SELECTION & APPLICATION

Of Self-Priming Centrifugal Pumps

GORMAN-RUPP PUMPS

The Pump People®

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.

The following data were acquired by actual accurate measurements.

System Requirements

Flow:. . . . . 200 gpm (12.6 lps)
Solids: . . . . .3″ (76.2 mm)
Configuration: . . . . Duplex, one pump for standby
Site Elevation: . . . . 5280′ (1609.3 m) above sea level

System Conditions

The accumulation of the data below 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.

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

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).

Discharge Pipe

500′ (152.4 m), 4″ (100 mm) C.I. pipe. Measured from pump discharge outlet.

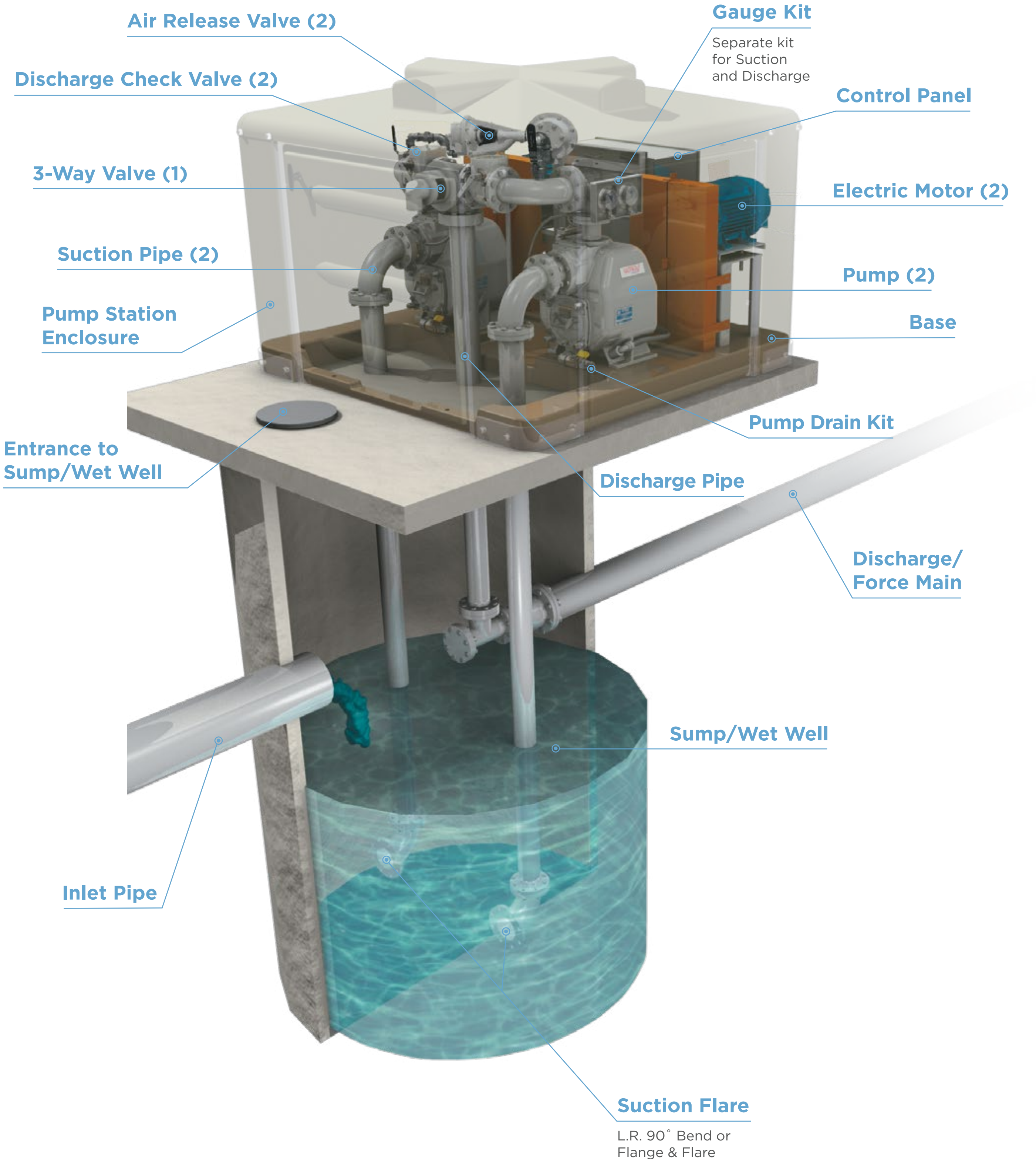
90° L.R. discharge elbow, check valve and gate valve equivalent to 49.8′ (15.2 m) of 4″ (100 mm) C.I. pipe (for friction loss calculation).

Priming Lift

10′ (3.0 m) measured from high liquid level to center line of pump suction.

Elements Of A Pumping Station

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.



Gorman-Rupp Self-Priming Pumps:

The Sensible Solution

A

B

C

D

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 service. Because they're self-priming, they can be mounted high and dry at floor level with only the suction line in the liquid – there's never a need for service personnel to enter the sump. When service or maintenance is required, it can be completed easily with common hand tools. There are no long drive shafts to install and align, and no hoists or cranes are required.

Gorman-Rupp self-priming pumps are available as basic units for connection to your power source or may be flex-coupled, v-belt driven or engine mounted.

A Ultra V Series®

High-Heads, Solids-Handling

Size: 3" (75 mm) to 6" (150 mm)
Max Capacity: 1904 GPM (120 lps)
Max Head: 168' (51 m)
Max Solids: 3" (76 mm)

B Ultra V Series® with UltraMate®

High-Heads, Solids-Handling

Size: 3" (75 mm) to 6" (150 mm)
Max Capacity: 1904 GPM (120 lps)
Max Head: 325' (99 m)
Max Solids: 3" (76 mm)

C Super T Series®

Solids-Laden Liquids & Slurries

Size: 2" (50 mm) to 10" (250 mm)
Max Capacity: 3400 GPM (215 lps)
Max Head: 168' (51 m)
Max Solids: 3" (76 mm)

D Super U Series®

High Efficiency Solids & Corrosive Liquids

Size: 3" (75 mm) to 6" (150 mm)
Max Capacity: 1500 GPM (95 lps)
Max Head: 207' (63 m)
Max Solids: 1.25" (32 mm)

E

F

G

E

80 Series®

Limited Solids & Corrosive Liquids

Size: 1.25” (32 mm) to 6” (150 mm)
Max Capacity: 1860 GPM (117 lps)
Max Head: 205’ (63 m)
Max Solids: 1.9” (49 mm)

F

O Series®

Clear Liquids

Size: 2” (50 mm) to 6” (150 mm)
Max Capacity: 1350 GPM (85 lps)
Max Head: 400’ (122 m)
Max Solids: 0.69” (18 mm)

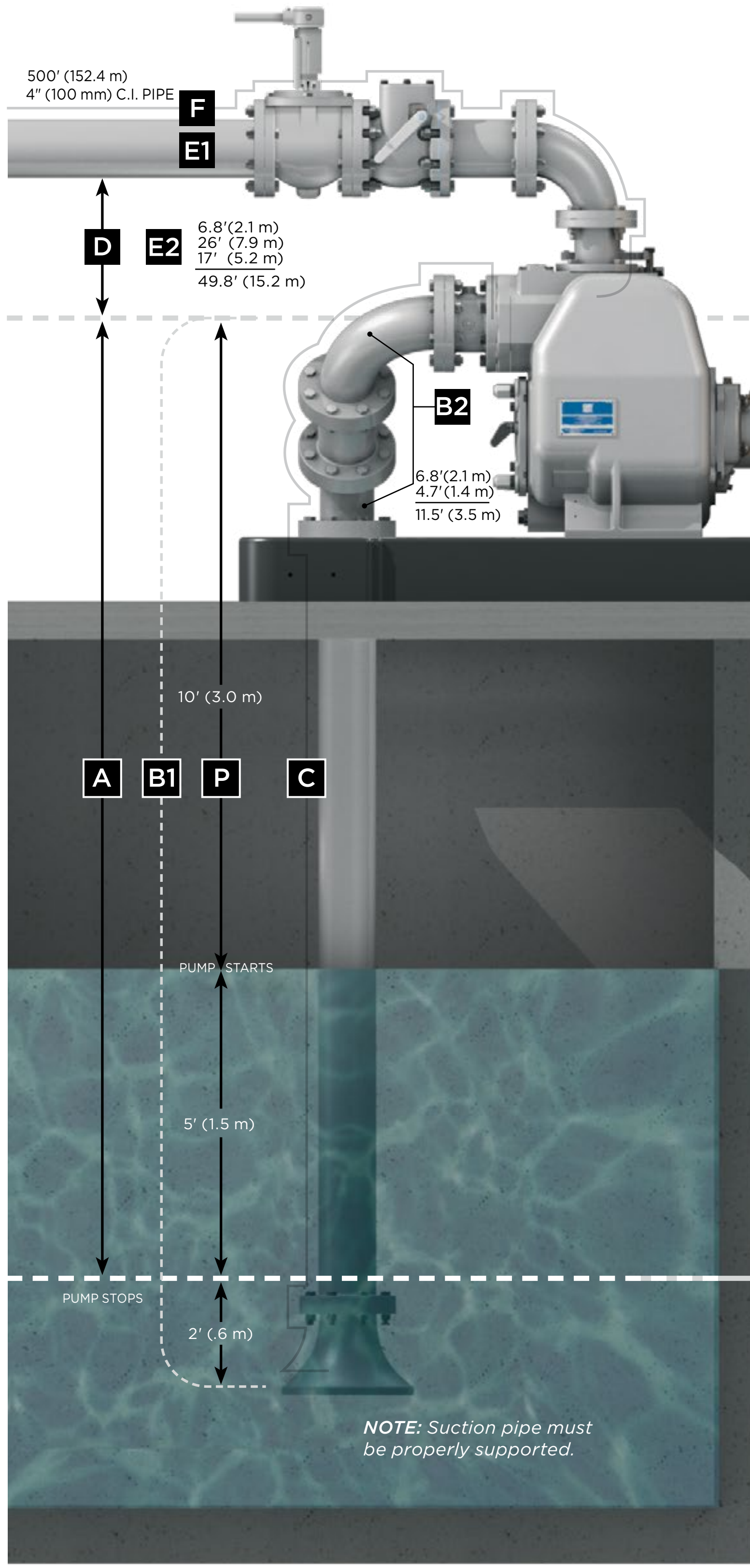
G

10 Series®

Solids & Corrosive Liquids

Size: 1.5” (38 mm) to 12” (300 mm)
Max Capacity: 6700 GPM (423 lps)
Max Head: 130’ (40 m)
Max Solids: 3” (76 mm)

1 How To Compute The Total Dynamic Head (TDH)



TOTAL DYNAMIC SUCTION HEAD: A + B = C

A. Static Suction Lift		15.00′ (4.6 m)
B. Friction, Suction (Consult Hydraulic Handbook)		
1. Pipe, Total Length, 4″ = 100 mm C.I.	17.00′ (5.2 m)	
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)	11.50′ (3.5 m)	
3. Total Pipe (Actual & Equivalent)	28.50′ (8.7 m)	
4. Total Friction Loss (28.5′ × .0443′ × .71) (8.7 m × .044 m × .71) (based on friction coefficient C=100, 4.43/100′ and correction factor to C=120=.71)		.90′ (.27 m)
C. Total Dynamic Suction Head*		-15.90′ (-4.8 m)

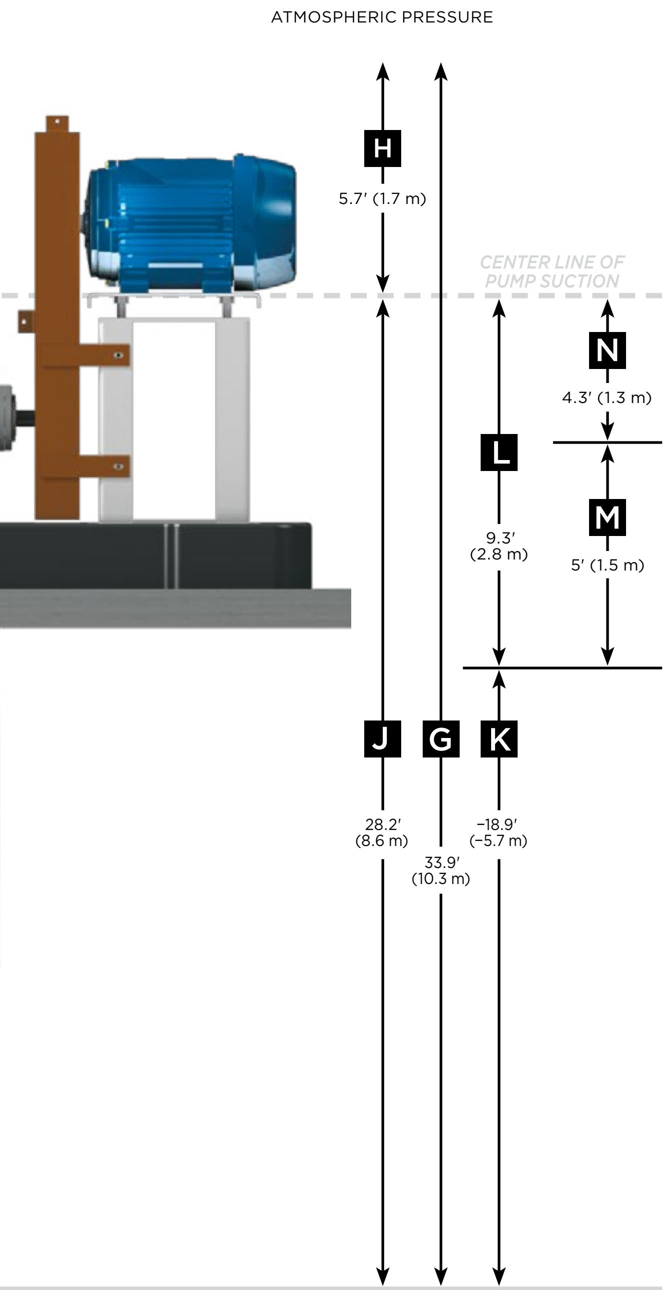
TOTAL DISCHARGE HEAD: D + E = F

D. Static Discharge Head		5.0′ (1.5 m)
E. Friction, Discharge or Force Main Line (Consult Hydraulic Handbook)		
1. Pipe, Total Length, 4″ = 100 mm C.I.	500.00′ (152.4 m)	
2. Fittings in Equivalent Length of Pipe a. One 90° L.R. Elbow, 4″ = 6.8′ (100 mm–2.1 m) b. One Check Valve, 4″ = 26′ (100 mm–7.9 m) c. One Plug Valve, 4″ = 17′ (100 mm–5.2 m)	49.80′ (15.2 m)	
3. Total Pipe (Actual & Equivalent)	549.80′ (167.6 m)	
4. Total Friction Loss (550′ × .0443′ × .71) (167.6 m × .044 m × .71) (based on friction coefficient C=100, 4.43/100′ and correction factor to C=120=.71)		17.30′ (5.3 m)
F. Total Dynamic Discharge Head		22.30′ (6.7 m)

TOTAL DYNAMIC HEAD: F - C = TDH

F. Total Dynamic Discharge Head	+22.30′ (6.7 m)	
C. Total Dynamic Suction Head	-15.90′ (4.8 m)	
Total Dynamic Head		38.20′ (11.6 m)

*Total dynamic suction head (TDSH) at the pump inlet can be negative. This occurs in suction lift applications where the liquid level is below the pump inlet. It can also happen in flooded applications where the liquid level is above the pump inlet if friction losses exceed the static suction head. A negative TDSH means the pump inlet pressure is below the ambient atmospheric pressure.



2 How To Compute The Net Positive Suction Head (NPSH)

	Detailed Computation
G. Atmospheric pressure (at sea level)	**33.90′** (10.3 m)
H. Atmospheric pressure corrected to 5280′ (1609 m) [site elevation]	**-5.70′** (-1.7 m)
J. Atmospheric pressure available at job site (G–H)	**28.20′** (8.6 m)
Deductions from available atmospheric pressure:	
1. Total dynamic suction lift	**15.90′** (4.8 m)
2. Vapor pressure 74° liquid	**1.00′** (.30 m)
3. Safety factor (may vary based on local regulations)	**2.00′** (.61 m)
K. Total net deductions from available atmospheric pressure (1+2+3)	**-18.90′** (-5.7 m)
L. NPSH Available (J–K)	**9.30′** (2.8 m)
M. NPSH Required (see performance curves)	**-5.00′** (-1.5 m)
N. NPSH Excess Available, or excess atmospheric pressure (L–M)	**4.30′** (1.3 m)

NOTE: Items M and N cannot be determined until pumps are selected.

How To Determine The Priming Lift

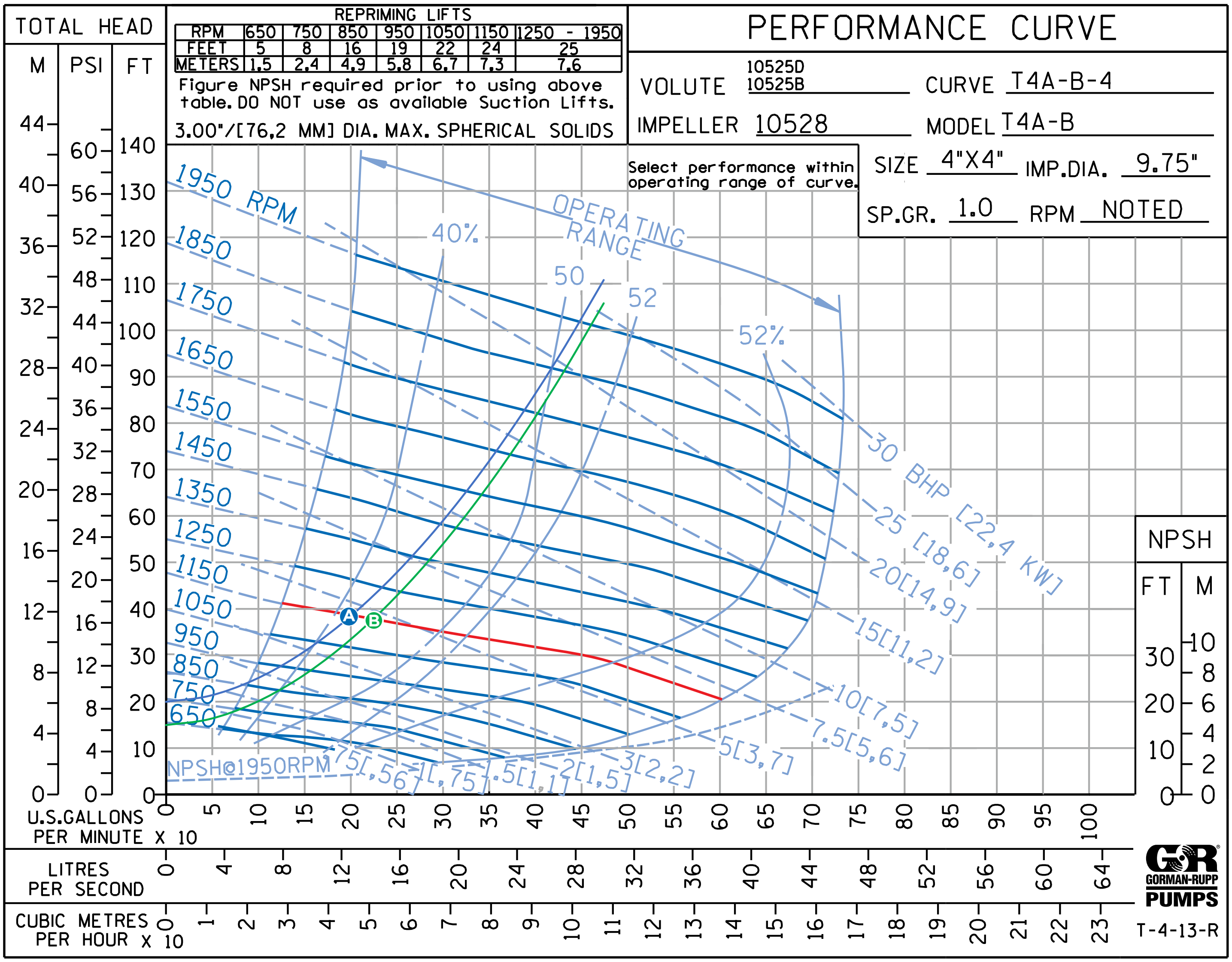
P. Priming lift	**10.00′** (3.0 m)

NOTE: Priming lift is measured from the pump start liquid level to the center line of the pump suction. Priming lift has no relation to net positive suction head.

3 Selecting The Correct Pump

After you've made the necessary calculations, you are ready to choose the correct pump for the application.

Capacity	200 gpm (12.6 lps)
Total Dynamic Head (TDH)	38.20′ (11.6m)
Total Dynamic Suction Lift (TDSL)	15.90′ (4.8 m)
Priming Lift	10.00′ (3.0 m)
Net Positive Suction Head (NPSH) Available	9.30′ (2.8 m)
Spherical Solids	3″ (76.2 mm)



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 a good selection. This is a standard motor on 60 hertz 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 maximum repriming 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.

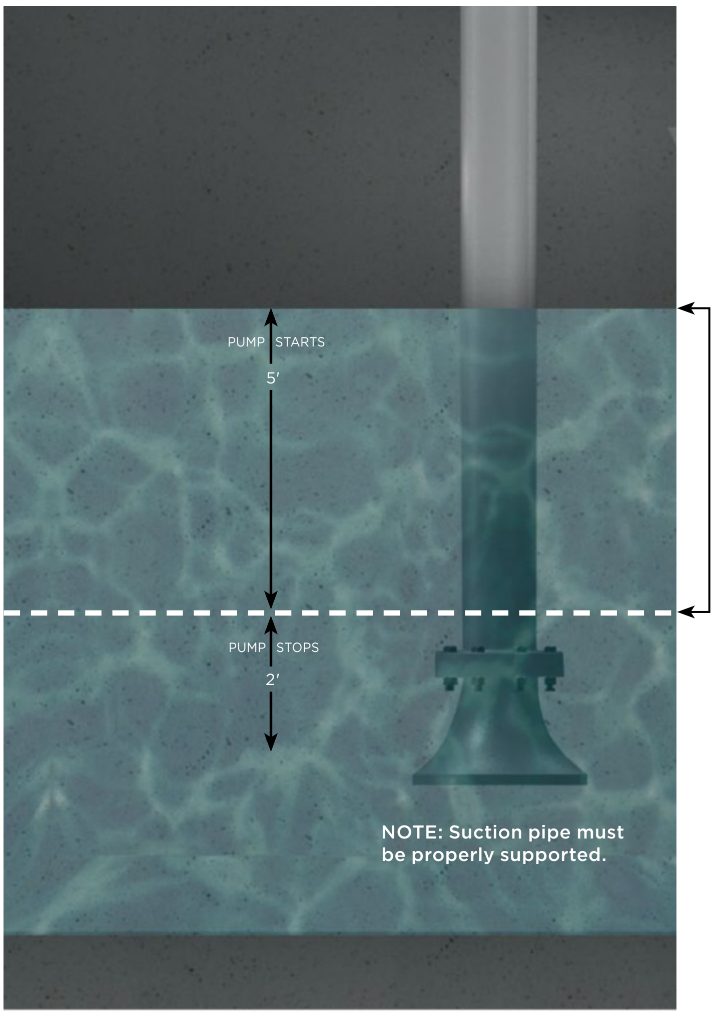
Conclusion:

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

4 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 brake horsepower (or kilowatt) lines to their performance curves. Referring to point A on 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). 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 36.8′ (11.2 m)
See B on curve.

TDH AT THIS LEVEL 38.2′ (11.6 m)
See A on curve.

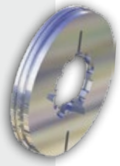
The change shown above is basically a change in static head. The actual performance of the pump is illustrated on the curve where the 1150 RPM curve and head system curve intersects. The difference in flow rate between points A and B is the band our selected pump will operate within from the beginning to the end of the pumping cycle.

Taking all this information into consideration, the best course of action is to select a 7½ HP (5.5kW) motor to ensure non-overloading operation throughout the pump's operating range.

A New Era In Solids-Handling Technology

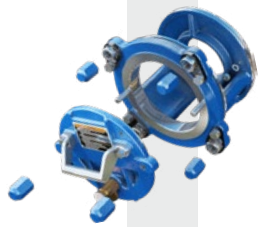
Super T Series® Eradicator® & Eradicator Plus

Ultra V Series® Eradicator®



Design Features

The Eradicator® system features an aggressive self-cleaning wearplate incorporating a number of notches and grooves, as well as a revolutionary tooth, that helps break up stringy materials and pass them through the pump without impacting performance or interrupting service.



System Benefits

Easier access to the impeller, improved operational efficiency, reduced maintenance costs and lower life-cycle costs are benefits of the Eradicator® system. The innovative design of the patented lightweight inspection plate greatly reduces expensive downtime by providing easy access to the impeller. The system can be factory-equipped in new pumps or purchased as a retrofit kit that is interchangeable with Super T Series pumps currently operating in the field.

Advanced Solids Management

For those extreme-duty applications where trash bags, wipes, hair, industrial by-products and agricultural wastes are present, Gorman-Rupp has introduced the Eradicator® Plus. Based on the same principles of the Eradicator, this new solids reduction technology is ideal when cutting and tearing of debris entering the pump is required.

Heavy-Duty Impeller

Eradicator® Plus pumps are equipped with a rugged, heavy-duty continuous vane impeller constructed of G-R Hard Iron for the most aggressive waste-handling applications. The pump out vanes incorporated into the thick back shroud help prevent the buildup of debris behind the impeller.

Replaceable Wearplate

The wearplate incorporated into Eradicator® Plus pumps is constructed of extra-thick G-R Hard Iron. It utilizes the same notches and grooves as the Eradicator wearplate, but with an oversized lacerating tooth that is designed to cut and shred organic solids before they enter the interior of the pump.

Configured To Suit Your Pumping Requirements

Close-coupled

V-belt Driven

Engine Driven Utility

Sound-attenuated Engine Driven

ReliaSource® Packaged Pumping Station

When you specify Gorman-Rupp pumps, you benefit from:

- Experienced staff of engineers dedicated to the design and construction of the most efficient and serviceable pumps in the industry.
- Trained representatives to help you select and apply pumps and related equipment for your specific application.

After Sale Support

Gorman-Rupp products stand the test of time due to our quality manufacturing processes, rigorous product testing and extensive after sale support.

Product Support

Every pump manufactured by Gorman-Rupp is supported with reference information. Pump operation and maintenance manuals (including parts lists), specification data sheets, performance curves and outline drawings in PDF and CAD formats are available on our website or through your distributor for every pump.

Warranty

The warranties on Gorman-Rupp products are some of the best in the industry. Gorman-Rupp has you covered with warranties up to 60 months.

Education & Safety

Gorman-Rupp is committed to remaining at the forefront of the industry with technology and safety. Training videos, demos and in-person training sessions created for our distributors and end-users help to keep everyone up to date on the latest safety tips and pump maintenance.

Parts

When you need a replacement part, you'll have it fast. Gorman-Rupp is fully committed to keeping your equipment running long after installation and ensuring your pump or lift station continues to meet your requirements year after year. We sell parts through our network of distributors. Find a distributor in your area for assistance.

Service

Should your pump or lift station require service, our worldwide network of factory-trained distributors are ready to quickly respond. Our distributors have the expertise to support you and your pump or lift station long after installation.

Manufacturing Facilities

Gorman-Rupp USA
Mansfield, Ohio, USA

Gorman-Rupp Canada
St. Thomas, Ontario, Canada

Gorman-Rupp Europe
Waardenburg, Netherlands
Namur, Belgium

Gorman-Rupp Africa
Cape Town, South Africa
Durban, South Africa
Johannesburg, South Africa (Headquarters)

Distribution Center

Grand Prairie, Texas, USA

Engineering and manufacturing superiority has been the hallmark of Gorman-Rupp since our inception in 1933. Today we bring our products to life in some of the most efficient, modern and state-of-the-art manufacturing facilities in the world. Gorman-Rupp has a selection of nearly 3,000 pump models, and our world-class team of distributors has worked closely with thousands of end users around the world. We have the proven expertise and the resources to specify, manufacture, test and service your pump, and to ensure reliable performance for the long haul.

GRPUMPS.COM

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