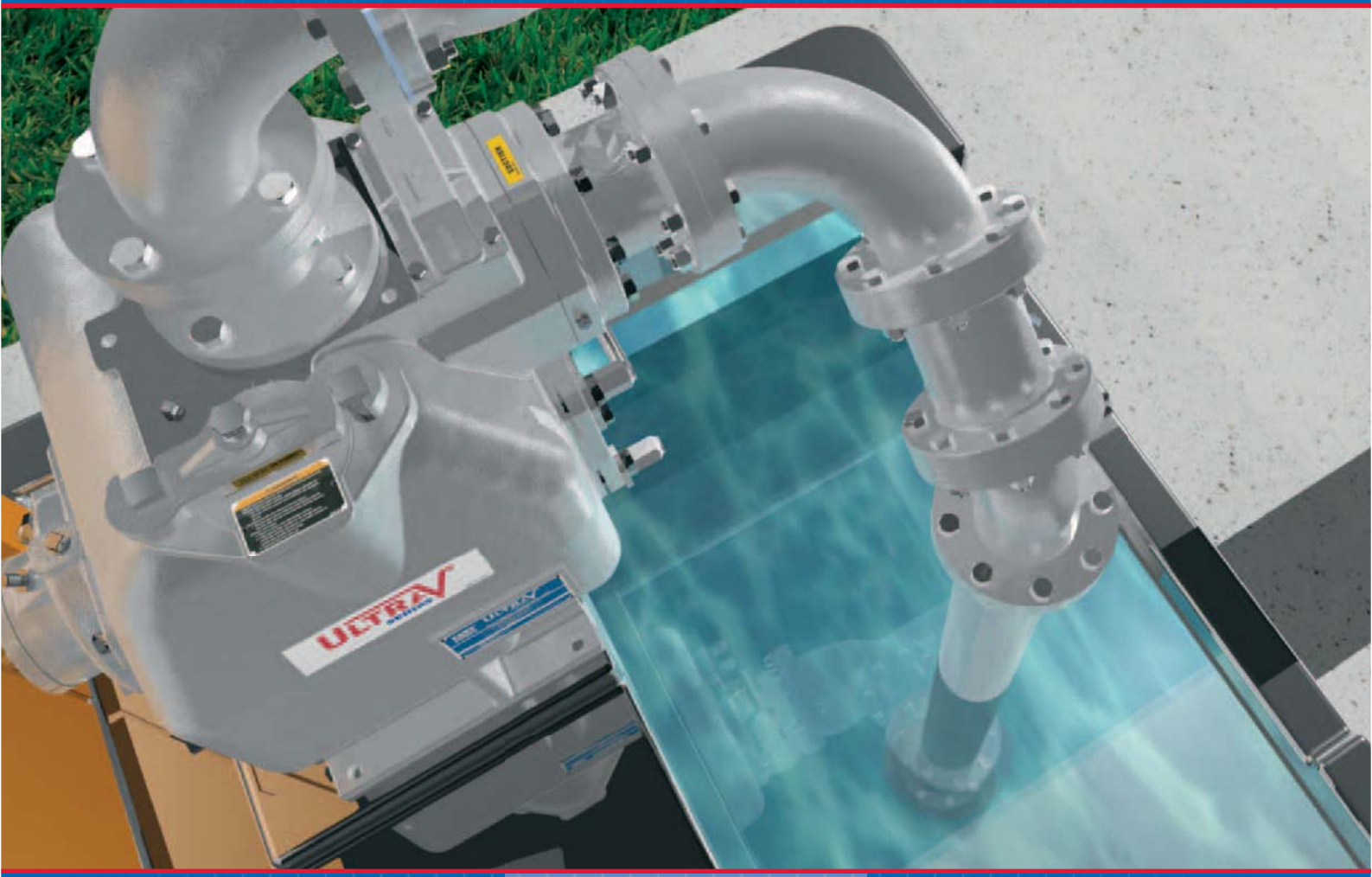
GORMAN-RUPP PUMPS

SELECTION & APPLICATION

OF SELF-PRIMING CENTRIFUGAL PUMPS



GORMAN-RUPP PUMPS

GRpumps.com



PUMP SELECTION

To assist with the selection of self-priming pumps, we have created the following hypothetical example. The problem and its solution we believe 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 mm)
Configuration: Duplex, one pump for standby
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.

1 HOW TO COMPUTE THE TOTAL DYNAMIC HEAD (TDH)

TOTAL DYNAMIC SUCTION LIFT: A + B = C

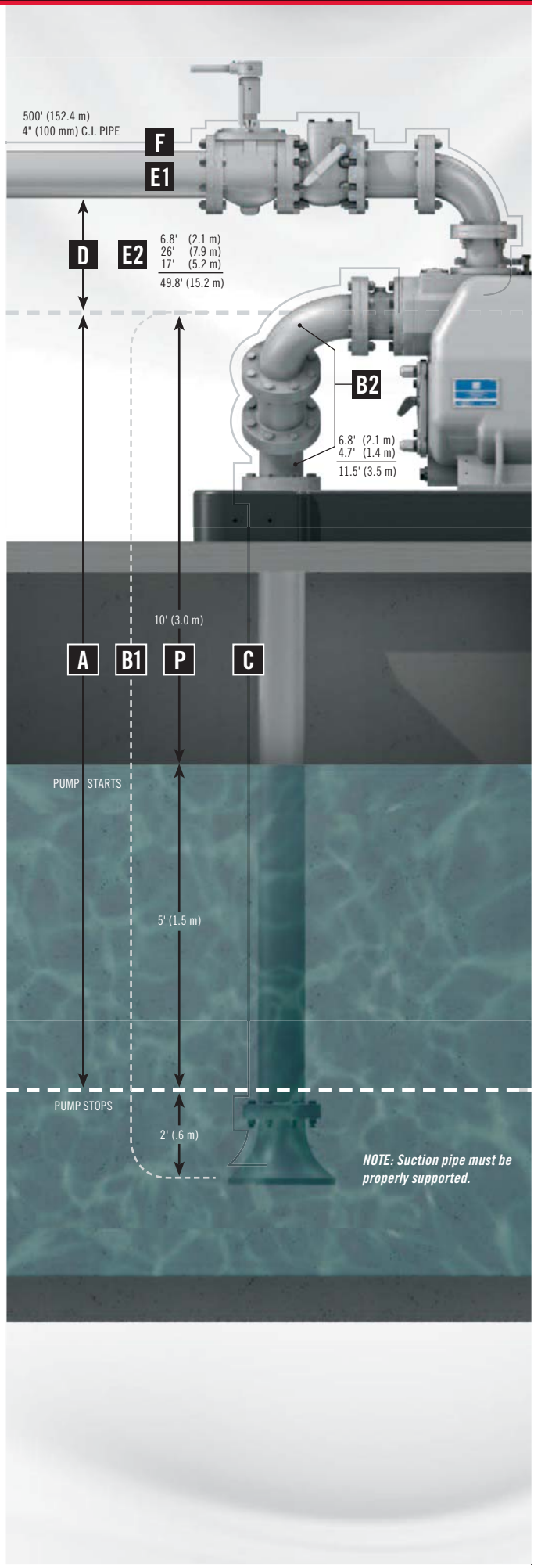
A. Static Suction Lift		**15.00'** (4.6 m)
B. Friction, Suction (Consult Hydraulic Handbook)		
1. Pipe, Total Length, 4" (100 mm) C.I.	**17.00'** (5.2 m)	
2. Fittings in Equivalent Length of Pipe		
a. One 90° L.R. Elbow, 4"–6.8' (100 mm–2.1 m)	**11.50'** (3.5 m)	
b. One 45° Elbow, 4"–4.7' (100 mm–1.4 m)		
3. Total Pipe (Actual & Equivalent)	**28.50'** (8.7 m)	
4. Total Friction Loss (.285' × 4.43' × .71') (.09 m × 1.4 m × .22 m) (based on friction coefficient C = 100, 4.43/100' and correction factor to C = 120 = .71)		**.90'** (.27 m)
C. Total Dynamic Suction Lift		**15.90'** (4.8 m)

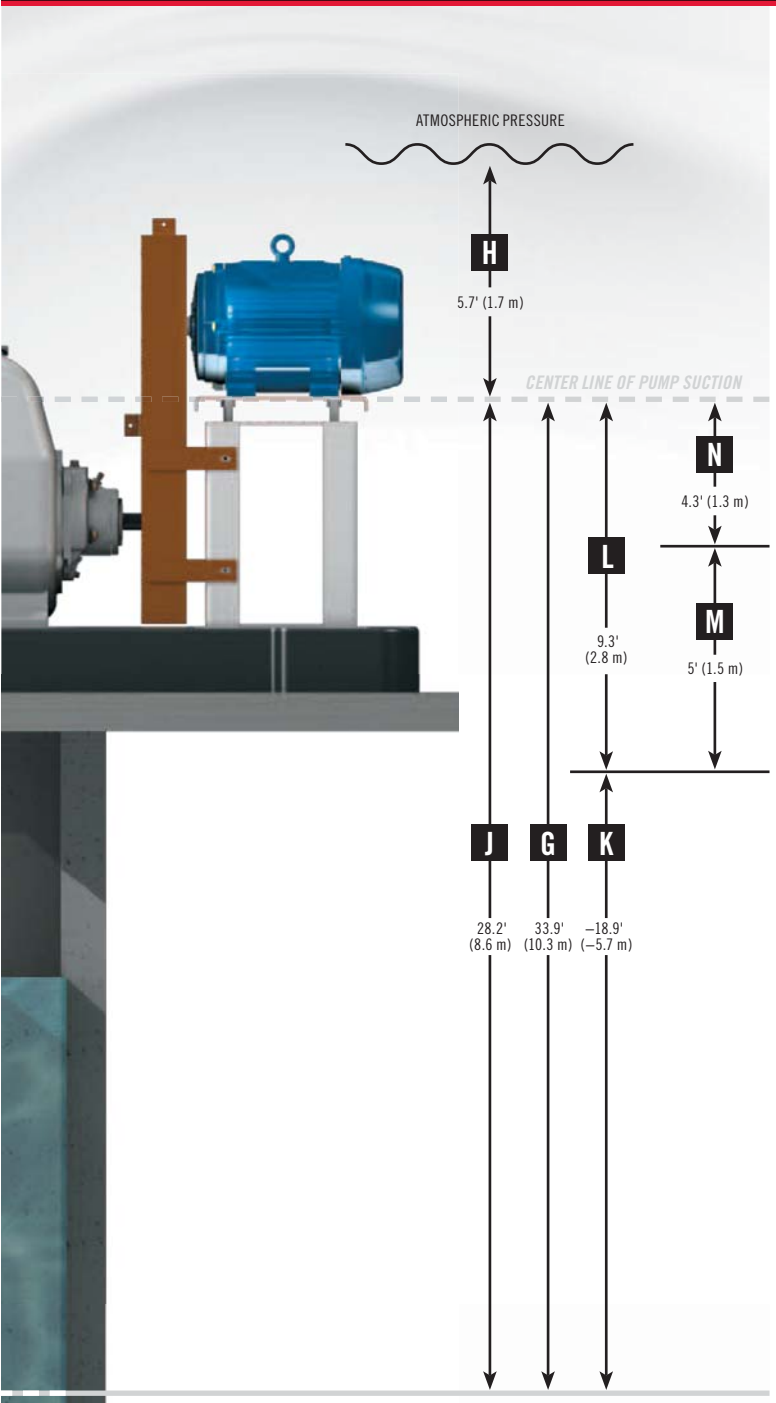
TOTAL DISCHARGE HEAD: D + E = F

D. Static Discharge Head		**7.50'** (2.3 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 (5.5' × 4.43' × .71') (1.7 m × 1.4 m × .22 m) (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		**24.80'** (7.5 m)

TOTAL DYNAMIC HEAD: C + F = TDH

C. Total Dynamic Suction Lift	**15.90'** (4.8 m)	
F. Total Dynamic Discharge Head	**+24.80'** (7.5 m)	
Total Dynamic Head		**40.70'** (12.4 m)





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)	**–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 state-to-state 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

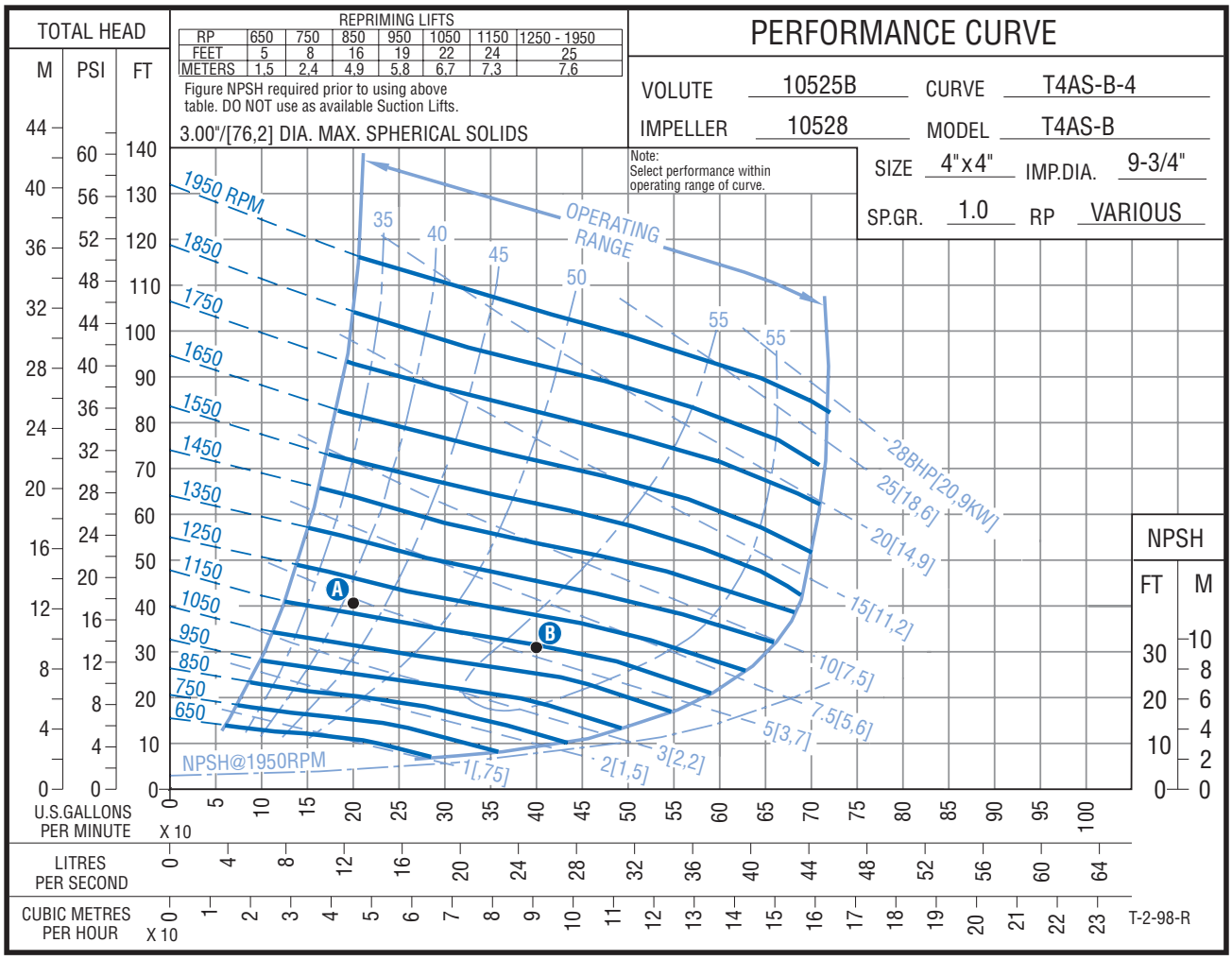
P. Priming lift	**10.00'** (3.0 m)

NOTE: Priming lift is measured from the high 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)	40.70' (12.4 m)
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 mm)



The 3" (76 m) 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:

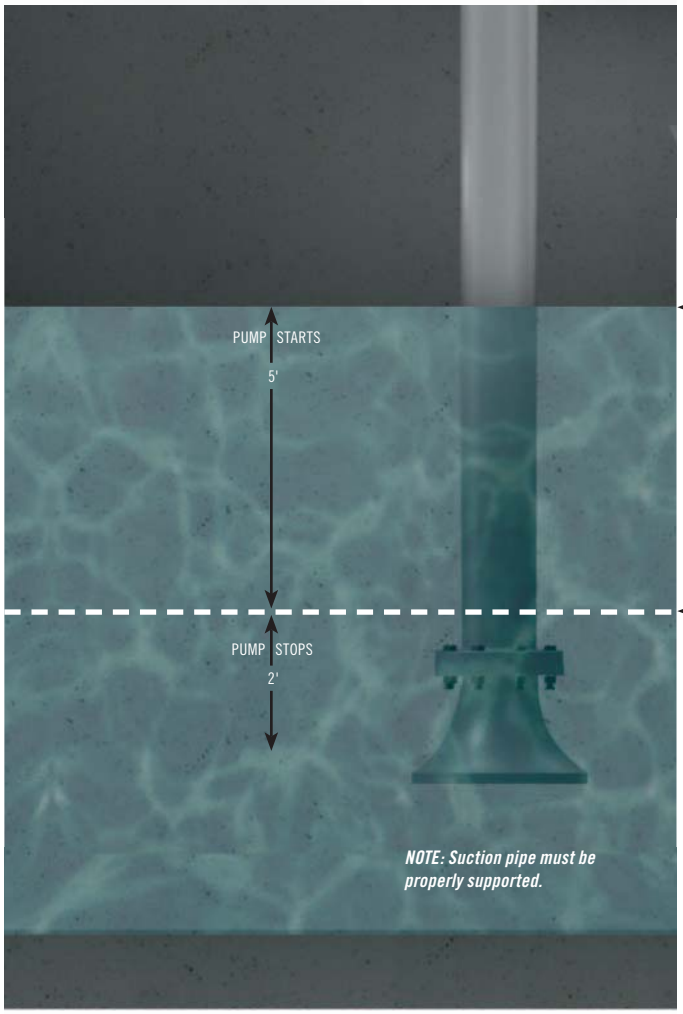
Model T4AS-B pump, equipped with a 9-3/4" (250 mm) diameter impeller, turning at 1150 RPM, is the correct selection.

4 SELECTING THE CORRECT MOTOR

To determine minimum TDH and pump operating range, pipe friction loss should again be calculated using a coefficient of C=140 (minimum TDH) or correction factor of .54. Total equivalent suction pipe length 27' (8.2 m) plus total equivalent discharge pipe length 537' (163.7 m) equals 564' (171.9 m).

Therefore:

Previous Determination (Pg. 2: B4 + E4)	17.75' (5.4 m)
Recalculation: 5.78' × 4.43' × .54' (1.8 m × 1.4 m × .16 m) =	–13.83' (–4.2 m)
Reduced Friction Loss	3.92' (1.2 m)



TDH AT THIS LEVEL 35.70' (10.9 m)

	40.70' (12.4 m)
	–5.00' (–1.5 m)
	35.70' (10.9 m)
	–3.92' (–1.2 m)
	31.78' (9.7 m)

or: 32' (9.7 m) TDH at point (B) on curve.

TDH AT THIS LEVEL 40.70' (12.4 m)
See (A) on curve.

REDUCED FRICTION LOSS OF 3.92' (1.2 m)

TDH at motor selection point is 32' (9.7 m).
See (B) on curve.

CONCLUSION: 7-1/2 HP MOTOR

To prevent motor overload throughout operating range 40.7' (12.4 m) TDH to 32' (9.7 m), the electric motor must be selected at 32' (9.7 m) TDH on the characteristic curve or 7.5 BHP.