R. A. ROSS & ASSOCIATES, INC.

In conjunction with

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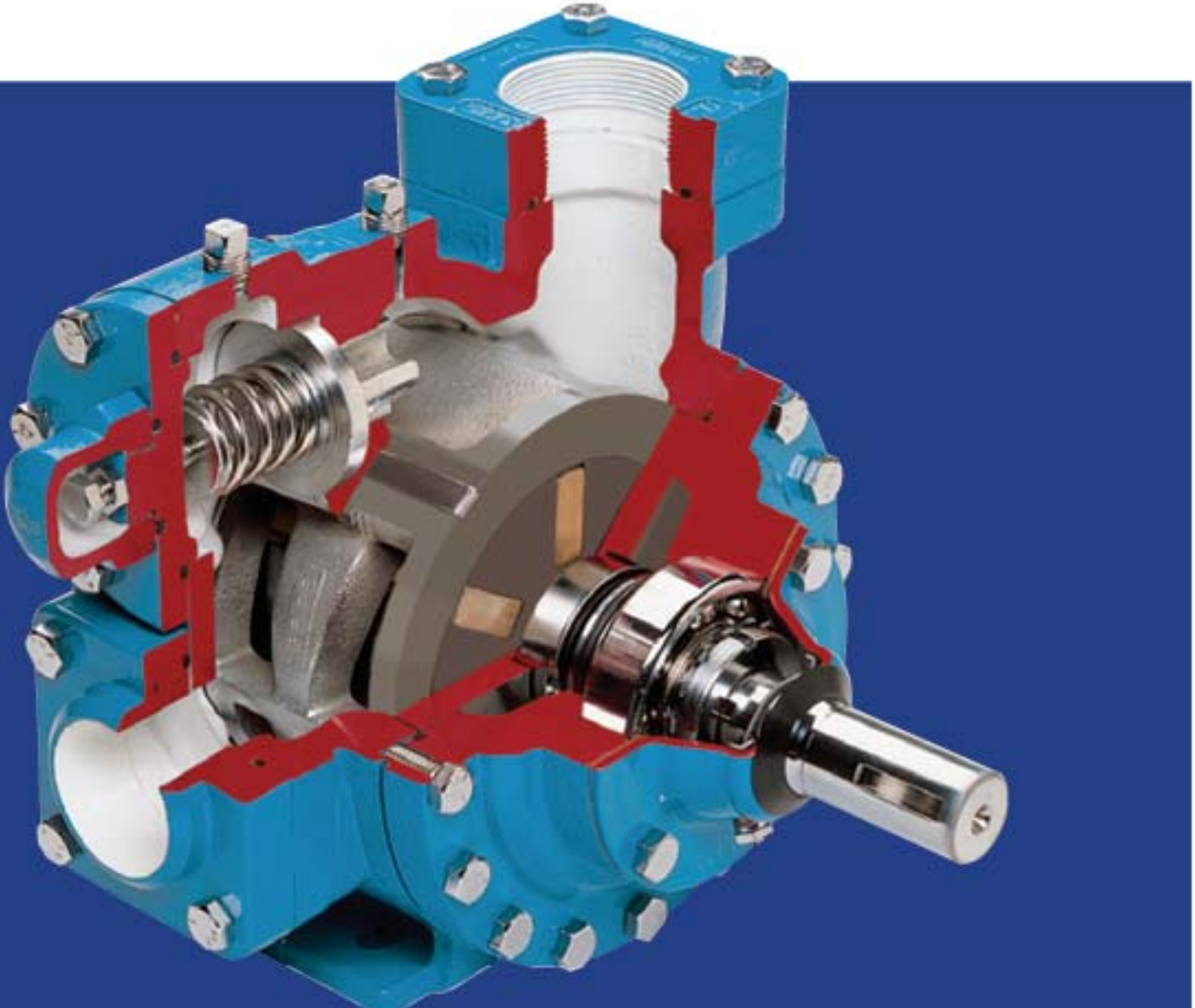
PSG

What we need to know in order to help you select the right hydraulic pumps



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Planning for a satisfactory and economical pump installation involves the two basic items of (1) selecting the proper type, size and speed of pumping equipment and (2) making a careful study of the suction and discharge conditions, including all details of the piping layout.

The proper selection of pumping equipment must consider all of the application conditions to include these important factors. For specific selection of Blackmer Positive Displacement Rotary Pumps, please refer to our individual Pump Characteristic Curves.

How much flow?

How much push?

How heavy?

How thick?

1. Approximate DELIVERY required in gallons per minute (G.P.M.).

2. Differential PRESSURE required in pounds per square inch (psi).

3. Specific GRAVITY of the liquid.

4. Maximum VISCOSITY of the liquid in Seconds Saybolt Universal (SSU).

How hot?

How much pull?

What liquid?

How long?

5. Pumping TEMPERATURE of the liquid in degrees Fahren heit.

6. SUCTION conditions when pumping in inches of mercury for vacuum, or psi for pressure.

7. Type of LIQUID to be handled.

8. Type of SERVICE, i.e. intermittent duty, semi-continuous duty, or continuous duty.

DEFINITIONS of HYDRAULIC TERMS

The Hydraulic Institute has made a study of hydraulic terms in an effort to establish standardization of definitions. Their recommendations are as follows:

Head - is the hydraulic pressure and is expressed in pounds-per-square-inch (psi) gauge using atmospheric pressure as the datum. It can be determined by use of pressure gauges or can be computed by using pipe friction tables and static head measurements.

Frictional Head - is the hydraulic pressure exerted to overcome frictional resistance of a piping system to the liquid flowing through it.

Static Suction **Lift** - is the hydraulic pressure be low atmospheric at the intake port with the liquid at rest. It is usually expressed in or converted to inches of mercury (Hg) vacuum.

Total Suction **Lift** - is the total hydraulic pressure below atmospheric at the intake port with the pump in operation (the sum of the static suction lift and the friction head of the suction piping).

Flooded Suction - is a very indefinite term which has been carelessly used for so many years that its meaning is no longer clear. More often than not, it merely indicates that suction conditions have not been accurately determined. One point to remember is that a static suction head may become a suction lift when the pump goes into operation.

Total Suction Head - is the hydraulic pressure above atmospheric at the intake port with the pump in operation (the difference between the static suction head and the friction head of the suction piping).

Static Discharge Head - is the hydraulic pressure exerted at the pump discharge by the liquid at rest, commonly measured as the difference in elevation between the pump discharge port and the delivery port.

Total Discharge Head - is the total hydraulic pressure at the discharge port with the pump in operation (the sum of the static discharge head and the friction head of the discharge piping).

Total Pumping Head (or Dynamic Head) - is the sum of the total discharge head and the total suction lift; or the difference between the total discharge head and the total suction head.

Head Expressed in Feet - although the foregoing definitions refer to the "head" as expressed in psi, it is also proper to specify the total pumping head in feet of liquid or feet of water. Conversions can be made between these expressions of psi to feet (See chart on Page 6), but since there will normally be an appreciable difference between the feet of head of a particular liquid and the feet of head of water, it is extremely important to specify which term is being used.

COMPUTING SUCTION & DISCHARGE CONDITIONS

Two methods are outlined in this bulletin for computing suction and discharge conditions: (1) by using the direct-reading charts for quick preliminary computations, and (2) by using the Intake and Discharge Analysis Form (Page 12) in conjunction with the Hydraulic Institute friction loss curves (Pages 13 thru 19).

FIRST PROCEDURE (using the direct-reading charts)

Total Suction Lift

(1) Given the maximum static lift in feet, determine the static vacuum in inches of mercury (Hg) from chart at top of Page 5.

(2) Compute total equivalent length of pipe in suction line by using the chart on Page 11.

(3) Read friction loss in inches of mercury per 100 ft. of pipe from the direct reading charts (Pages 7 thru 10). Multiply this value by the total equivalent length of pipe and divide by 100.

(4) Add this friction loss to the static suction lift to obtain the total suction lift.

Total Discharge Head

(1) Follow the same procedure as in steps 1 and 2 above but refer to static discharge head chart on Page 6.

(2) Refer to the direct-reading charts as in step 3 above, but read friction loss from the psi column.

(3) Add this friction loss to the static discharge head to obtain the total discharge head.

example

DATA

Liquid to be pumped.............gasoline
Gallons per minute 90
Static suction lift. ....10' liquid
Suction line...........................43' of 2½" pipe, with one 2½" elbow
Static discharge head...........40' liquid
Discharge line.......................80' of 2" pipe, with 5 elbows

SUCTION

1. From static lift chart (p. 5), 10' lift=6.4 in. Hg — 6.4 in. Hg
2. Total equivalent length suction pipe (from page 11) =43'+7' = 50"
3. From Table (Page 8), friction per 100' = 3.7 in. Hg
4. Frictional head of suction piping $\frac{50 \times 3.7}{100}$ = 1.9 in. Hg — 1.9 in. Hg

Total suction lift 8.3 in. Hg

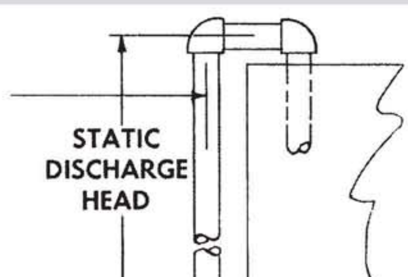
DISCHARGE

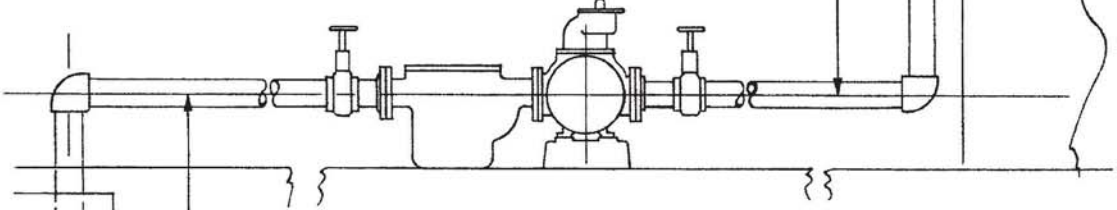
1. From static head chart (Page 6), 40' head = 12.5 psi — 12.5 psi
2. Total equivalent length discharge pipe (from page 11) = 80 + (5 x 5)=105'
3. From table (Page 8), friction per 100' = 4.4 psi
4. Frictional head of discharge piping $\frac{105 \times 4.4}{100}$ = 4.6 psi — 4.6 psi
5. Total discharge head — 17.1 psi

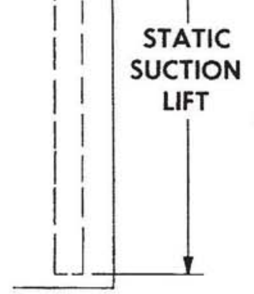
NOTE: To determine the required horsepower, first convert the total suction lift from in. Hg to psi (using the pressure conversion factors on page 21). Then add this value to the total discharge head to obtain the total pumping or dynamic head, from which the required horsepower can be determined using Blackmer Characteristic Curves printed separately.

TYPICAL ROTARY PUMP INSTALLATION

Rotary pumps are used extensively for difficult liquid applications involving volatile or viscous liquids. Consequently it is of utmost importance that a careful study be made of each application to be certain that proper size suction and discharge piping will be used and that the pump be located most advantageously in relation to the liquid source. Remember that it is always easier to push a liquid than to pull it.







Although the suction condition is commonly the last factor considered in planning a pump installation, experience proves that for a majority of applications this will be the most important factor. It is always desirable to plan the installation so that a minimum suction lift is required, particularly when handling volatile liquids (or even some viscous liquids which include "light ends" that may be vaporized under vacuum); or liquids which are so viscous that it is difficult to pull them through a suction pipe. Remember that if a pump is "starved" for liquid, the result will be excessive cavitation, vibration, and a noticeable reduction in the delivery rate.