PUMP SELECTION

To assist with the selection of self-priming pumps, we have created the following hypothetical example. We believe the problem and its solution to be typical of a job that might confront engineers and users.

We shall assume there is a requirement for a wastewater collection system that will require a lift station to pump the wastewater to a pretreatment collection system.

SYSTEM REQUIREMENTS

Flow:

[Flow specifications]
PUMP SELECTION

To assist with the selection of self-priming pumps, we have created the following hypothetical example. We hope the selection procedure will be typical of a job that might confront engineers and users.

We shall assume there is a requirement for a wastewater collection system that will require a lift station to pump the wastewater to a pretreatment collection system. The following data were acquired by actual accurate measurements.

SYSTEM REQUIREMENTS

- **Flow**: 200 gpm (12.6 lps)
- **Solids**: 3" (76 mm)
- **Configuration**: Duplex, one pump for standby
- **Site Elevation**: 5280' (1609.3 m) above sea level

SYSTEM CONDITIONS

- **Static Suction Lift**: 15' (4.6 m) vertical distance from low liquid level to center line of pump suction.
- **Suction Pipe**: 17' (5.2 m), 4" (100 mm) C.I. pipe. Measured from end of suction pipe to pump suction.
- **90° L.R. elbow and 45° elbow equivalent to 11.5' (3.5 m) of 4" (100 mm) C.I. pipe (for friction loss calculation).
- **Static Discharge Head**: 7.5' (2.3 m) vertical distance from center line of pump suction to invert of discharge outlet.
- **Discharge Pipe**: 500' (152.4 m), 4" (100 mm) C.I. pipe. Measured from pump discharge outlet.
- **90° L.R. discharge elbow, check valve and gate valve equivalent to 49.8' (15.2 m) of 4" (100 mm) C.I. pipe (for friction loss calculation).
- **Priming Lift**: 10' (3.0 m) measured from high liquid level to center line of pump suction.

The accumulation of the preceding data now permits calculating the Total Dynamic Suction Lift (TDSL), Total Discharge Head (TDH), and Net Positive Suction Head (NPSH) using the worksheets on the following pages.
HOW TO COMPUTE THE TOTAL DYNAMIC HEAD (TDH)

TOTAL DYNAMIC SUCTION LIFT: A + B = C

A. Static Suction Lift
1. Friction Loss (in feet)
2. Friction Loss (in meters)
3. Total Friction Loss
4. Total Dynamic Suction Lift

B. Friction, Suction
1. Pipe, Total Length, 4" (100 mm) C.I.
2. Fittings in Equivalent Length of Pipe
   a. One 90° L.R. Elbow, 4"–6.8' (100 mm–2.1 m)
   b. One 45° Elbow, 4"–4.7' (100 mm–1.4 m)
   c. One Plug Valve, 4"–17' (100 mm–5.2 m)

TOTAL DYNAMIC DISCHARGE HEAD: D + E = F

D. Static Discharge Head
1. Friction Loss (in feet)
2. Friction Loss (in meters)
3. Total Friction Loss
4. Total Dynamic Discharge Head

E. Friction, Discharge or Force Main Line
1. Pipe, Total Length, 4" (100 mm) C.I.
2. Fittings in Equivalent Length of Pipe
   a. One Check Valve, 4"–26' (100 mm–7.9 m)
   b. One Plug Valve, 4"–17' (100 mm–5.2 m)

TOTAL DYNAMIC HEAD: C + F = TDH

C. Total Dynamic Suction Lift
F. Total Dynamic Discharge Head

TDH

NOTE: Suction pipe must be properly supported.
1. **HOW TO COMPUTE THE TOTAL DYNAMIC HEAD (TDH)**

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

3. **SELECTING THE CORRECT PUMP**

**NOTE:**
- Suction pipe must be properly supported.
- Suction pipe must be properly supported.

**CONCLUSION:**
Model T4AS-D pump, equipped with a 9-3/4” (250 mm) diameter impeller, turning at 1150 RPM, is the correct selection.
HOW TO COMPUTE THE TOTAL DYNAMIC HEAD (TDH)

Before you can model the necessary calculations, you are ready to choose the correct pump for the application.

The 3" (76 mm) spherical solids requirement suggests a model T4AS-B. A typical Super T curve is shown. A 9-3/4" (250 mm) diameter impeller, turning at 1150 RPM, would be the correct selection. This is a standard motor on 60 cycle frequency. It may be flex-coupled to the pump; however, for versatility, it may be v-belt driven. Note NPSH requirement of 5' (1.5 m) well within the available NPSH of 9.30' (2.8 m). The priming characteristic of the 9-3/4" (250 mm) diameter impeller at 1150 RPM is 24' (7.3 m) (see priming performance data on each curve). We require only 10' (3 m) of priming lift.

CONCLUSION:
Model T4AS-B pump, equipped with a 9-3/4" (250 mm) diameter impeller, turning at 1150 RPM, is the correct selection.

NOTE: Suction pipe must be properly supported.

HOW TO DETERMINE THE PRIMING LIFT

HOW TO COMPUTE THE NET POSITIVE SUCTION HEAD (NPSH)

SELECTING THE CORRECT PUMP

The model pump will operate at the flow beginning in the red area and RPM requiring V belt. Setting of the simulated data consideration. Select pump of the chart to be in safety of its own design limit to ensure exact handling operation throughout the pump’s operating range.
SELECTING THE CORRECT MOTOR

Calculating the correct motor size for a pump involves the use of a complicated formula. To make this process easier, many manufacturers add horsepower (or kilowatt) lines to their performance curves. Referring to the curve, the closest non-overloading horsepower line represents 5 brake horsepower (BHP) or 3.7kW.

A good rule of thumb to use when selecting motors is to apply a motor which will provide sufficient power to cover the entire length of the selected pump curve (a practice which results in a “non-overloading” motor selection). Applying too small a motor will ultimately result in a motor that will be overloaded and may not operate efficiently. Using our example, the selected operating speed of the pump is 1150 RPM. The performance of a pump will follow along this speed curve but will vary due to normal pump wear and changes in sump level. The calculation below accounts for the sump level change between the pump on and off levels.

TDH AT THIS LEVEL 35.70’ (10.9 m)

\[ 40.70’ (12.4 m) - 5.00’ (1.5 m) = 35.70’ (10.9 m) \]

or:

36’ (11.0 m) TDH at point on curve.

TDH AT THIS LEVEL 40.70’ (12.4 m)

See point on curve.

The change shown above is basically a change in static head. The actual performance of the pump is illustrated on the curve where the 1150 RPM curve and hydraulic system curve intersect (this is noted on the curve as point). The difference in flow rate between points A and B will be the actual pump flow rate after the pump has been running for some time. The calculation below accounts for the sump level change between the pump on and off levels.

SELECTING THE CORRECT PUMP

HOW TO COMPUTE THE NET POSITIVE SUCTION HEAD (NPSH)

HOW TO DETERMINE THE PRIMING LIFT

NOTE: Suction pipe must 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’s self-priming centrifugal pumps are available as basic units for connection to your power source or may be flex-coupled, v-belt driven or engine mounted. In fact, we recommend using self-priming pumps with a partially filled pump casing and a completely dry suction line!

Our reputation for quality has made Gorman-Rupp the world’s leader in self-priming centrifugal pumps. In addition, it makes us your best solution – meeting all of your industrial or municipal waste handling needs.

The following data were acquired by actual accurate measurements. To assist with the selection of self-priming pumps, we have created the following hypothetical example. We believe the problem and its solution to be typical of a job that might confront engineers and users.

We shall assume there is a requirement for a wastewater collection system that will require a lift station to pump wastewater to a pretreatment collection system. The following data were acquired by actual accurate measurements.

**SYSTEM REQUIREMENTS**

*Flow:

**OF SELF-PRIMING CENTRIFUGAL PUMPS**

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’s self-priming centrifugal pumps are available as basic units for connection to your power source or may be flex-coupled, v-belt driven or engine mounted. In fact, we recommend using self-priming pumps with a partially filled pump casing and a completely dry suction line!

Our reputation for quality has made Gorman-Rupp the world’s leader in self-priming centrifugal pumps. In addition, it makes us your best solution – meeting all of your industrial or municipal waste handling needs.
Although the pump is the heart of a pumping station, other elements should be considered when designing a system. This example should give some of the items that can make up a system.

1. Control Panel
2. Electric Motor (2)
3. Base
4. Inlet Pipe
5. Air Release Valve (2)
6. Discharge/Force Main
7. Entrance to Sump/Wet Well
8. Entrance to Sump/Wet Well
9. Pump Station Enclosure
10. Pump Drain Kit
11. Return Pipe
12. 90° L.R. Flange & Flare
13. Entrance to Sump/Wet Well
14. Entrance to Sump/Wet Well
15. Entrance to Sump/Wet Well
16. Entrance to Sump/Wet Well
17. Entrance to Sump/Wet Well
18. Entrance to Sump/Wet Well
19. Entrance to Sump/Wet Well
20. Entrance to Sump/Wet Well
21. Entrance to Sump/Wet Well
22. Entrance to Sump/Wet Well

SYSTEM CONDITIONS

1. Static Suction Lift: 15' (4.6 m) vertical distance from low liquid level to center line of pump suction.
2. Suction Pipe: 17' (5.2 m), 4" (100 mm) C.I. pipe. Measured from end of suction pipe to pump suction.
3. Static Discharge Head: 7.5' (2.3 m) vertical distance from center line of pump suction to invert of discharge outlet.
4. Discharge Pipe: 500' (152.4 m), 4" (100 mm) C.I. pipe. Measured from pump discharge outlet.
5. Priming Lift: 10' (3.0 m) measured from high liquid level to center line of pump suction.

The accumulation of the preceding data now permits calculating the Total Dynamic Suction Lift (TDSL), Total Discharge Head (TDH), and Net Positive Suction Head (NPSH) using the worksheets on the following pages.