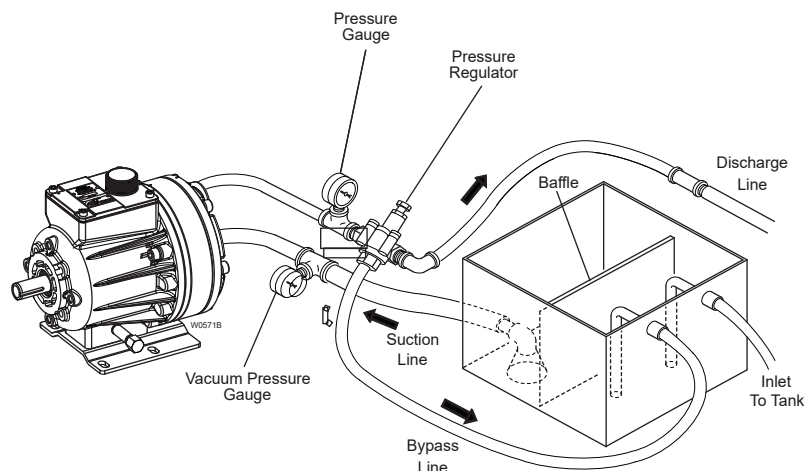
On a belt-drive system, align the sheaves accurately; poor alignment wastes horsepower and shortens the belt and bearing life. Make sure the belts are properly tightened as specified by the belt manufacturer.

On a direct-drive system, align the shafts accurately. Unless otherwise specified by the coupling manufacturer, maximum parallel misalignment should not exceed 0.015 in. (0.4 mm) and angular misalignment should be held to 1° maximum. Careful alignment extends life of the coupling, pump, shafts, and support bearings. Consult coupling manufacturer for exact alignment tolerances.

Drive couplings, belts and pulleys must be of suitable design, correctly sized, fitted, and rated for the maximum load required.

On a close-coupled system, coat the motor shaft liberally with anti-seize.

The pump, motor and related components must be adequately grounded.



D/G-66 Installation

Inlet Piping (Suction Feed)

CAUTION: When pumping at temperatures above 160° F (71°C), attention must be paid to the vapor pressure curve of the liquid. A pressure-feed system may be required.

Do not supply more than one pump from the same inlet line.

Install drain cocks at any low points of the suction line, to permit draining in freezing conditions.

Provide for permanent or temporary installation of a vacuum gauge to monitor the inlet suction. To maintain maximum flow, ensure the system NPSHa exceeds the NPSHr of the pump.

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.

Isolate the pump and motor stand from the supply tank and support them separately.

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

Install the inlet and bypass lines so they empty into the supply tank below the lowest water level on the opposite side of the baffle from the pump suction line.

Do not use a line strainer or filter in the suction line unless regular maintenance is assured. If a line strainer is used in the system, install it in the inlet line to the supply tank. It should have a free-flow area of at least three times the free-flow area of the inlet.

To reduce aeration and turbulence, install a completely submerged baffle plate to separate the incoming and outgoing liquids.

Install a vortex breaker in the supply tank, over the outlet port to the pump.

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

Hose and Routing

Size the suction line at least one size larger than the pump inlet, and so that the velocity will not exceed 1-3 ft/sec (0.3 to 0.9 m/s):

For pipe in mm: $\text{Velocity (m/sec)} = 21.2 \times \text{LPM}/\text{Pipe ID}^2$

For pipe in inches: $\text{Velocity (ft/sec)} = 0.408 \times \text{GPM}/\text{Pipe ID}^2$

Keep the suction line as short and direct as possible. A maximum of 1m (3 feet) is recommended.

Use flexible hose and/or expansion joints to absorb vibration, expansion, or contraction.

If possible, keep the suction line level. Do not have any high points to collect vapor unless these high points are vented.

To reduce turbulence and resistance, do not use 90° elbows. If turns are necessary in the suction line, use 45° elbows or arrange sweeping curves in the flexible inlet hose.

If a block valve is used, be sure it is fully opened so that the flow to the pump is not restricted. The opening should be at least the same diameter as the inlet plumbing ID.

Install piping supports where necessary to relieve strain on the inlet line and to minimize vibration.

Inlet Piping (Pressure Feed)

Provide for permanent or temporary installation of a vacuum/pressure gauge to monitor the inlet vacuum or pressure. Pressure at the pump inlet should not exceed 250 psi (17 bar); if it does get higher, install an inlet pressure reducing regulator. Do not supply more than one pump from the same inlet line.

Inlet Calculations

Acceleration Head

Calculating the Acceleration Head

Use the following formula to calculate acceleration head losses. Subtract this figure from the NPSHa, and compare the result to the NPSHr of the Hydra-Cell pump.

$$Ha = (L \times V \times N \times C) \div (K \times G)$$

where:

Ha = Acceleration head (ft of liquid)

L = Actual length of suction line (ft) — not equivalent length

V = Velocity of liquid in suction line (ft/sec)

$$\text{or } V = \text{GPM} \left(\frac{0.408}{\text{Pipe ID}^2} \right)$$

N = RPM of crankshaft

C = Constant determined by type of pump — Use 0.066 for D/G03, M03, M23, G13, D/G10, D/G04 and H/G25 pumps. Use 0.04 for D/G15, D/G35, and D/G-66 pumps. Use 0.628 for F/G20/21/22 pumps.

K = Constant to compensate for compressibility of the fluid — use: 1.4 for de-aerated or hot water; 1.5 for most liquids; 2.5 for hydrocarbons with high compressibility

G = Gravitational constant (32.2 ft/sec²)

D/G-66 Installation

Friction Losses

Calculating Friction Losses in Suction Piping

When following the above recommendations (under “Inlet Piping”) for minimum hose/pipe I.D. and maximum length, frictional losses in the suction piping are negligible (i.e., $H_f = 0$) if you are pumping a water-like fluid.

When pumping more viscous fluids such as lubricating oils, sealants, adhesives, syrups, varnishes, etc., frictional losses in the suction piping may become significant. As H_f increases, the available NPSH (NPSHa) will decrease, and cavitation will occur.

In general, frictional losses increase with increasing viscosity, increasing suction line length, increasing pump flow rate, and decreasing suction line diameter. Changes in suction line diameter have the greatest impact on frictional losses: a 25% increase in suction line diameter cuts losses by more than two times, and a 50% increase cuts losses by a factor of five times.

Consult the factory before pumping viscous fluids.

Minimizing Acceleration Head and Frictional Losses

To minimize the acceleration head and frictional losses:

- Keep inlet lines less than 1 m (3 ft) long.
- Use inlet hose at least one size larger than the size of the inlet port of the pump.
- Use flexible, non-collapsible suction hose and/or expansion joints to absorb vibrations, expansions and contractions.
- Minimize fittings (elbows, valves, tees, etc.)
- **Use a suction stabilizer on the inlet.**

Net Positive Suction Head

NPSHa must be equal to or greater than NPSHr. If not, the pressure in the pump inlet will be lower than the vapor pressure of the fluid—and cavitation will occur.

Calculating the NPSHa

Use the following formula to calculate the NPSHa:

$$NPSHa = P_t + H_z - H_f - H_a - P_{vp}$$

where:

P_t = Atmospheric pressure

H_z = Vertical distance from surface liquid to pump center line (if liquid is below pump center line, the H_z is negative)

H_f = Friction losses in suction piping

H_a = Acceleration head at pump suction

P_{vp} = Absolute vapor pressure of liquid at pumping temperature

Notes:

- In good practice, NPSHa should be 2 ft (0.6 m) greater than NPSHr.
- All values must be expressed in feet of liquid.

Atmospheric Pressure at Various Altitudes

Altitude (ft)	Pressure (ft of H ₂ O)	Altitude (ft)	Pressure (ft of H ₂ O)
0	33.9	1500	32.1
500	33.3	2000	31.5
1000	32.8	5000	28.2

Discharge Piping

Note: Consult the Factory before manifolding two or more pumps together.

Hose and Routing

Use shortest, most-direct route for discharge line.

Select pipe or hose with **working pressure** rating of at least 1.5 times maximum system pressure. EXAMPLE: Select a 1500 psi W. P.-rated hose for systems to be operated at 1000 psi gauge pressure.

Use about 6 ft (1.8 m) of flexible hose between pump and rigid piping to absorb vibration, expansion or contraction.

Support pump and piping independently. Size discharge line so that velocity of fluid will not exceed 2-3 m/sec (8-10 ft/sec):

For pipe in mm: Velocity (m/sec) = $21.2 \times \text{LPM}/\text{Pipe ID}^2$

For pipe in inches: Velocity (ft/sec)

$$\text{or } V = 0.408 \left(\frac{\text{GPM}}{\text{Pipe ID}^2} \right)$$

Note: Pumps with a non-metallic pumping head are limited to 250 psi (17 bar) maximum working pressure rating.

Pressure Regulation

Install pressure regulator or unloader in discharge line. Bypass pressure must not exceed pressure limit of pump.

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

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

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

Route the bypass line to the supply tank, not to the suction line (to reduce the chance of turbulence and cavitation within the pump).

If the pump may be run for a long time with the discharge closed and fluid bypassing, install a thermal protector in the bypass line (to prevent severe temperature buildup in the bypassed fluid).

The safety pressure regulating valve must be checked for correct operation on a regular basis.

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 pressure gauge to monitor discharge pressure at pump.

For additional system protection install safety relief valve in discharge line downstream from pressure regulator.

D/G-66 Installation

Before Initial Start-Up

Before you start the pump, be sure that:

- All shut-off valves are open, and pump has adequate supply of fluid.
- All connections are tight.
- Oil level is 4 inches (102 mm) from the top of the oil fill port.
- The relief valve on the pump outlet is adjusted so the pump starts under minimum pressure.
- All pulleys and belts are properly aligned, and belts are tensioned according to specification.
- All pulleys and belts have adequate safety guards.
- Ensure that the materials of construction of the pump are compatible with the liquid being pumped.

Initial Start-Up Procedure

1. Turn on power to pump motor.
2. Check inlet pressure or vacuum. To maintain maximum flow, inlet vacuum must not exceed 180 mm Hg at 21°C (7 in. Hg at 70° F). Inlet pressure must not exceed 250 psi (17 bar).
3. Listen for any erratic noise and look for unsteady flow.
4. If system has airlock and pump fails to prime:
 - a. Turn off power.
 - b. Remove pressure gauge or plug from tee fitting at pump outlet (refer to illustration drawing at the front of this section).

Note: Fluid may come out of this port when the plug is removed. Provide an adequate catch basin for fluid spillage, if required. Fluid will come out of this port when the pump is started, so we recommend that you attach adequate plumbing from this port so fluid will not be sprayed or lost. Use high-pressure rated hose and fittings from this port. Take all safety precautions to assure safe handling of the fluid being pumped.

- c. Jog system on and off until fluid coming from this port is air-free.
 - d. Turn off power.
 - e. Remove plumbing that was temporarily installed, and reinstall pressure gauge or plug.
5. Adjust discharge pressure regulator to desired operating and bypass pressures. Do not exceed maximum pressure rating of pump.
 6. After pressure regulator is adjusted, set safety relief valve at 100 psi (7 bar) higher than desired operating pressure. To verify this setting, adjust discharge pressure regulator upward until relief valve opens. Follow recommendations in **Step 4b Note** for handling fluid that will come from relief valve.
 7. Reset discharge pressure regulator to desired system pressure.
 8. Provide return line from relief valve to supply tank, similar to bypass line from pressure regulator, never back to suction line.

D/G-66 Maintenance

Note: The numbers in parentheses are the Reference Numbers on the exploded view illustrations found in this manual and in the Parts Section.

Daily

Check oil level and condition of oil. The oil is at the correct level for the model of pump;

D/G-66 - 4 inches (102 mm) from the top of the oil fill port.
Use the appropriate Hydra-Oil for the application (contact Wanner Engineering if in doubt).

CAUTION: If you are losing oil but don't see any external leakage, or if the oil becomes discolored and contaminated, one of the diaphragms (50) may be damaged. Refer to the Fluid-End Service Section. Do not operate the pump with a damaged diaphragm.

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

Periodically

Change the oil after the first 100 hours of operation, and then according to the guidelines below.

Hours Between Oil Changes @ Various Process Fluid Temperatures

Pressure	RPM	<90°F (32°C)	<139°F (60°C)	<180°F (82°C)
Metallic Pump Head				
<650 psi (45 bar)	<600	6,000	4,500	3,000
	<1000	4,000	3,000	2,000
<1000 psi (69 bar)	<600	4,000	3,000	2,000
	<1000	2,000	1,500	1,000
Non-Metallic Pump Head				
<250 psi (17 bar)	<600	4,000	3,000	—
	<1000	2,000	1,500	—

Note: Minimum oil viscosity for proper hydraulic end lubrication is 16-20 cST (80-100 SSU).

Note: Use of an oil cooler is recommended when process fluid and/or hydraulic end oil exceeds 180°F (82°C) for Metallic Pump Head models or when hydraulic end oil exceeds 180°F (82°C) for Non-Metallic Pump Head models.

When changing, remove the drain plug cap (8) at the bottom of the pump so all oil and accumulated sediment will drain out.

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

Check the inlet pressure or vacuum periodically with a gauge. If vacuum at the pump inlet exceeds 7 in. Hg (180 mm Hg), check the inlet piping system for blockages. If the pump inlet is located above the supply tank, check the fluid supply level and replenish if too low.

CAUTION: Protect the pump from freezing. Refer also to the "Shutdown Procedure".

D/G-66 Maintenance

Shutdown Procedure During Freezing Temperatures

Take all safety precautions to assure safe handling of the fluid being pumped. Provide adequate catch basins for fluid drainage and use appropriate plumbing from drain ports, etc., when flushing the pump and system with a compatible antifreeze.

1. Adjust discharge pressure regulating valve so pump runs under minimum pressure. Stop pump.
2. Drain supply tank; open any draincocks in system piping and collect drainage; remove plug (62) from manifold and collect drainage.
3. Close draincocks in system piping and replace manifold plug.
4. Fill supply tank with enough antifreeze to fill system piping and pump.

Note: Disconnect the system return line from the supply tank and connect it to a separate reservoir.

5. Start pump and allow it to run until system is filled with antifreeze.

Note: If the system has an air lock and the pump fails to prime, follow step 4 of the Initial Start-up Procedure to clear the air.

6. When mostly antifreeze is flowing from system return line, stop pump. Connect system return line back to supply tank and circulate antifreeze for short period.
7. It is also good practice to change oil in hydraulic end before storage for an extended period. This will remove any accumulated condensation and sediment from oil reservoir. Drain and refill hydraulic end with appropriate Hydra-Oil and operate pump for short period to assure smooth performance.

Service (Fluid End)

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.

CAUTION: Do not remove the four SHCS (5) that go through the back of the pump housing (1) and thread into the cylinder housing (48), unless you are repairing the hydraulic end of the pump.

Tools and Supplies

The following tools and supplies are recommended for servicing the fluid end of the pump:

- Wanner D66/G66 Tool Kit, P/N A03-191-1100
- 3/4-in, and 1 1/8-in (non-metallic only) hex socket
- 7/32-in, 3/8-in, and 5/8-in (non-metallic only) hex bit socket
- Large and small flat head screwdrivers
- Mallet
- O-ring Pick
- Small Pliers
- Required Torque Wrenches: 12 ft-lbs (16 N-m), 65 ft-lbs (88 N-m), 90 ft-lbs (122 N-m, metallic only), 180 ft-lbs (244 N-m, metallic only), 150 ft-lbs (203 N-m non-metallic only), and 20 ft-lbs (27 N-m, metallic only).
- New Hydra oil
- Lubricating gel
- Fine emery cloth

The following additional supplies are recommended for servicing the hydraulic end of the pump:

- 17-mm hex socket or box-end wrench
- Grease
- Anaerobic seal sealant

D/G-66 Service (Fluid End)

1. Remove Manifold (59) and Valve Plate (54)

- a. All Head Materials: Using 3/4-in hex socket remove nine HHCS (60) and nine washers (6) around manifold (59) and pump housing (1). Do not remove four SHCS (5) that are installed through back of pump housing (1).
- b. Metallic Head: Using 3/8-in hex bit socket remove the five SHCS (61) around the manifold inlet.
- c. Non-Metallic Head: Using 1 1/8-in hex socket remove the one HHCS center bolt (75) from the manifold center.

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

- d. Remove manifold (59) and support plate (74, used on non-metallic pump only).
- e. Inspect manifold for warping or wear around inlet and outlet ports. If wear is excessive, replace manifold. To check for warped manifold, remove O-rings and place straightedge across it. If warped, replace.
- f. Metallic Head: Using 3/8-in hex bit socket remove nine SHCS (56) from valve plate. Using 5/8-in hex bit socket remove the one SHCS (58) from valve plate center.
- g. Non-Metallic Head: Using 3/8-in hex bit socket remove four SHCS (56) from valve plate.
- h. Inspect valve plate (54) for warping as in step e for manifold. If warped, replace.

NOTE: Plastic valve plates and manifolds should also be inspected for cracks and replaced as necessary.

2. Inspect Valve Assemblies (parts 63-70)

NOTE: The five inlet and five outlet valve assemblies in the pump are identical (but face in opposite directions).

Inspect each valve assembly as follows:

- a. Remove the five inlet valve assemblies using the valve puller tool supplied in the Wanner Tool Kit. Be careful not to break the metal ridge around O-ring groove.
- b. Remove tetra seal, O-ring (66), between valve retainer (70) and valve seat (64) using a flat head screwdriver.
- c. Insert flat head screwdriver in the gap created by the removal of O-ring (66). Using the screwdriver pop apart the valve retainer (70) and valve seat (64). Collect the remaining parts of the five valve assemblies (63-70) for inspection.
- d. With pliers grip one discharge retainer (70) leg and firmly pull away from the valve plate. Remove five discharge retainers (70) from the discharge valve assemblies.
- e. Once valve retainers are removed collect valve spring washer (69), valve spring (68), valve disc (67), O-ring (66) for inspection. **Caution springs are under slight load. Parts may fall out of valve during disassembly.**
- f. Remove five discharge valve seats (64) using the valve puller tool supplied in the Wanner Tool Kit. Be careful not to break metal ridge around O-ring groove.
- g. Check 10 valve springs (68). If shorter than new spring, replace. (Don't stretch old spring.)
- h. Check 10 valve discs (67). If worn, replace. Inspect valve seats (64) for wear. If worn, replace and install new O-ring (65).
- i. Place retainer (70) with the small side down. Put the parts back into the retainer in the following order: Valve spring washer (69), valve spring (68), valve disc (67), valve seat (64). Press the valve retainer and disc to snap the valve assembly back together.
- j. Grease up tetra seal O-ring (66), and push into the gap between the valve retainer (70) and valve seat (64). Make sure tetra seal is fully installed.
- k. Reinstall valve assemblies:
 - Clean valve ports and valve shoulders with emery cloth, and grease with lubricating gel or petroleum jelly.
 - **Inlet (5 center valves).** Insert inlet valve assembly into valve plate (54) retainer (70) side first. Use a dead blow mallet to tap the valves back into the valve plate until they bottom out. Grease and place the dampening washer (63) on top of the valve seat (64).
 - **Outlet (5 outer valves).** Grease and place the dampening washer (63) on bottom of the discharge valve bores in the valve plate (54). Place valve assembly on the discharge ports of the valve plate (54), valve seat toward the valve plate. Place 1 3/4-in hex socket or 2" schedule 40 pipe onto legs of the valve retainer. Tap the tool until the valve retainer bottoms out.

D/G-66 Service (Fluid End)

3. Inspect and Replace Diaphragms (50)

- a. Lift diaphragm (50) by one edge and turn pump shaft until diaphragm pulls up. This will expose machined cross holes in valve plunger shaft behind diaphragm.
- b. Insert 1/8-in Allen wrench or diaphragm tool through one of cross holes to hold diaphragm up. (The proper size diaphragm tool is included in the Wanner Tool Kit.)
- c. With a 7/32-in hex bit socket remove FHSC (53). Make sure to hold Allen wrench/diaphragm tool to prevent diaphragm rotation. Next remove follower (51), and O-ring (52) in center of diaphragm.

- d. Remove diaphragm and inspect carefully.

NOTE: A ruptured diaphragm indicates a pumping system problem, and replacing only the diaphragm will not solve the larger problem.

Inspect diaphragm (50) for following:

- **Half-moon marks.** Usually caused by cavitation of pump (See Troubleshooting section).
 - **Concentric circular marks.** Usually caused by cavitation of pump (See Troubleshooting section).
 - **Small puncture.** Usually caused by sharp foreign object in fluid, or by ice particle.
 - **Diaphragm pulled away** from center screw or from cylinder sides. Usually caused by fluid being frozen in pump, or by overpressurization of pump.
 - **Diaphragm stiff and inflexible.** Usually caused by pumping fluid incompatible with diaphragm material, or diaphragm operated at temperatures below rated capability.
 - **Diaphragm edge chewed away.** Usually caused by overpressurizing system.
- e. Inspect plunger (49) for any rough surfaces or edges. Do not remove plunger from valve plunger (32). 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. Reinstall O-ring (52) into center of follower (51). Insert follower (51) back into the diaphragm (50). Use new diaphragm (50) or reuse old diaphragm (if good).
- g. Clean FHSC (53) including any oil and old thread locker. Apply activator and medium-strength thread locker to screw.
- h. Clean valve plunger (32) female threads. Apply medium strength thread-locker to female threads.
- i. Reinstall diaphragm (50), follower (51), O-ring (52) and FHSC (53) into valve plunger (32). Tighten FHSC to 144 in.-lbs (16 N-m). **Warning do not overtighten as this can cause damage to valve plunger (32).**
- j. Repeat steps a. thru i. for all five diaphragms (50).

4. Flush Contaminant from Hydraulic End (use if diaphragm has ruptured)

- a. Remove oil drain plug (8) and allow all oil and contaminants to drain out. Replace oil drain plug.
- b. Remove oil fill cap (2) and fill reservoir with kerosene or solvent, manually turn pump shaft to circulate kerosene, and drain.

CAUTION: If you have EPDM diaphragms, or if food grade oil is in the reservoir, do not use kerosene or solvents. Instead, flush with the same lubricant used in the reservoir. Pumps with EPDM diaphragms have an "E" as the 7th digit of the Model No.

- c. Repeat step b.
- d. Fill reservoir with fresh oil, manually turn pump shaft to circulate oil, and drain once again.
- e. Refill reservoir. If oil appears milky, there is still contaminant in reservoir. Repeat flushing procedure until oil appears clean.
- f. Replace oil fill cap (2).

D/G-66 Service (Fluid End)

5. Prime Hydraulic Cells on Kel-Cell Pumps

Method #1 (with system head pressure less than 2 psi)

- With pump horizontal, and fluid-end head removed, remove oil fill cap (2) and fill reservoir with correct oil to 4 inches (102 mm) below top of fill port. Have catch basin for oil leaks from behind diaphragms when priming. Catch oil and dispose of properly. **Do not reuse.**
- Force air out of oil in hydraulic cell (behind diaphragms) by turning shaft and pumping piston. (A shaft rotator is included in the Wanner Tool Kit.) Keep pressure on diaphragms while turning shaft until bubble-free flow of oil comes from behind all diaphragms. Watch oil level in reservoir. If oil gets too low during priming, air will be drawn into pistons (inside hydraulic end) and cause pump to run rough.
- Quickly attach assembled valve plate (54) (before oil runs out past diaphragms) with center bolt socket head screw (58) for metallic head, or four SHCS (56) for non-metallic head. Do not tighten screw completely. Leave gap between valve plate and cylinder housing (48). Turn shaft 2-3 turns to force out any remaining air behind diaphragms. Hydraulic cells are now primed.
- Metallic Head: Using 5/8-in hex bit socket hand tighten SHCS Center Bolt (58). Using 3/8-in hex bit socket hand tighten nine SHCS (56).
- Non-Metallic Head: Using 3/8-in hex bit socket hand tighten four SHCS (56).
- Wipe off excess oil from around pump head.
- Check that oil level is 4 inches (102 mm) from top of fill port.
- Replace oil fill cap with O-ring (2) and complete installation.

Method #2 (with system head pressure greater than 2 psi)

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

- Completely assemble pump.
- Remove oil fill cap (2) and fill reservoir with correct Hydra-oil to 4 inches (102 mm) below top of fill port.
When tank head pressure is being used to prime, use the following steps:
- Install pump in system and connect tank supply line to pump inlet. Connect pump discharge line. Leave end of line open to allow air to pass out.
- Slowly turn pump shaft by hand and watch for bubbles at 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.
- Replace oil fill cap with O-ring (2) and complete installation.

When compressed air is being used to prime, use the following steps:

- Insert clean air hose to pump inlet and restrict pump outlet. Turn shaft quarter turn and apply air pressure into manifold to put pressure on diaphragms. Note air 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.
- Replace oil fill cap with O-ring (2) and complete installation.

6. Reinstall Valve Plate (54), and Manifold (59)

- Install valve assemblies in valve plate (54) as outlined in paragraph 2, step k.
- Metallic Head: Using 5/8-in hex bit socket hand tighten, then torque, SHCS Center Bolt (58) to 180 ft-lbs (244 N-m). Using 3/8-in hex bit socket hand tighten, then torque, nine SHCS (56) to 65 ft-lbs (88 N-m).
- Non-Metallic Head: Using 3/8-in hex bit socket hand tighten, then torque, four SHCS (56) to 20 ft-lbs (27 N-m).
Warning do not overtighten as this can cause damage to the valve plate.
- Metallic Head: Reinstall ten O-rings (55) between valve plate (54) and manifold (59). Use petroleum jelly or lubricating gel to hold them in place.
- Non-Metallic Head: Reinstall three O-rings (71, 72, 73) between valve plate and manifold. Use petroleum jelly or lubricating gel to hold them in place.
- Reinstall manifold (59) onto valve plate (54). Be sure drain plug (62) is at bottom of manifold. If pumping head is non-metallic, support plate (74) is also used.
- Metallic Head: Insert all nine bolts (60) and nine washers (6) around edge of manifold. Using 3/4-in hex socket, hand tighten, then torque nine HHCS to 90 ft-lbs (122 N-m). Install all five SHCS (61). Using 3/8-in hex bit socket, hand tighten, then torque five SHCS to 65 ft-lbs (88 N-m).
- Non-Metallic Head: Insert all nine bolts (60) and nine washers (6) around edge of manifold. Using 3/4-in hex socket, hand tighten, then torque nine HHCS to 65 ft-lbs (88 N-m). Install one HHCS (75). Using 1-1/4 inch socket, hand tighten, then torque to 150 ft-lbs (203 N-m).
Warning do not overtighten as this can cause damage to pump head.

D/G-66 Service (Hydraulic End)

NOTE: The numbers in parentheses are the Reference Numbers on the exploded view illustrations found in the Parts Section.

Caution: Do not disassemble the hydraulic end of the pump unless you are a skilled mechanic. For assistance, contact Wanner Engineering (TEL 612-332-5681 or FAX 612-332-6937) or the distributor in your area.

Caution: The four socket head cap screws (5) that screw through the back of the pump housing (1) into the cylinder housing (48) hold these parts together. Do not remove these four screws except when repairing the hydraulic end.

NOTE: The following service procedures refer several times to the Wanner D/G-66 Tool Kit. We strongly urge you not to try to repair the hydraulic end of the pump without using the tools in this kit (available from Wanner or your local distributor). Refer also to the list of tools and supplies in the Fluid-End Service Section.

1. Remove Pump Housing

- a. Remove manifold (59), valve plate (54), and diaphragms (50), from pump housing (1). Refer to Fluid-End Service Section.
- b. Drain oil from pump housing by removing drain plug (8). Dispose of oil properly.
- c. Check shaft assembly (90) for sharp burrs. Smooth any burrs, to prevent scarring seals (7) when removing shaft assembly.
- d. Reinsert two cap screws (60) through cylinder housing (48) and into pump housing (1) from front end (at 10 and 2 o'clock positions) to support parts as pump is being disassembled. Install shaft rotator (from D/G-66 Tool Kit) over shaft assembly. Push shaft rotator on all the way, so front of shaft rotator touches pump housing. Tighten shaft rotator set screw into keyway. This keeps shaft assembly (90) attached to pump housing (1) when cylinder housing (48) is removed.
- e. One at a time, remove each of the four cap screws (5) from cylinder housing (48) and replace with an assembly stud (from the D/G-66 Tool Kit). Tighten nuts to within 3/4 in. (17 mm) from cylinder housing.
NOTE: The assembly studs will catch the cylinder housing as it is unbolted and allow the cylinder housing to be removed slowly under spring tension.
- f. Slide cylinder housing out on two cap screws (60) that were inserted for support in Step d above.
NOTE: The preload on the piston return springs will push the cylinder housing out of the pump housing. Remove the cylinder housing assembly.
- g. Remove cam assembly (90) by loosening set screw in the shaft rotator and sliding the shaft assembly out of seals (7). After removal from housing (1) inspect cam assembly.
CAUTION: These parts are heavy and may need a second person or a lifting device to remove them.
- h. Remove bearing adjustment plate (42) from the cylinder housing (48) and inspect the bearing cup (90A). Inspect all parts for wear and replace if necessary.

- i. Inspect Housing Bearing (90B) after removal of the cam assembly (90) from the pump housing (1).

NOTE: If the bearings are pitted or binding, or if the bearing cup in the housing is worn, contact Wanner Engineering.

CAUTION: If a bearing cup or bearing cone is replaced, they must be replaced as a pair or premature failure will result.

2. Disassemble Pistons

- a. Place cylinder housing assembly (48) on clean flat surface, with piston-fee side down.
- b. With diaphragms (50) removed (see the Fluid-End Service Section), thread 3/8-in x 3" SHCS screw approximately three turns into one of valve plungers (32). Tap screw lightly with hammer, and plunger (49) should slip off the valve plunger. Remove 3/8-in x 3" SHCS screw. Piston assembly (91) can then be removed. Repeat for remaining cylinders.
- c. Inspect and clean all parts of piston assembly (91). Replace O-rings and any other parts that are worn or damaged. Repeat on remaining piston assemblies.

3. Reassemble Pistons

NOTE: When reassembling the hydraulic pistons, use new plungers (49). They are press-fit onto the valve plungers (32) and are not reusable.

- a. Drop two steel balls (27) into bottom of piston assembly (92). **NOTE:** Using grease on the O-rings, and lubricating the parts, will aid in assembly.
- b. Insert retaining washer (28) to hold steel balls in place.
- c. Insert valve plunger (32) into valve cylinder (30). Slide bias spring (33), separator (34), spring (35) over valve plunger (32) inside valve cylinder (30). The long bias spring goes first, followed by the separator, and finally the shorter stiffer spring (35).
- d. Insert one O-ring into the bottom of spring retainer (36).
- e. Install one O-ring (31) onto valve cylinder (30).
- f. Install two O-rings (29) onto spring retainer (36). Use grease to hold O-rings in place.
- g. Slide assembled valve cylinder (30), valve plunger (32), bias spring (33), separator (34), spring (35) into spring retainer (36).
- h. Slide complete cylinder-and-retainer assembly into piston assembly (92).
- i. Insert piston return spring (37) into piston assembly (92).
- j. Repeat steps a. through i. for remaining four piston assemblies.

4. Remove Shaft Seals (7)

Inspect shaft seals (7). Replace if they look damaged in any way. Remove shaft seals by pounding out from inside pump housing (1). Replace both shaft seals. Clean bore of pump housing with emery cloth.

D/G-66 Service (Hydraulic End)

5. Reassemble Pump Housing, Shaft Assembly, and Cylinder Housing

- a. With pump housing (1) horizontal and mounted on baseplate (11), insert cam assembly (90) into pump housing. If shaft seals (7) are still in pump housing, cover shaft keyway with masking tape and slide it through seals. Remove tape. Place shaft rotator (from D/G-66 Tool Kit) over end of cam assembly shaft and slide it up tight against pump housing. Keep cam assembly (90) horizontal and tight against pump housing bearing. Tighten shaft rotator set screw to shaft keyway. This will hold the cam assembly horizontal and aid in assembly.
- b. Install O-ring (38) into pump housing (1) O-ring groove. Use grease to hold O-ring in groove.
- c. Place cylinder housing (48) face-down on clean surface.
- d. Insert bearing adjustment plate (42), with bearing cup (90A), dowel pin (41), and key (40), into cylinder housing (48).
- e. Insert five piston assemblies into cylinder housing (48).
- f. Pick up cylinder housing assembly (48). To aid in assembly, insert two cap screws (60) through cylinder housing from front side (at 10 and 2 o'clock positions). Align cylinder housing (48) with pump housing (1) and thread the two cap screws into the pump housing. Slide the cylinder housing on until piston feet contact cam assembly (90). Insert up to eight more cap screws (60) through cylinder housing and into pump housing (1) to aid in alignment.
- g. Using 17-mm box-end wrench, install four 10-mm x 120-mm fully-threaded HHCS (from D/G-66 Tool Kit) through pump housing (1) where four socket head cap screws (5) were fastened. Tighten HHCS evenly. Cylinder housing assembly (48) will pull tight against pump housing (1). One at a time, remove fully-threaded HHCS and replace with cap screws (5). Tighten four cap screws to 65 ft-lbs (88 N-m).
- h. Remove shaft rotator.

6. Install Shaft Seals

- a. Cover cam assembly shaft keyway (90) with masking tape to protect inside diameter of seals. Grease shaft and slide on one shaft seal (7) up to pump housing (1). Pack inside (spring side) of second shaft seal (7) half- full of grease. Slide shaft seal on and flush against first shaft seal. Make sure outside diameters of two shaft seals are clean and free of grease. Remove protective tape from cam assembly shaft.
- b. Apply an anaerobic seal sealant or bearing retaining compound to outside diameter of shaft seals (7). Install shaft rotator/seal inserter (from the D/G-66 Tool Kit) over the cam assembly shaft. Using mallet, tap shaft rotator/seal inserter to push two seals into the pump housing (1). Wipe off excess sealant.

7. Reinstall Plungers

NOTE: If the plungers (49) have been removed from the valve plungers (32), do not reuse them. Install new ones.

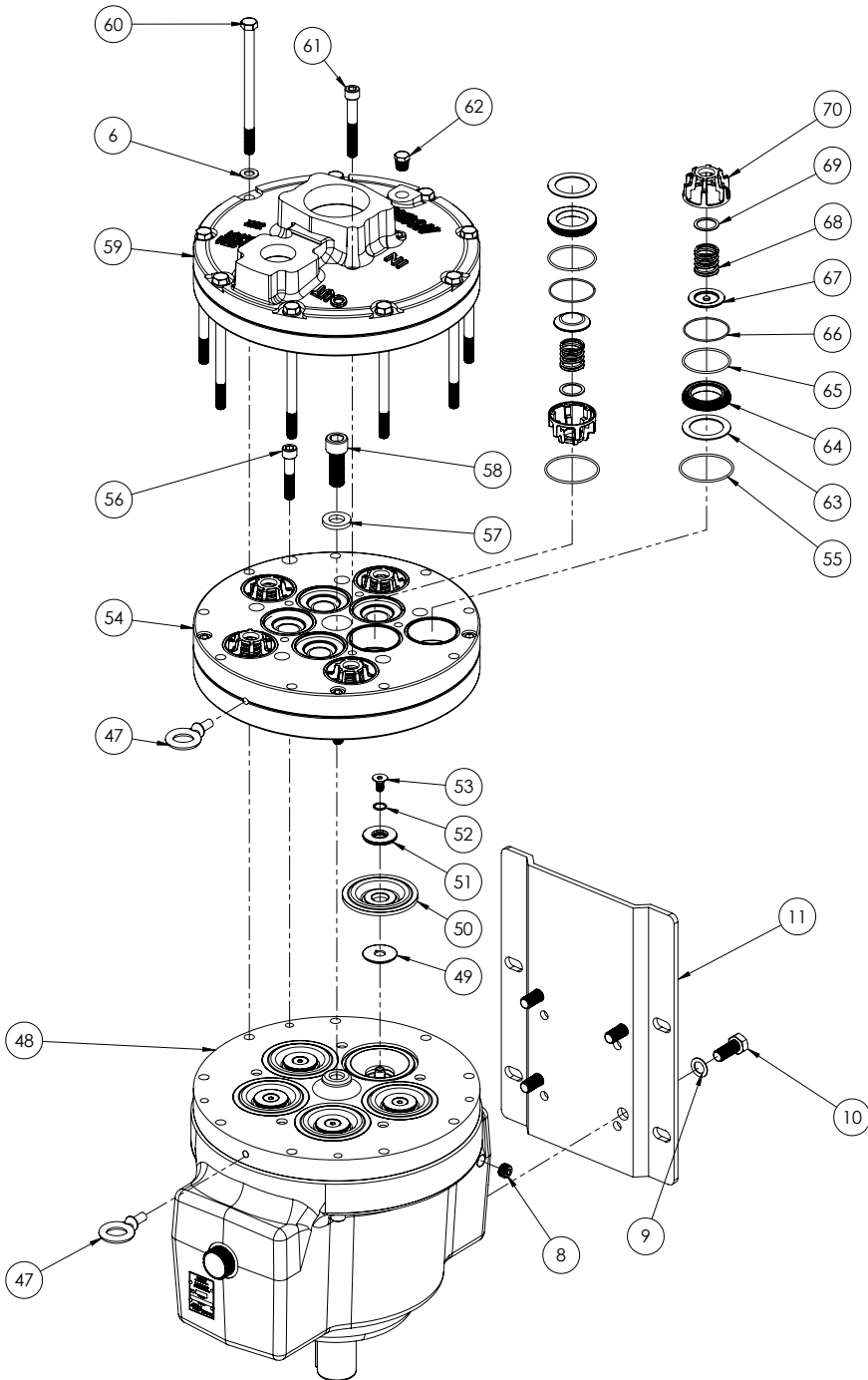
- a. Place plunger (49) onto exposed screw end of plunger guide lifter tool (from D/G-66 Tool Kit). The flat side of plunger should face plunger guide lifter tool.
- b. Screw plunger guide lifter tool (with plunger) into valve plunger (32) until tight.
- c. Pull valve plunger (32) up until its cross holes are exposed. Insert valve plunger holder (from D/G-66 Tool Kit) through top cross hole.
- d. Hold hex bolt with wrench. At the same time, tighten the hex nut against the plunger (49) with another wrench.
- e. Remove the plunger guide tool.
NOTE: Before removing the valve plunger holder tool, install new diaphragm. See Reinstall Diaphragms below.
- f. Repeat procedure for remaining cylinders.

8. Reinstall Diaphragm

NOTE: Keep the valve plunger holder tool installed in valve plunger (32) (as explained in Reinstall Plungers above).

- a. Clean female threads on valve plunger (32), then apply small amount of thread locker to female threads.
- b. Place O-ring (52) into follower (51).
- c. Place diaphragm (50) onto plunger (49), ridge side out.
- d. Center follower (51) on diaphragm.
- e. Clean threads on screw (53), then apply small amount of activator and thread locker to the screw.
- f. Insert follower screw (53), with O-ring (52), through follower (51) and diaphragm (50). Screw into valve plunger (32).
- g. Hold valve plunger holder tool and tighten screw (53) to 12 ft-lbs (16 N-m).
- h. Repeat above procedure for remaining cylinders.
- i. Fill reservoir with fresh oil and prime pump (See Fluid End Service Section).

D/G-66 Fluid End Parts - Metallic

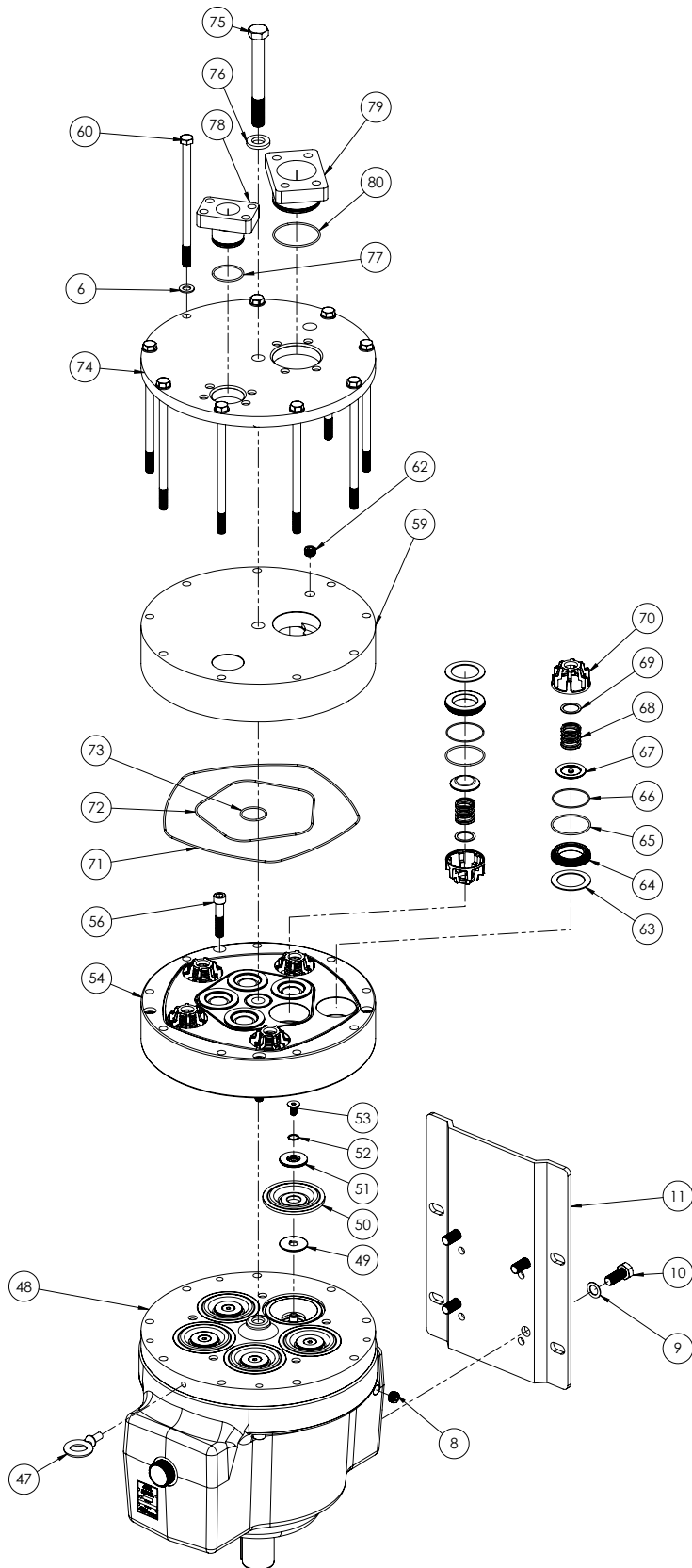


TORQUE/LOCTITE REQUIREMENTS		
ITEM#	TORQUE	LOCTITE#
8	--	567
10	--	609
53	12 FT-LBS	242
56	65 FT-LBS	--
58	180 FT-LBS	--
60	90 FT-LBS	--
61	65 FT-LBS	--

D/G-66 Fluid End Parts - Metallic

Ref. No.	Part Number	Description	Quantity/ Pump	Ref. No.	Part Number	Description	Quantity/ Pump
6	D40-048-2010	Hardened Washer, 1/2"	9	64	D66-020-1010	Valve Seat, 17-4 PH	10
8	D25-038-2211	Plug, 3/8 NPT	2		D66-020-1011	Valve Seat, Nitronic 50	10
9	D40-054-2010	Lockwasher, 5/8	4		D66-020-1017	Valve Seat, Hastelloy C276	10
10	D40-087-2010	Screw, 5/8 HHCS	4	65	D40-035-2110	O-Ring, Buna-N	10
11	D40-025-1010	Baseplate	1		D40-035-2111	O-Ring, FKM	10
47	D40-102-2000	Eyebolt, 7/16, Wanner Blue	2		D40-035-2113	O-Ring, EPDM	10
48	D66-002-1020	Cylinder Housing	1	66	D40-092-2110	O-Ring, Buna-N	10
49	D66-016-1010	Plunger	5		D40-092-2111	O-Ring, FKM	10
50	D66-018-2320	Diaphragm, Buna-N, 4"	5		D40-092-2113	O-Ring, EPDM	10
	D66-018-2315	Diaphragm, FKM, 4"	5	67	D66-021-1015	Disc, Valve, 17-4 PH	10
	D66-018-2313	Diaphragm, EPDM, 4"	5		D66-021-1011	Disc, Valve, Nitronic 50	10
51	D66-017-1010	Follower, SS 316	5		D66-021-1017	Disc, Valve, Hastelloy C276	10
	D66-017-1011	Follower, Hastelloy C276	5	68	D40-022-3110	Spring, 17-7 PH	10
52	D40-047-2110	O-Ring, Buna-N	5		D40-022-3118	Spring Elgiloy	10
	D40-047-2111	O-Ring, FKM	5		D40-022-3119	Spring, Hastelloy	10
	D40-047-2113	O-Ring, EPDM	5	69	D40-123-1010	Washer, Valve Spring, SS 316	10
53	D40-030-2010	Screw, 3/8 FHSC, SST	5		D40-123-1017	Washer, Valve Spring, Hastelloy	10
	D40-030-2017	Screw, 3/8 FHMS, T40, Hastelloy	5	70	D66-023-2310	Valve Spring Retainer, Celcon	10
54	D66-003-1007	Valve Plate, Iron	1		D66-023-2328	Valve Spring Retainer, PVDF	10
	D66-003-1002	Valve Plate, SS 316	1				
	D66-003-1003	Valve Plate, Brass	1				
	D66-003-1029	Valve Plate, Duplex 2205 SST	1				
	D66-003-1010	Valve Plate, NAB	1				
55	D66-085-2110	O-Ring, Buna-N	10				
	D66-085-2111	O-Ring, FKM	10				
	D66-085-2113	O-Ring, EPDM	10				
56	D40-101-2010	Screw, 1/2 SHCS	9				
57	D66-048-2024	Washer, 3/4"	1				
58	D66-081-2026	Screw, 3/4 SHCS	1				
59	D66-004-1029	Manifold, Ductile Iron, SAE	1				
	D66-004-1030	Manifold, Ductile Iron, NPT	1				
	G66-004-1030	Manifold, Ductile Iron, BSPT	1				
	D66-004-1032	Manifold, SS 316, SAE	1				
	D66-004-1033	Manifold, SS 316, NPT	1				
	G66-004-1033	Manifold, SS 316, BSPT	1				
	D66-004-1038	Manifold, Manganese Bronze, SAE	1				
	D66-004-1039	Manifold, Manganese Bronze, NPT	1				
	G66-004-1039	Manifold, Manganese Bronze, BSPT	1				
	D66-004-1036	Manifold, Duplex 2205 SST, SAE	1				
	D66-004-1037	Manifold, Duplex 2205 SST, NPT	1				
	G66-004-1037	Manifold, Duplex 2205 SST, BSPT	1				
60	D66-048-2014	Screw, 1/2 HHCS	9				
61	D66-029-2019	Screw, 1/2" SHCS	5				
62	D25-038-2210	Fitting, Plug Pipe, 3/8 NPT, Brass	1				
	D25-038-2211	Fitting, Plug Pipe, 3/8 NPT, 316 SST	1				
63	D40-125-2310	Washer, Dampening, Celcon	10				
	D40-125-2318	Washer, Dampening, PVDF	10				

D/G-66 Fluid End Parts - Non-Metallic



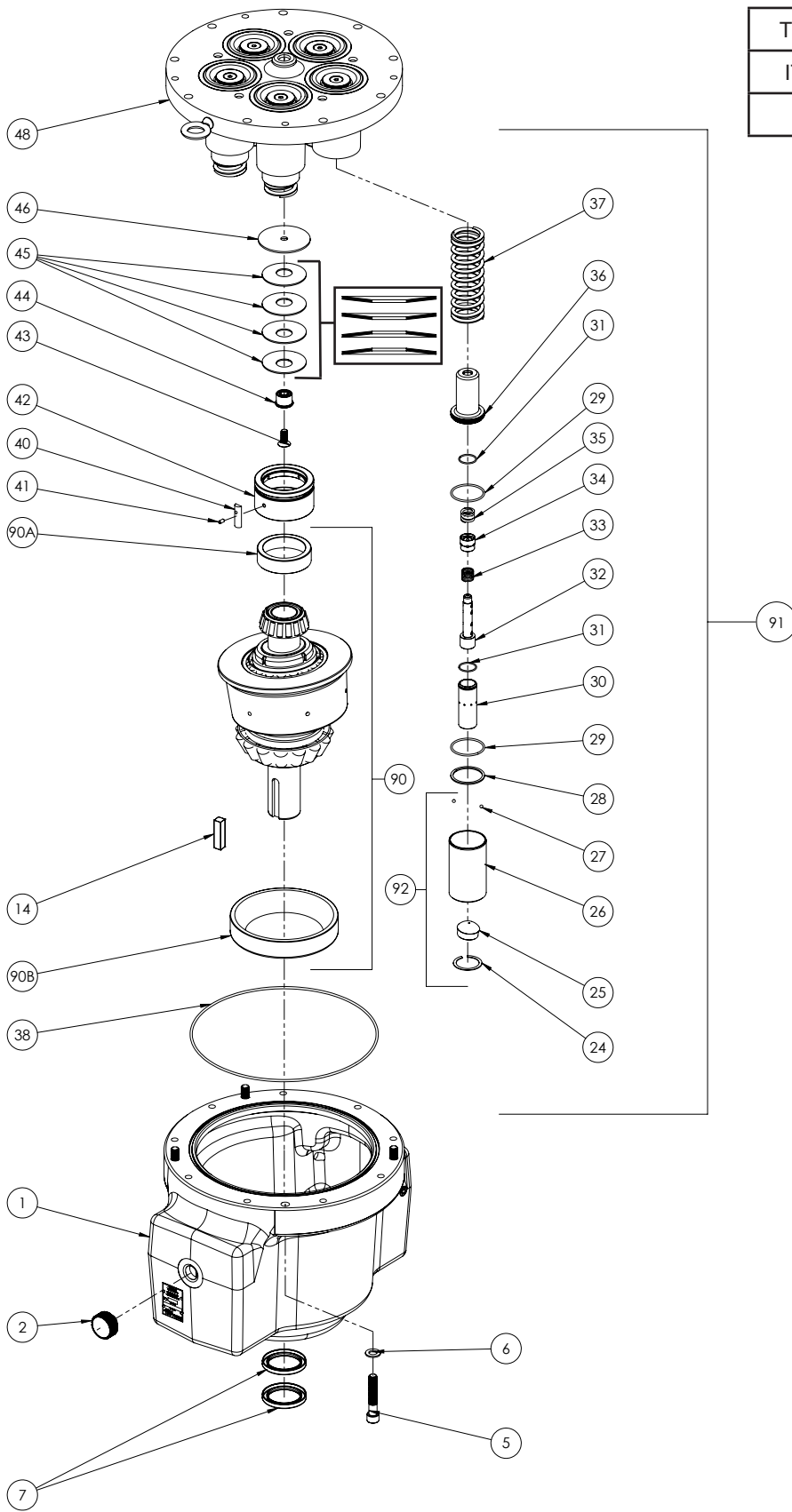
TORQUE/LOCTITE REQUIREMENTS		
ITEM#	TORQUE	LOCTITE#
8	--	567
10	--	609
53	12 FT-LBS	242
56	20 FT-LBS	--
60	65 FT-LBS	--
75	150 FT-LBS	--

D/G-66 Fluid End Parts - Non-Metallic

Ref. No.	Part Number	Description	Quantity/ Pump
6	D40-048-2010	Hardened Washer, 1/2"	9
8	D25-038-2211	Plug, 3/8 NPT	2
9	D40-054-2010	Lockwasher, 5/8	4
10	D40-087-2010	Screw, 5/8 HHCS	4
11	D40-025-1010	Baseplate	1
47	D40-102-2000	Eyebolt, 7/16, Wanner Blue	1
48	D66-002-1020	Cylinder Housing	1
49	D66-016-1010	Plunger	5
50	D66-018-2320	Diaphragm, Buna-N, 4"	5
	D66-018-2315	Diaphragm, FKM, 4"	5
	D66-018-2313	Diaphragm, EPDM, 4"	5
51	D66-017-1010	Follower, SS316	5
	D66-017-1011	Follower, Hastelloy C276	5
52	D40-047-2110	O-Ring, Buna-N	5
	D40-047-2111	O-Ring, FKM	5
	D40-047-2113	O-Ring, EPDM	5
53	D40-030-2010	Screw, 3/8 FHSC, SST	5
	D40-030-2017	Screw, 3/8 FHMS, T40, Hastelloy	5
54	D66-003-1050	Valve Plate, Polypropylene	1
56	D40-101-2010	Screw, 1/2 SHCS	4
59	D66-004-1050	Manifold, Polypropylene	1
60	D66-029-2020	Screw, 1/2 HHCS	9
62	D66-038-2015	Pipe Plug, 3/8-18, Polypropylene	1
63	D40-125-2310	Washer, Dampening, Celcon	10
	D40-125-2318	Washer, Dampening, PVDF	10
64	D66-020-1010	Valve Seat, 17-4 PH	10
	D66-020-1011	Valve Seat, Nitronic 50	10
	D66-020-1017	Valve Seat, Hastelloy C276	10
65	D40-035-2110	O-Ring, Buna-N	10
	D40-035-2111	O-Ring, FKM	10
	D40-035-2113	O-Ring, EPDM	10
66	D40-092-2110	O-Ring, Buna-N	10
	D40-092-2111	O-Ring, FKM	10
	D40-092-2113	O-Ring, EPDM	10
67	D66-021-1015	Disc, Valve, 17-4 PH	10
	D66-021-1011	Disc, Valve, Nitronic-50	10
	D66-021-1017	Disc, Valve, Hastelloy C276	10
	D66-021-3300	Disc, Valve, Ceramic	10
68	D40-022-3110	Spring, 17-7 PH	10
	D40-022-3118	Spring Elgiloy	10
	D40-022-3119	Spring, Hastelloy	10
69	D40-123-1010	Washer, Valve Spring, SS316	10
	D40-123-1017	Washer, Valve Spring, Hastelloy	10
70	D66-023-2310	Valve Spring Retainer, Celcon	10
	D66-023-2328	Valve Spring Retainer, PVDF	10

Ref. No.	Part Number	Description	Quantity/ Pump
71	D66-081-2110	O-Ring, Buna-N	1
	D66-081-2111	O-Ring, FKM	1
	D66-081-2113	O-Ring, EPDM	1
72	D66-080-2110	O-Ring, Buna-N	1
	D66-080-2111	O-Ring, FKM	1
	D66-080-2113	O-Ring, EPDM	1
73	D66-084-2110	O-Ring, Buna-N	1
	D66-084-2111	O-Ring, FKM	1
	D66-084-2113	O-Ring, EPDM	1
74	D66-100-1011	Support Plate	1
75	D66-031-2020	Screw, 3/4 HHCS	1
76	D66-048-2024	Washer, 3/4"	1
77	D66-083-2110	O-Ring, Buna-N	1
	D66-083-2111	O-Ring, FKM	1
	D66-083-2113	O-Ring, EPDM	1
78	D66-200-0107	Adapter, SAE Outlet	1
79	D66-200-0106	Adapter, SAE Inlet	1
80	D66-082-2110	O-Ring, Buna-N	1
	D66-082-2111	O-Ring, FKM	1
	D66-082-2113	O-Ring, EPDM	1

D/G-66 Hydraulic End Parts



TORQUE/LOCTITE REQUIREMENTS		
ITEM#	TORQUE	LOCTITE#
43	--	242

D/G-66 Hydraulic End Parts

Ref. No.	Part Number	Description	Quantity/ Pump
1	D66-001-1010	Housing	1
2	D03-039-1030	Assembly, Oil Cap with O-ring	1
5	D40-101-2040	Screw, 1/2 SHCS	4
6	D40-048-2010	Hardened Washer, 1/2"	4
7	D40-031-2110	Shaft Seal.....	2
14	D40-085-2210	Shaft Key.....	1
24	D40-050-1010	Retainer, Foot.....	5
25	D40-013-1010	Foot	5
26	D66-014-1010	Piston	5
27	D10-015-3010	Ball, .1875 Dia	10
28	D40-041-1010	Retainer, Ball.....	5
29	D40-034-2110	O-Ring, Buna-N.....	10
30	D66-043-1010	Valve Cylinder	5
31	D10-034-2110	O-Ring, Buna-N	10
32	D40-044-1010	Valve Plunger	5
33	D66-019-3110	Spring, Low Pressure Bias.....	5
34	D66-005-1000	Separator, Kel-Cell.....	5
35	D66-019-3112	Spring	5
36	D66-042-1010	Retainer, Return Spring.....	5
37	D40-019-3112	Spring, Piston Return	5
38	D40-037-2110	O-Ring, Buna-N	1
40	D35-113-1010	Key, Round Radius.....	1
41	D35-110-2011	Pin Dowel, 3/16"	1
42	D35-012-1011	Bearing Carrier.....	1
43	G35-115-2011	Screw, M10 SFHC.....	1
44	D35-112-1011	Guide, Disc Spring	1
45	D40-075-3110	Spring Disc Adjusting Plate.....	4
46	D35-116-1010	Backup Washer	1
48	D66-002-1020	Cylinder Housing.....	1
90	D66-007-1220	Cam Assembly	1
91	D66-014-1210	Piston Assembly.....	5
92	D66-014-1209	Foot Piston Assembly	5

D/G-66 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.
	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.

D/G-66 Replacement Parts Kits

TO ORDER REPLACEMENT PARTS KIT: A Replacement Parts Kit contains 11 digits corresponding to customer-specified design options.

1	2	3	4	5	6	7	8	9	10	11
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Digit	Code	Order Description
1-3		Pump Configuration
	D66	For all D66 Pumps
	G66	For all G66 Pumps
4		Kit Designator
	K	Complete Fluid End Kit
	D	Diaphragm Kit
	V	Valve Kit (diaphragms not included)
5-6		Pump Head Material
	52	Metallic Pump Head Version
	55	Non-metallic Pump Head Version
7		Diaphragm & O-ring Material
	E	EPDM Metallic Pump Head
	G	FKM Metallic Pump Head
	H	FKM Non-metallic Pump Head
	R	EPDM Non-metallic Pump Head
	T	Buna-N Metallic Pump Head
	U	Buna-N Non-metallic Pump Head
8		Valve Seat Material
	H	17-4 Stainless Steel
	N	Nitronic® 50
	T	Hastelloy® C
	X	Not included in Diaphragm Kit
9		Valve Material
	F	17-4 Stainless Steel
	N	Nitronic® 50
	T	Hastelloy® C
	X	Not included in Diaphragm Kit
10		Valve Springs
	E	Elgiloy® (Exceeds SST grade 316L)
	H	17-7 Stainless Steel
	T	Hastelloy® C
	X	Not included in Diaphragm Kit
11		Valve Spring Retainers
	C	Celcon®
	M	PVDF
	X	Not included in Diaphragm Kit

Kit Contents			Kit Designator		
Part Number*	Description	QTY	K	D	V
D66-018-__	Diaphragm	5	•	•	
D40-047-__	O-ring, follower	5	•	•	
D66-085-__	O-ring, manifold ^{1,3}	10	•	•	•
D66-084-__	O-ring, Center bolt manifold ²	1	•	•	•
D66-080-__	O-ring, Inner manifold ²	1	•	•	•
D66-081-__	O-ring, Outer manifold ²	1	•	•	•
D40-035-__	O-ring, valve seat**	10	•		•
D66-020-__	Valve seat**	10	•		•
D66-021-__	Valve**	10	•		•
D40-022-__	Valve spring**	10	•		•
D40-092-__	Tetra seal**	10	•		•
D66-023-__	Retainer, Valve**	10	•		•
D40-123-__	Washer, valve spring**	10	•		•
D40-125-__	Washer, Dampening	10	•		•
A01-113-3400	Threadlocker	1	•	•	

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

**These parts may come pre-assembled as a cartridge valve assembly.

Hydra-Cell® is a registered trademark of Wanner Engineering, Inc.
 Kel-Cell® is a registered trademark of Wanner Engineering, Inc.
 Celcon® is a registered trademark of the Celanese Company.
 Elgiloy® is a registered trademark of Elgiloy Limited Partnership
 Hastelloy® C is a registered trademark of Haynes International, Inc.
 Nitronic® 50 is a registered trademark of AK Steel Corporation

¹ D66 Metallic.

³ G66 Metallic.

² D66 Non-metallic.

D/G-66 Warranty

Limited Warranty

Wanner Engineering, Inc. ("Wanner") extends to the original purchaser of equipment supplied or manufactured by Wanner and bearing its name, a limited one-year warranty from the date of purchase against defects in material or workmanship, under normal use and service, and provided the equipment is installed, operated and maintained in accordance with instructions supplied by Wanner. Wanner will repair or replace, at its option, defective parts without charge if: (a) you provide written notice of any defect within thirty (30) days from the discovery of the defect; (b) the claim is received by Wanner before the expiration of the warranty period; and (c) such parts are returned with transportation charges prepaid to Wanner Engineering, Inc., 1204 Chestnut Avenue, Minneapolis, Minnesota 55403. A return goods authorization must be received prior to the return of the defective part. No allowance will be made for repairs undertaken without Wanner written consent or approval.

Notwithstanding anything to the contrary, this warranty does not cover:

1. Electric motors (if applicable) not manufactured by Wanner. The warranties, if any, on such equipment are assigned to you by Wanner (without recourse) at the time of purchase.
2. Normal wear and/or damage caused by or related to abrasion, corrosion, abuse, negligence, accident, faulty installation or tampering which impairs normal operation.
3. Transportation costs.

This limited warranty is exclusive, and is in lieu of any other warranties (oral, express, implied or statutory) including, but not limited to, implied warranties of merchantability and fitness for a particular purpose; warranties of non-infringement; warranties arising from course of dealing or usage of trade or any other matter. Any descriptions of the equipment, drawings, specifications, and any samples, models, bulletins, or similar material used in connection with the sale of equipment are for the sole purpose of identifying the equipment and are not to be construed as an express warranty that the equipment will conform to such description. Any field advisory or installation support is advisory only. Every form of liability for direct, special, incidental or consequential damages or loss is expressly excluded and denied. All liability of Wanner shall terminate one (1) year from the date of purchase of the equipment.



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