SELECTION & APPLICATION OF SELF-PRIMING CENTRIFUGAL PUMPS

GORMAN-RUPP PUMPS

PUMP SELECTION
To assist with the selection of self-priming pumps, we have created the following hypothetical scenario. You might encounter a job that might concern engineers and users.

We shall assume there is a requirement for a submersible system in a sump or pit to invert the wastewater to a pretreatment collection system.

The accumulation of the preceding data now permits calculating the Total Dynamic Suction Lift (TDSL), Total Head at Inlet (TDH), and Net Positive Suction Head (NPSH) according to the following equations.

1. Determine the suction lift (TDH) which is the vertical distance from the low liquid level to the center line of the pump suction flange. We will use 15’ (4.6 m) vertical distance from center line of pump suction to center line of discharge outlet.

2. Calculate the Static Head.

3. Calculate the Static Discharge Head (TDH) using the worksheets on the following pages.

4. Calculate the Priming Lift.

5. Calculate the Total Dynamic Suction Lift (TDSL) = TDH + Static Head + Priming Lift (or TDH + Total Head at Inlet + 0).

6. Determine the NPSH required. To do this: Subtract TDH from TDSL.

7. Select a pump that is equal to or greater than the NPSH calculated.

SYSTEM REQUIREMENTS

1. Pumps
2. Base
3. Flange & Flare
4. L.R. 90° Bend or 45° Elbow
5. Entrance to Sump/Wet Well
6. Suction Flare
7. Electric Motor (2)
8. Control Panel
9. Pump Drain Kit
10. 3-Way Valve (1)
11. Air Release Valve (2)
12. Discharge Check Valve (2)

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SELF-PRIMING | THE SENSIBLE SOLUTION

Self-priming pumps are a sensible solution for industrial and municipal applications. They require very little attention, resulting in significant savings of maintenance time and money. Gorman-Rupp self-priming centrifugal pumps are available in the 0, 10, and 80 Series for a wide range of applications. A centrifugal pump can be self-priming, providing a mechanism for the pump to fill itself with liquid. Gorman-Rupp offers a variety of self-priming pumps tailored to your needs.

Flexible Coupled V-Belt Engine-Driven

- Centrifugal
- Flexible Coupled
- V-Belt

Although the pump is the heart of a pumping station, other elements must be considered when designing a system. This example identifies some of the factors that can make up a system.

System Conditions

- Head: 150' (45.7 m) above sea level
- Inflow: 250 gpm (152.6 lps)
- Friction losses: 4.5' (1.37 m)
- Sump/Wet Well: 10' (3.0 m)
- Hydraulic Capacity: 150 gpm (93.7 lps)
- Electric Motor: 20 HP
- Pump Station Enclosure
- Inlet Pipe 4" (100 mm) C.I. pipe. Measured from end of capillary pipe (for friction loss calculation).

Pump Selection

To assist in the selection of self-priming pumps, we created the following hypothetical example. We chose a 2400 gpm (149 lps) centrifugal pump to supply 200 gpm (12.6 lps) to a system.

- Head: 150' (45.7 m) above sea level
- Sump/Wet Well: 10' (3.0 m)
- Pressure: 100 psi (6.9 bar)
- Hydraulic Capacity: 150 gpm (93.7 lps)
- Electric Motor: 20 HP
- Pump Station Enclosure

- Inlet Pipe: 4" (100 mm) C.I. pipe. Measured from end of capillary pipe (for friction loss calculation).

Pump Selection

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The following data were acquired by actual accurate measurements.
Self-priming pumps are a sensible solution for industrial and municipal applications. They require very little attention, readjusting or significant savings of maintenance time and money. Gorman-Rupp self-priming centrifugal pumps are available in many configurations and applications. The Self-priming pump can be vertical or horizontal, and typical applications include: water, waste water, other slurries, sump applications, and many more. Classic Gorman-Rupp self-priming pumps are available in a variety of materials, including carbon steel, stainless steel, and various corrosion-resistant alloys. The design of self-priming pumps allows them to perform effectively in the absence of suction head and to excel in high-head situations where traditional pumps fall short. Gorman-Rupp self-priming centrifugal pumps are easy to install and easy to service. Because they have only one moving part – impeller and shaft – and no suction or discharge check valves – no maintenance problems are created. A full line of Gorman-Rupp self-priming pumps is available as basic units for connection to your power source or may be flex-coupled, v-belt driven or engine mounted. The most efficient solids-handling configuration capabilities allow these pumps to do it with the pump casing only straight-in suction which eliminates entrance restrictions and provides better suction and discharge (2) - the calculation being of an essential function throughout the installation. 

**SELF-PRIMING | THE SENSIBLE SOLUTION**

**Solids-handling High-Heads V-Belt**

- **Centrifugal** provide 60% increased flow. Self-cleaning pumps handle 200% more pressure and 80 Series® configuration capabilities allow these pumps to do it with the pump casing only straight-in suction which eliminates entrance restrictions and provides better suction and discharge (2) - the calculation being of an essential function throughout the installation.

**PUMPS**

**Ultra V Series®**
- Max. Head: 400’ (121.9 m)
- Max. Solids: 1.25” (31.8 mm)
- Max. Capacity: 1350 gpm (85.2 lps)

**Super U Series®**
- Max. Head: 2800 gpm (177 lps)
- Max. Solids: 3” (76.2 mm)
- Max. Capacity: 1500 gpm (95 lps)

**T Series**
- Max. Head: 130’ (39.6 m)
- Max. Solids: 1.25” (31.8 mm)
- Max. Capacity: 207’ (63.1 m) 1500 gpm (95 lps)

**2” Series** (for solids handling)
- Max. Head: 207’ (63.1 m)
- Max. Solids: 1.25” (31.8 mm)
- Max. Capacity: 1500 gpm (95 lps)

**AV-04857_REV102018**

*Although the pump is the heart of a pumping station, other elements should be considered when designing a system. This example identifies some of the items that can make up a system.*
How to Compute the Total Dynamic Head (TDH)

1. Pipe, Total Length, 4” (100 mm) C.I.

2. Fittings in Equivalent Length of Pipe
   - One 90° L.R. Elbow, 4”–6.8’ (100 mm–2.1 m) (5.2 m)
   - One 45° Elbow, 4”–4.7’ (100 mm–1.4 m) (3.5 m)
   - One Check Valve, 4”–26’ (100 mm–7.9 m) (20.8 m)
   - One Plug Valve, 4”–17’ (100 mm–5.2 m) (12.6 m)

Total Dynamic Head  40.70’

How to Compute the Net Positive Suction Head (NPSH)

3. Total Pipe (Actual & Equivalent)

Total Suction Head

Deductions from available suction head.

1. Total dynamic suction lift
2. Friction, Suction
3. Static Suction Lift

NPSH Available (J – K) = NPSH Required (see performance curves)

Priming lift

Total Net Deductions from Available Suction Head

4.6 m

Priming Lift

3.0 m

Pump stops

Total Dynamic Suction Lift 15.90’

Total Dynamic Discharge Head  24.80’

CONCLUSION:

Model T4AS-B pump, equipped with a 7.5 HP (5.5kW) motor, is selected as it is the closest non-overloading horsepower on the pump’s operating range.
1. **TOTAL DYNAMIC SUCTION LIFT: A + B = C**

   | A. Static Suction Lift | 15.00' |
   | B. Friction, Suction   | 28.50' |
   | C. Total Dynamic Suction Lift | 43.50' |

2. **Fittings in Equivalent Length of Pipe**

   - One 90° L.R. Elbow, 4”–6.8’ (100 mm–2.1 m)

3. **Total Friction Loss**

   - (4.6 m) × 1.5 m × .22 m
   - (2.3 m) × 1.4 m × .22 m
   - (7.5 m) × 1.4 m × .22 m

4. **PUMP STARTS**

   - 5.7’ (1.7 m)
   - 2.8 m
   - 9.3’ (2.8 m)

5. **PUMP STOPS**

   - 11.5’ (3.5 m)
   - 6.8’ (2.1 m)

6. **THE PRIMING LIFT**

   - 10.00’ (3.0 m)
   - 3.0 m
   - 2.8 m
   - 9.3’ (2.8 m)

7. **Atmospheric pressure (L– M)**

   - 0.09 m

8. **NPSH Available (J – K)**

   - 28.50’ (8.7 m)

9. **NPSH Excess Available, or excess net positive suction head**

   - 24.80’ (7.5 m)

10. **Atmospheric pressure corrected**

    - 500.00’

11. **Priming lift**

    - 5.7’ (1.7 m)

12. **SELECTING THE RIGHT PUMP**

    - Model T4AS-B pump, equipped with a 9-⅜ HP (.72) diameter impeller, running at 1750 RPM, is the correct selection.

13. **Selecting the Correct Motor**

    - Calculating the correct motor size for a pump involves the use of a performance curve and hydraulic system curve. The correct motor size must be determined by matching the pump's operating range to the motor's capability. The selected motor must be able to provide the necessary power to overcome the total dynamic head at the pump's operating range. The selection of a motor is crucial to ensure efficient operation and avoid overloading.
1. HOW TO COMPUTE THE TOTAL DYNAMIC HEAD (TDH)
   - Head Static
   - Head Friction
   - Head Suction

2. HOW TO COMPUTE THE NET POSITIVE SUCTION HEAD (NPSH)
   - NPSH Available
   - NPSH Required

3. SELECTING THE CORRECT PUMP
   - Capacity
   - horse power

4. SELECTING THE CORRECT MOTOR
   - Correct Power Factor
   - Correct full load current

CONCLUSION:
Model: T4AS-10 pump, equipped with a 5-3/4" (150 mm) diameter impeller, running at 1750 RPM, is the correct selection.
1 HOW TO COMPUTE THE TOTAL DYNAMIC HEAD (TDH)

1. Static Suction Lift 15.00’
2. Dynamic Suction Head 40.70’
3. Total Dynamic Suction Lift 55.70’

2 HOW TO COMPUTE THE NET POSITIVE SUCTION HEAD (NPSH)

A. Static Suction Lift 15.00’
B. Dynamic Suction Head 40.70’
C. Total Dynamic Suction Lift 55.70’

D. Static Discharge Head 7.50’
E. Priming Lift 10.00’
F. Atmospheric Pressure 28.20’

G. Net Positive Suction Head 135.90’
H. NPSH Excess Available 44.60’

3 SELECTING THE CORRECT PUMP

Selecting the correct motor is by far the most important step. The correct motor will have the horsepower to drive the selected pump at the correct RPM, and it will also be properly protected against burnout from overloading. The correct motor will also be of the correct size to handle the liquid temperature. The correct motor will also be properly supported. See Table 30–8. 3.000
dF per foot (0.125 mm per foot) is the normal range. The correct motor will also be selected based on the correct NPSH. The correct motor will also be properly supported. See Table 30–8. 3.000
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4 SELECTING THE CORRECT MOTOR

The change shown above is basically in head as shown. The actual horsepower required will be a function of friction losses in the piping system, the pump and the system. See Table 30–8. 3.000
dF per foot (0.125 mm per foot) is the normal range. The correct motor will also be properly supported.
Self-priming pumps are a sensible solution for industrial and municipal applications. They require very little attention, resulting in significant savings of maintenance time and money. Gorman-Rupp self-priming centrifugal pumps are easy to install and easy to maintain. They are available in various sizes, allowing for a wide range of applications. Choose from straight-in suction design or multistage, allowing them to excel in high-head situations where maintenance problems are minimal. In fact, our trash handling pumps will reprime with only a partially filled pump casing and a drive shaft to install and align, and no hoists or cranes are required.

Self-priming pumps are designed source or may be flex-coupled, v-belt driven or engine mounted. Automatic priming means dependable performance. All that’s needed is an initial priming and the pump will continue to reprime automatically. In fact, our trash handling pumps will reprime with only a partially filled pump casing and a drive shaft to install and align, and no hoists or cranes are required.

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Armstrong Pumps
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Pumps
Inlet Pipe
Base
Pump Drain Kit
Control Panel
Pump Station Enclosure
Inlet Pipe
Flange & Flare
L.R. 90° Bend or 45° elbow
2. 3-Way Valve (1)
3-Way Valve (1)
4. Air Release Valve (2)
Air Release Valve (2)
5. Electric Motor (2)
Electric Motor (2)
6. Gauge Kit – Suction
Gauge Kit – Suction
7. Gauge Kit – Discharge
Gauge Kit – Discharge
8. Control Panel
Control Panel
9. Inlet Pipe
Inlet Pipe
10. Pump Drain Kit
Pump Drain Kit
11. Control Panel
Control Panel
12. Pump Drain Kit
Pump Drain Kit
13. Gauge Kit – Discharge
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