D-04/G-04 Contents

D-04/G-04 Specifications

Maximum Capacity @ max rated pressure				
	rpm	gpm	l/min	
D/G-04-X	1750	2.88	10.9	
D/G-04-E	1750	2.03	7.7	
D/G-04-S	1750	1.42	5.4	
Delivery				
	psi	bar	revs/gal	revs/liter
D/G-04-X	500	34.5	564	149
	1500	103.5	585	154
	2500	172	611	161
D/G-04-E	500	34.5	746	196
	1500	103.5	804	211
	2500	172	867	228
D/G-04-S	500	34.5	1,017	268
	1500	103.5	1,100	289
	2500	172	1,239	326

Max Inlet Pressure	500 psi (34.5 bar)
Pressure Variable to	2,500 psi (172 bar)
Max Temperature	250°F (121°C) – consult factory for temperatures above 160°F (71°C)
Inlet Port	D-04: 1/2 inch NPT G-04: 1/2 inch BSPT
Discharge Port	D-04: 1/2 inch NPT G-04: 1/2 inch BSPT
Shaft Diameter	7/8 inch (22.23 mm)
Shaft Rotation	Bi-directional
Bearings	Ball bearings
Oil Capacity	1.1 US quarts (1.05 liters)
Weight	37 lbs (16.8 kg)

Calculating Required Horsepower

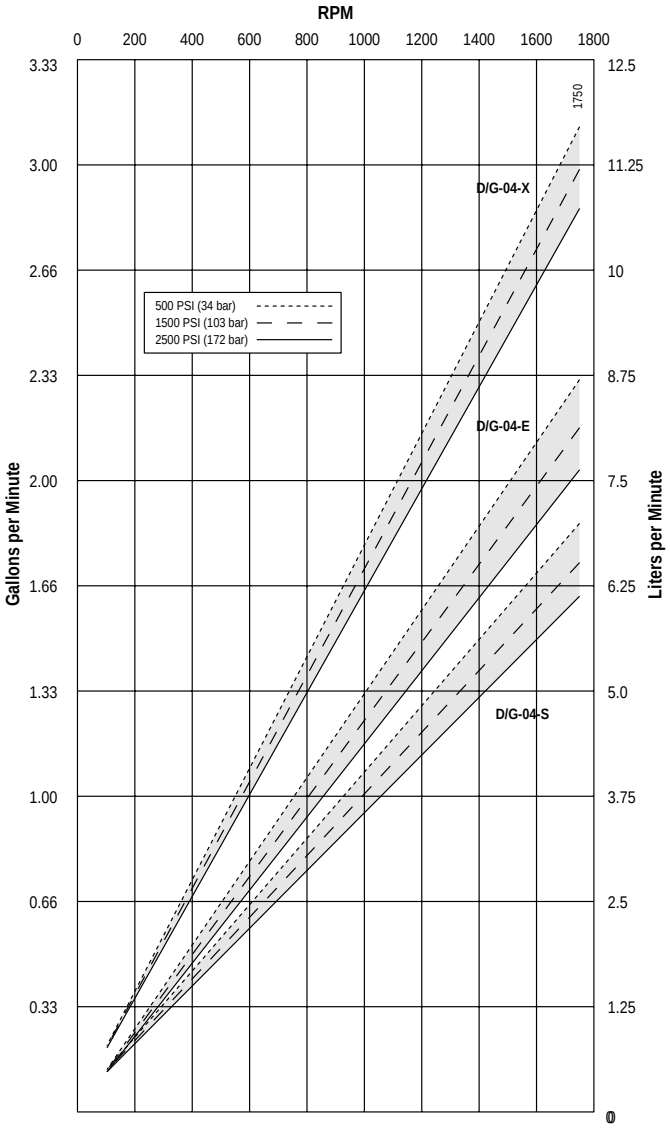
$$\frac{6 \times \text{rpm}}{63{,}000} + \frac{\text{gpm} \times \text{psi}}{1{,}460} = \text{electric motor HP*}$$

$$\frac{6 \times \text{rpm}}{84{,}428} + \frac{\text{lpm} \times \text{bar}}{511} = \text{electric motor kW*}$$

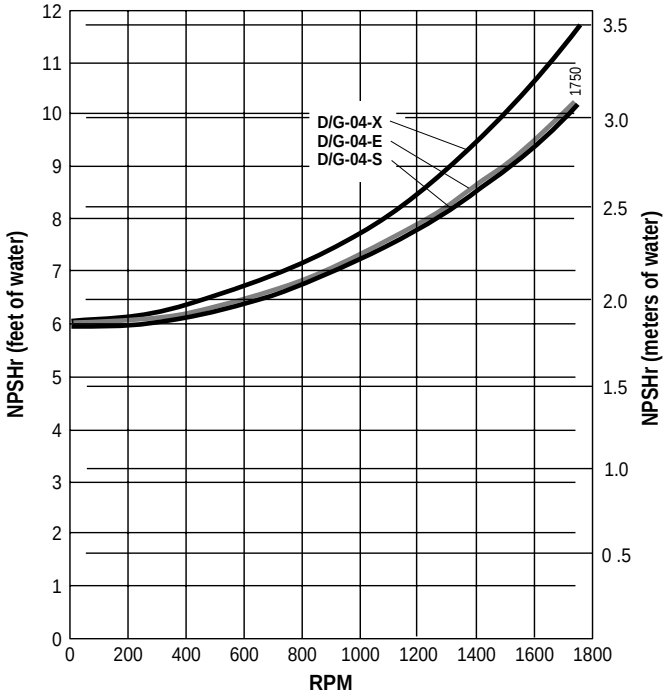
* HP and kW required for electric motors; must be at rpm used in calculation. Consult engine manufacturer for gasoline or diesel power requirements.

D-04/G-04 Specifications

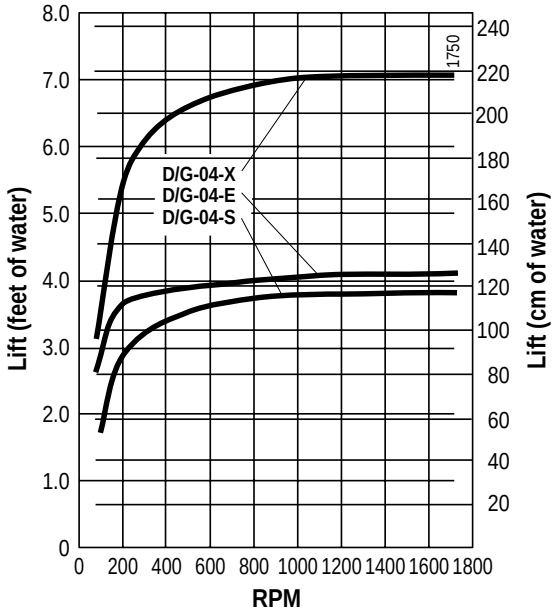
Performance



Net Positive Suction Head – NPSHr



Dry Lift



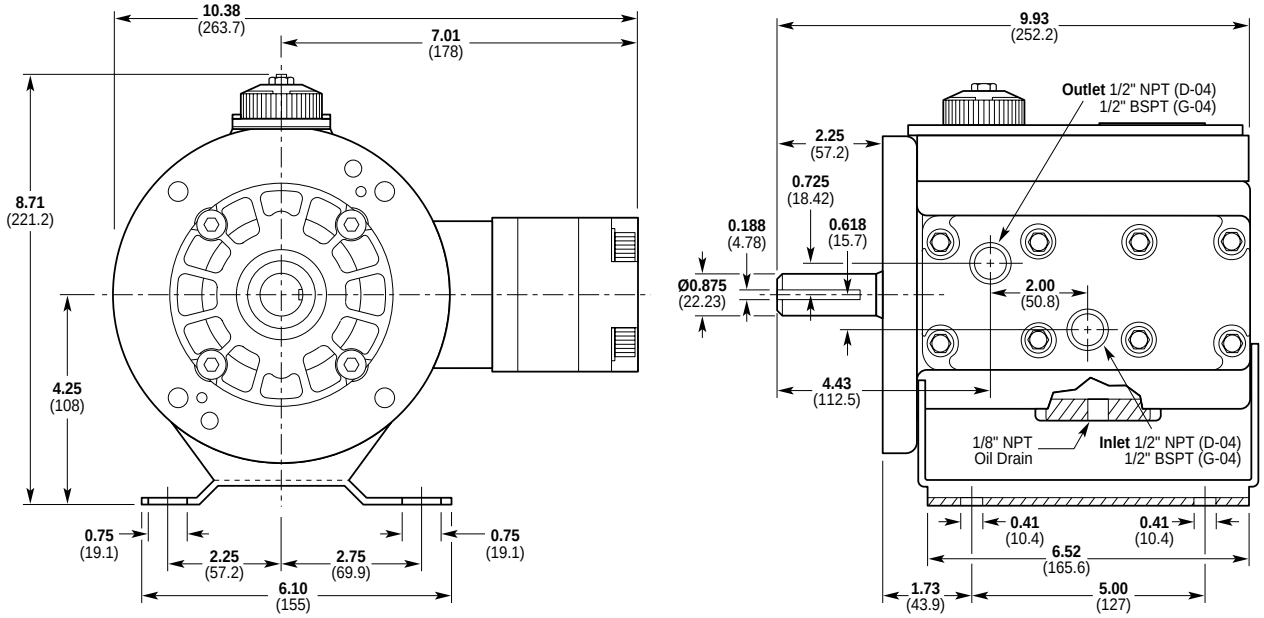
D-04/G-04 Dimensions

D-04/G-04 Models with Metallic Pumping Head

Brass

304 Stainless Steel

316 Stainless Steel



D-04/G-04 Installation

NOTE: The numbers in parentheses are the Reference Numbers on the illustrations in the Parts Manual.

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, securely attach the pump to a 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 .015" and angular misalignment should be held to 1 degree maximum. Careful alignment extends life of the coupling, pump, shafts, and support bearings. Consult coupling manufacturer for exact alignment tolerances.

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

Important Precautions

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

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

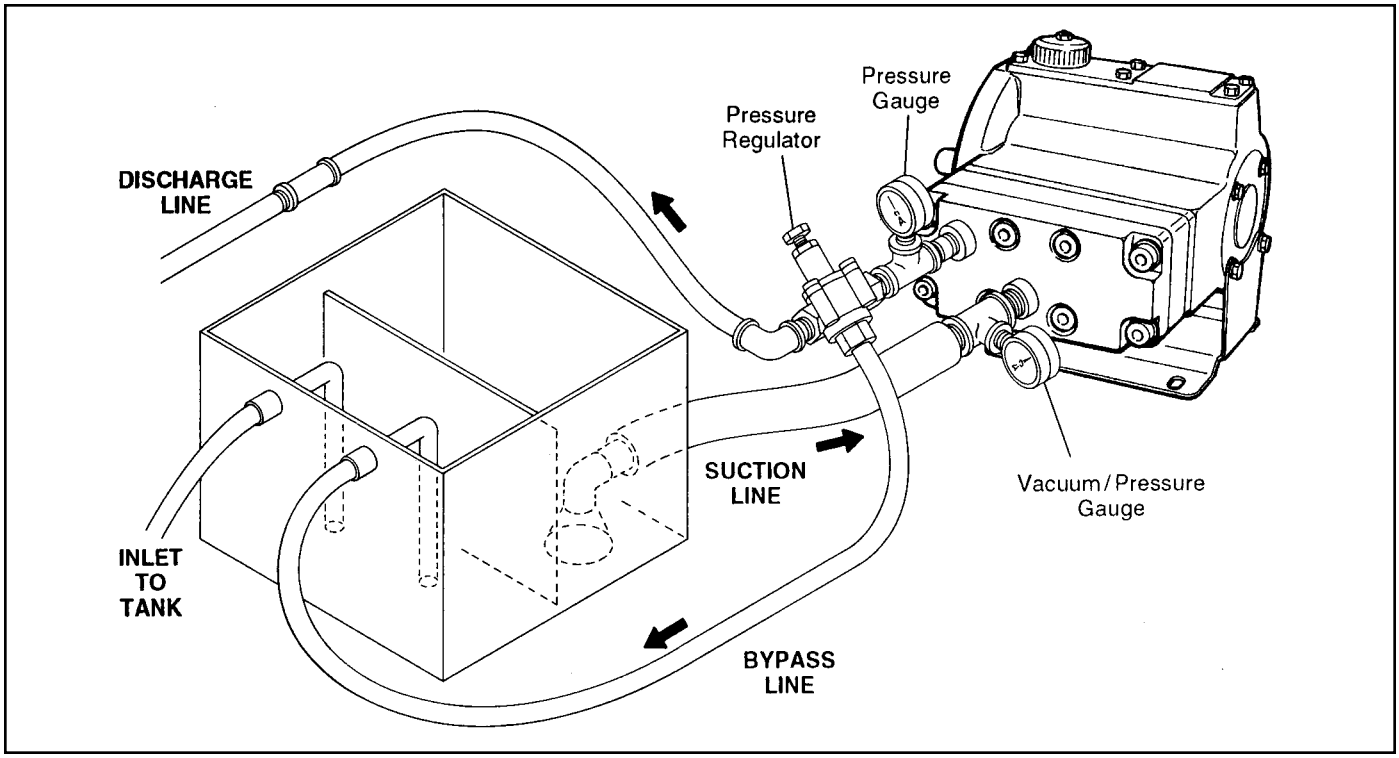
Safety Guards. Install adequate safety guards over all pulleys, belts, and couplings. Follow all codes and regulations regarding installation and operation of the pumping system.

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.

Consult the Factory for the following situations:

- Extreme temperature applications above 160° F (71°C) or below 40° F (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



D-04/G-04 Installation

Inlet Piping (Suction Feed)

CAUTION: When pumping at temperatures above 160° F (71° C), use a pressure-feed system.

Install draincocks 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, vacuum at the pump inlet should not exceed 7 in. Hg at 3 gpm and 70° F (180 mm Hg at 11.4 liters/min and 21° C). **Do not supply more than one pump from the same inlet line.**

Supply Tank

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

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.

If a line strainer is used in the system install it in the inlet line to the supply tank.

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 Size and Routing

Use the shortest, most-direct route from the supply tank to the pump. If elbows are needed, 45° are recommended. Any restrictions in the inlet piping may cause pump output to drop. **Do not install any 90° elbows in the pump inlet.**

- Use flexible noncollapsible hose between the pump and rigid piping or supply tank. This will absorb vibration, and allow for expansion or contraction.
- Use the largest practical hose. The smallest permissible size is 5/8 in. (16 mm) I.D.
- All valves, fittings, and unions must also have 5/8-in. (16 mm) minimum I.D. Do not exceed 5 feet of hose and piping between and supply tank and the pump inlet.
- Support the pump and piping independently.
- Make sure all joints are sealed and tight, to prevent the pump from drawing air into the inlet.
- Do not use a line strainer or filter in the suction line unless regular maintenance is assured. If used, it should have a free-flow area of at least three times the free-flow area of the inlet.

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 500 psi (34 bar); if it could get higher, install an inlet pressure 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) [$V = GPM \times (0.408 \div \text{pipe ID}^2)$]

N= RPM of crank shaft

C= Constant determined by type of pump — use 0.066 for the D-04 and G-04 Hydra-Cell 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/sec^2)

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., Hf = 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 Hf 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 flowrate, 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 5 ft (1.5 m) long
- Use at least 5/8 in. (16 mm) I.D. inlet hose
- Use soft hose (low-pressure hose, noncollapsing) for the inlet lines
- 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 = Pt + Hz - Hf - Ha - Pvp

where:

Pt = Atmospheric pressure

Hz = Vertical distance from surface liquid to pump centerline (if liquid is below pump centerline, the Hz is negative)

Hf = Friction losses in suction piping

Ha = Acceleration head at pump suction

Pvp = Absolute vapor pressure of liquid at pumping temperature

NOTES:

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

Atmospheric Pressure at Various Altitudes

Altitude (ft)	Pressure (ft of H_2O)	Altitude (ft)	Pressure (ft of H_2O)
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.

NOTE: Single-acting pumps create a pulsing flow. Using pulsation dampening devices in the discharge line can reduce or eliminate this.

Hose and Routing

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

Select pipe or hose with a **working pressure** rating of at least 1.5 times the maximum system pressure. EXAMPLE: Select a 3000-psi W.P.-rated hose for systems to be operated at 2000-psi-gauge pressure.

Use about 6 ft (1.8 m) of flexible hose between the pump and rigid piping.

Support the pump and piping independently.

Pressure Regulation

IInstall a pressure regulator or unloader in the discharge line. Bypass pressure must not exceed the pressure limit of the pump.

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

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

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

Route the bypass line to the supply tank, or to the suction line as far as possible from the pump (to reduce the chance of turbulence and cavitation).

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).

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

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

For additional system protection, install a "pop-off" safety relief valve in the discharge line, downstream from the pressure regulator.

D-04/G-04 Installation

Before Initial Start-Up

Before you start the pump, be sure that:

- All shutoff valves are open, and the pump has an adequate supply of fluid.
- All connections are tight.
- The oil level is 1/4 inch (6 mm) above the cast surface in the upper oil reservoir.
- 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.

Initial Start-Up Procedure

1. Turn on power to the pump motor.
2. Check the inlet pressure or vacuum. To maintain maximum flow, inlet vacuum must not exceed 7 in. Hg at 70° F (180 mm Hg at 21° C). Inlet pressure must not exceed 500 psi (34 bar).
3. Listen for any erratic noise, and look for unsteady flow. If the pump does not clear, refer to the Trouble-shooting Section.
4. If the system has an air lock and the pump fails to prime:

   a. Turn off the power.

   b. Remove the pressure gauge or plug from the tee fitting at the pump outlet (refer to the illustration on page 3).

   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 the system on and off until the fluid coming from this port is air-free.

   d. Turn off the power.

   e. Remove the plumbing that was temporarily installed, and reinstall the pressure gauge or plug.
5. Adjust the discharge pressure regulator to the desired operating and bypass pressures. Do not exceed the maximum pressure rating of the pump.
6. After the pressure regulator is adjusted, set the “pop-off” safety relief valve at 100 psi (7 bar) higher than the desired operating pressure. To verify this setting, adjust the discharge pressure regulator upward until the relief valve opens. Follow the recommendations in the above NOTE (step 4b) for handling the fluid that will come from the relief valve.
7. Reset the discharge pressure regulator to the desired system pressure.
8. Provide a return line from the relief valve to the supply tank, similar to the bypass line from the pressure regulator.