Water Supply Using Bamboo Pipe. AID-UNC/IPSED Series Item No. 3, International Program in Sanitary Engineering Design, University of North Carolina, 1966.

WATER LIFTING

Pump Specifications: Choosing or Evaluating a Pump

The form given in Figure 1, the "Pump Application Fact Sheet," is a check list

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FIGURE 1

PUMP APPLICATION FACT SHEET

NAME John Doe DATE July 24, 1981
ADDRESS P.O. Box 393
Xanadu
Gondwanaland

1. Liquid to be handled: Fresh Water

2. Erosive effect of liquid:
(a) Weight percent of solids: 1-2 percent
(b) Type of solids: Sand
(c) Size of solids: largest particle -1mm

3. Maximum temperature of liquid entering pump: 35°C

4. Special situations (explain):
(a) Gases in liquid: no
(b) Liquid boiling: no

5. Capacity required: ______ liters per minute
or: 1200 kilograms per hour - made up of
or: 600 Kg per hour from lower outlet
and 600 Kg per hour from upper outlet

6. Power source available:
(a) Electrical: 110 volts
AC: single phase or: DC: ______ volts
50 cycles per second
(b) Fuel: ______
(c) Other: ______

7. Differential head and suction head: See sketch

8. Pipe material: Suction: Galvanized Iron (see sketch for pipe size)
Discharge: Galvanized Iron (see sketch for pipe size)

9. Pump connections required: Standard pipe thread
Pipe size (inside diameter): Inlet: 5.25cm* Outlet: 5.25cm*

10. Sketch of piping (all fittings and valves shown) attached

11. Other comments:

Figure 1. Pump Specification Fact Sheet. Make a copy of this form for your own use.

NOTE: For advice on pump selection or application, send the completed form (keeping a copy for your own information) to a local university, a pump manufacturer or to VITA.

* Actually this piping is the same as 2" U.S. Schedule 40.

for collecting the information needed to get help in choosing a pump for a particular situation. If you have a pump on hand, you can also use the form to estimate its capabilities. The form is an adaptation of a standard pump

specification
sheet used by engineers.

Fill out the form and send it off to a manufacturer or a technical assistance organization like VITA to get help in choosing a pump. If you are doubtful about how much information to give, it is better to give too much information than to risk not giving enough. When seeking advice on how to solve a pumping problem or when asking pump manufacturers to specify the best pump for your service, give complete information on what its use will be and how it will be installed. If
the experts are not given all the details, the pump chosen may give you trouble.

The "Pump Application Fact Sheet" is shown filled in for a typical situation. For
your own use, make a copy of the form. The following comments on each numbered item on the fact sheet will help you to complete the form adequately.

1. Give the exact composition of the liquid to be pumped: Fresh or salt water, oil, gasoline, acid, alkali, etc.

2. Weight percent of solids can be found by getting a representative sample in a pail. Let the solids settle to the bottom and decant the liquid (or filter the liquid through a cloth so that the liquid coming through is clear). Weigh the solids and the liquid, and give the weight percent of solids.

If this is not possible, measure the volume of the sample (in liters, U.S. gallons, etc.) and the volume of solids (in cubic centimeters, teaspoons, etc.) and send these figures. Describe the solid material completely and send a small sample if possible. This is important; if the correct pump is not selected, the solids will erode and/or break moving parts.

Weight percent of solids =

100 x weight of solids in liquid sample
----
weight of liquid sample

3. If you do not have a thermometer to measure temperature, guess at it, making sure you guess on the high side. Pumping troubles are often caused when liquid temperatures at the intake are too high.

4. Gas bubbles or boiling cause special problems, and must always be mentioned.

5. Give the capacity (the rate at which you want to move the liquid) in any convenient units (liters per minute, U.S. gallons per minute) by giving the total of the maximum capacity needed for each outlet.

6. Give complete details on the power source.

A. If you are buying an electric motor for the pump, be sure to give your voltage. If the power is A.C. (Alternating Current) give the frequency (in cycles per second) and the number of phases. Usually this will be single phase for most small motors. Do you want a pressure switch or other special means to start the motor automatically?

B. If you want to buy an engine driven pump, describe the type and cost of fuel, the altitude, maximum air temperature, and say whether the air is unusually wet or dusty.

C. If you already have an electric motor or engine, give as much information about it as you can. Give the speed and sketch the machine, being especially careful to show the power shaft diameter and where it is with respect to the mounting. Describe the size and type of pulley if you intend to use a belt drive. Finally, you must estimate the power. The best thing is to copy the name plate data completely. If possible give the number of cylinders in your engine, their size, and the stroke.

7. The "head" or pressure to be overcome by the pump and the capacity (or required flow of water) determine the pump size and power. The entry "Determining Pump Capacity and Horsepower Requirements," explains the calculation of simple head situations. The best approach is to explain the heads by drawing an accurate piping sketch (see Item 10 in the "Pump Application Fact Sheet"). Be sure to give the suction lift and piping separately from the discharge lift and piping. An accurate description of the piping is essential for calculating the friction head. See Figure 2.

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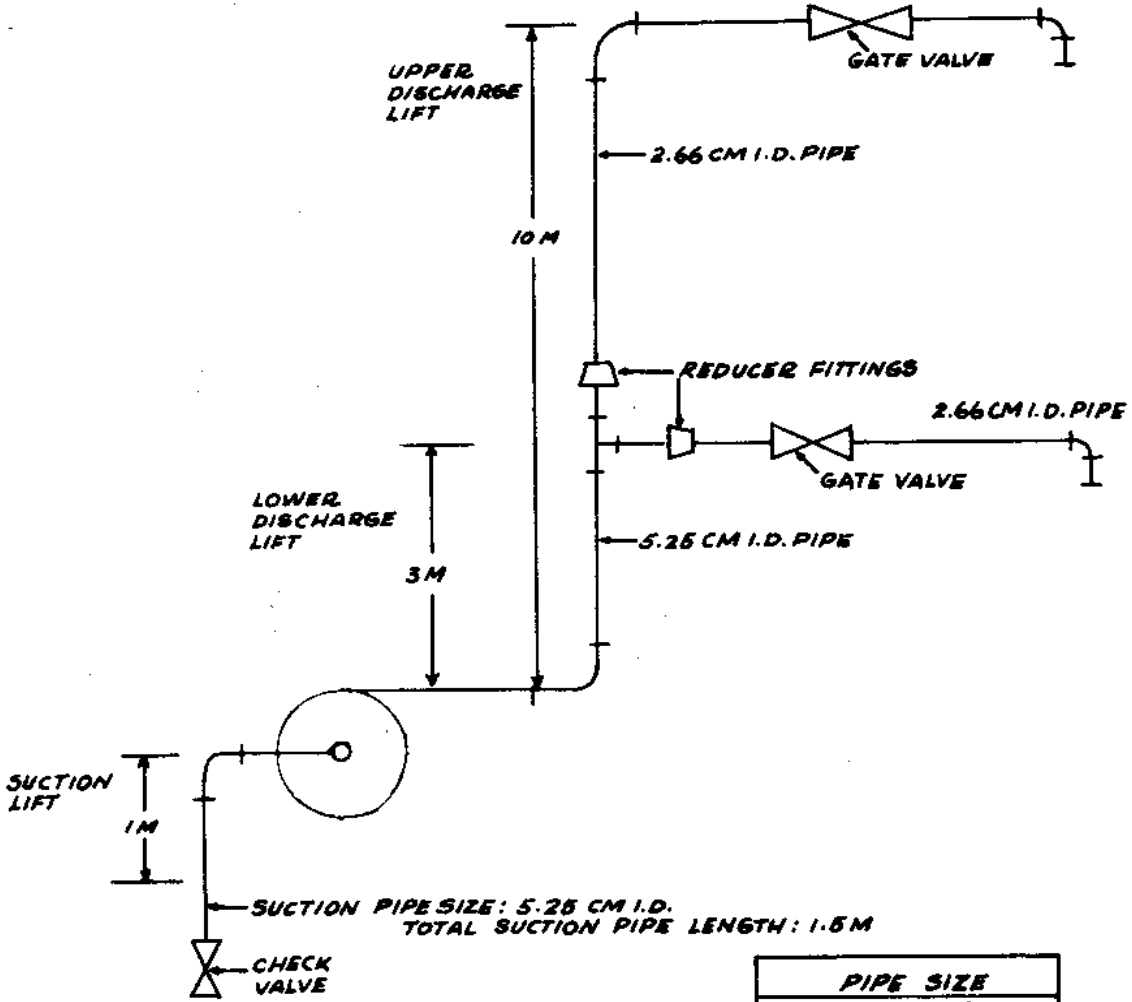
FIGURE 2

(NOT DRAWN TO SCALE)



PIPE SIZE	
DIAMETER IN CM	
INSIDE	OUTSIDE
2.66	3.34
5.25	6.04

8. The piping material, inside diameter, and thickness are necessary for making the head calculations and to check whether pipes are strong enough to

withstand the pressure. See "Water Lifting and Transport-Overview" for comments on specifying pipe diameter.

9. Connections to commercial pumps are normally flanged or threaded with standard pipe thread.

10. In the sketch be sure to show the following:

(a) Pipe sizes; show where sizes are changed by indicating reducing fittings.

(b) All pipe fittings-elbows, tees, valves (show valve type), etc.

(c) Length of each pipe run in a given direction. Length of each size pipe and vertical lift are the most important dimensions.

11. Give information on how the pipe will be used. Comment on such points as:

o Indoor or outdoor installation?
o Continuous or intermittent service?
o Space or weight limitations?

Source:

Benjamin P. Coe, VITA Volunteer, Schenectady, New York.

Determining Pump Capacity and Horsepower Requirements

With the alignment chart in Figure 1, you can determine the necessary pump size

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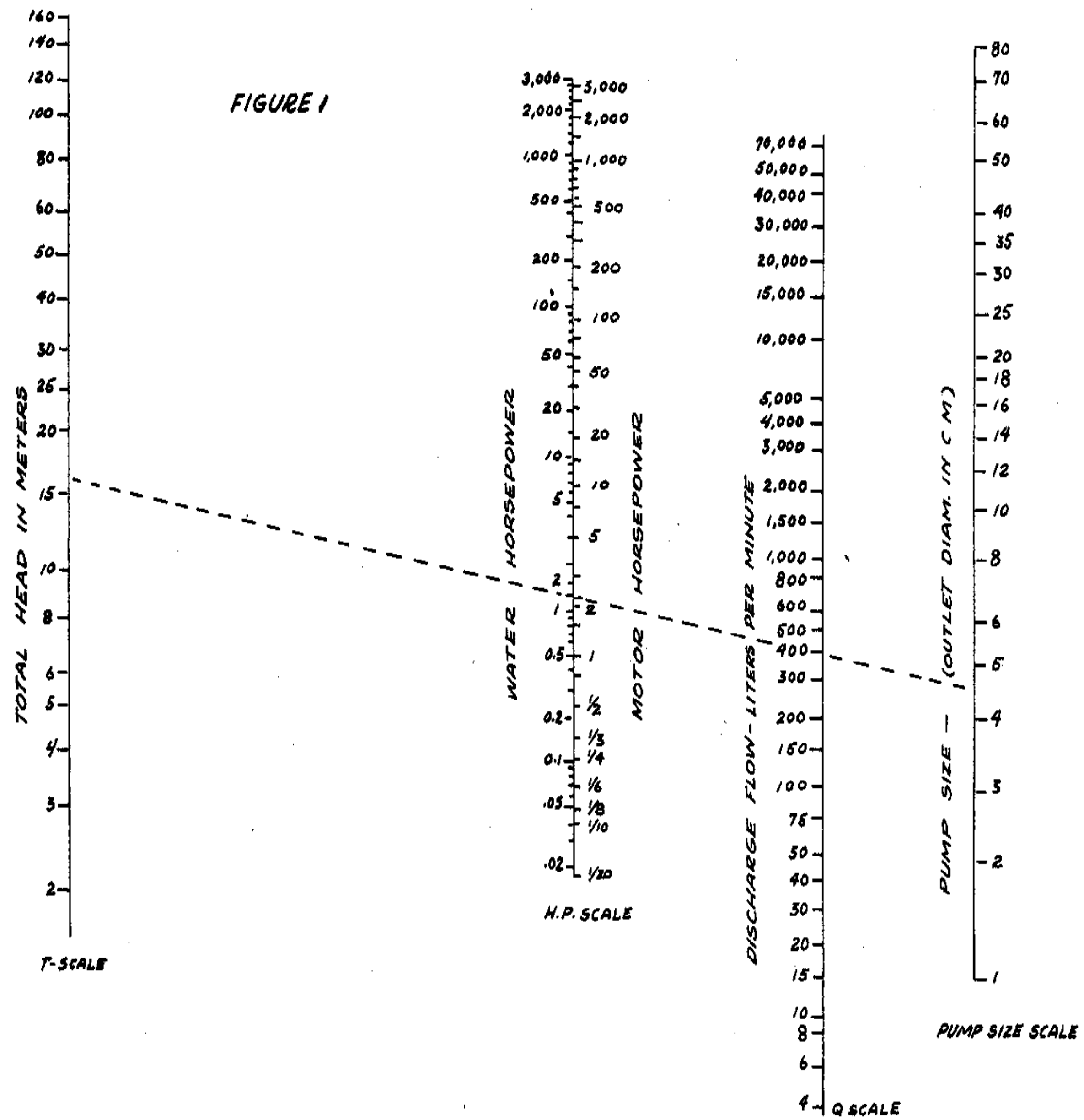
FIGURE I



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(diameter or discharge outlet) and the amount of horsepower needed to power the pump. The power can be supplied by people or by motors.

An average healthy person can generate about 0.1 horsepower (HP) for a reasonably long period and 0.4HP for short bursts. Motors are designed for varying amounts of horsepower.

To get the approximate pump size needed for lifting liquid to a known height through simple piping, follow these steps:

1. Determine the quantity of flow desired in liters per minute.

2. Measure the height of the lift required (from the point where the water enters the pump suction piping to where it discharges).

3. Using the entry "Determining Pipe Size or Velocity of Water in Pipes," page 74, choose a pipe size that will give a water velocity of about 1.8 meters per second (6' per second). This velocity is chosen because it will generally give the most economical combination of pump and piping; Step 5 explains how to convert for higher or lower water velocities.

4. Estimate the pipe friction-loss head (a 3-meter head represents the pressure at the bottom of a 2-meter-high column of water) for the total equivalent pipe length, including suction and discharge piping and equivalent pipe lengths for valves and fittings, using the following equation:

Friction-loss head = F x total equivalent pipe length

100

where F equals approximate friction head (in meters) per 100 meters of pipe.

To get the value of F, see the table below. For an explanation of total equivalent pipe length, see preceding sections.

5. To find F (approximate friction head in meters per 100m of pipe) when water velocity is higher or lower than 1.8 meters per second, use the following equation:

F [V.sup.2]
at 1.8/[sec.sup.x]
F= ----------------------------
1.8/[sec.sup.2]

where V = higher or lower velocity

Example:

If the water velocity is 3.6m per second and F at 1.8m/sec is 16, then:

F = 16 x [3.6.sup.2] 16 x 13
---------------- = ------- = 64
[1.8.sup.2] 3.24

6. Obtain "Total Head" as follows:

Total Head = Height of Lift + Friction-loss Head

Average friction loss in meters for fresh water flowing through steel pipe velocity is 1.8 meters (6 feet) per second

Pipe inside diameter: cm 2.5 5.1 7.6 10.2 15.2 20.4 30.6 61.2
inches(*) 1" 2" 3" 4" 6" 8" 12" 24"

F (approximate friction 16 7 5 3 2 1.5 1 0.5
loss in meters per 100
meters of pipe)

(*) For the degree of accuracy of this method, either actual inside diameter in inches, or nominal pipe size, U.S. Schedule 40, can be used.

7. Using a straightedge, connect the proper point on the T-scale with the proper point on the Q-scale; read motor horsepower and pump size on the other two scales.

Example:

Desired flow: 400 liters per minute
Height of lift: 16 meters, No fittings
Pipe size: 5cm
Friction-loss head: about 1 meter
Total head: 17 meters

Solution:

Pump size: 5cm
Motor horsepower: 3HP

Note that water horsepower is less than motor horsepower (see HP-scale, Figure 1).

This is because of friction losses in the pump and motor. The alignment chart should be used for rough estimate only. For an exact determination, give all information on flow and piping to a pump manufacturer or an independent expert. He has the exact data on pumps for various applications. Pump specifications can be tricky especially if suction piping is long and the suction lift is great.

For conversion to metric horsepower given the limits of accuracy of this method, metric horsepower can be considered roughly equal to the horsepower indicated by the alignment chart (Figure 1). Actual metric horsepower can be obtained by multiplying horsepower by 1.014.

Source:

Kulman, CA. Nomographic Charts. New York: McGraw-Hill Book Co., 1951.

Determining Lift Pump Capability

The height that a lift pump can raise water depends on altitude and, to a lesser extent, on water temperature. The graph in Figure 1 will help you to find out

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<u>Example</u>:

Suppose your elevation is 2000 meters and the water temperature is 25C. The graph shows that the normal lift would be 4 meters.

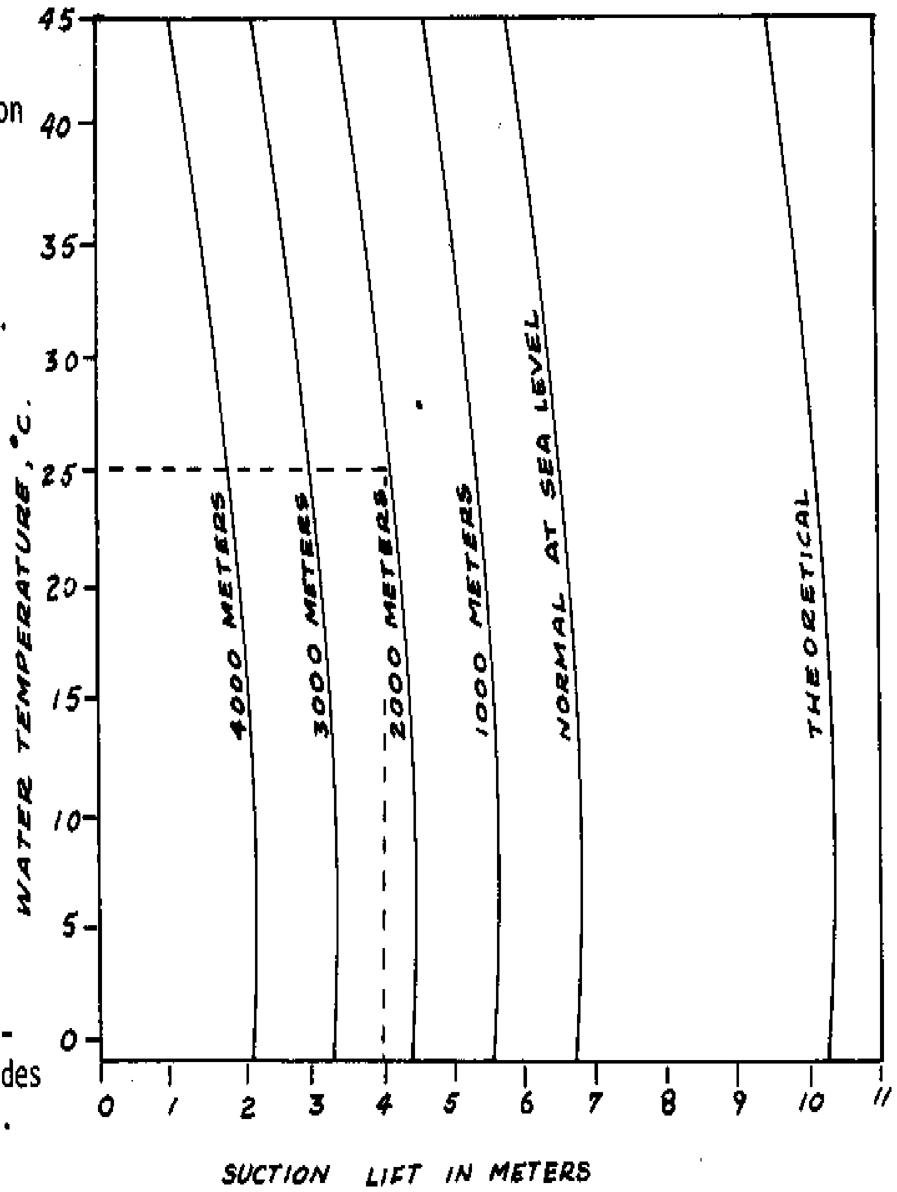

Figure 1. Graph showing lift pump capabilities at various altitudes and water temperatures. Broken lines indicate example given in text.

FIGURE I

what a lift pump can do at various altitudes and water temperatures. To use it, you will need a measuring tape and a thermometer.

If you know your altitude and the temperature of your water, Figure 1 will tell you the maximum allowable distance between the pump cylinder and the lowest water level expected. If the graph shows that lift pumps are marginal or will not work, then a force pump should be used. This involves putting the cylinder down in the well, close enough to the lowest expected water level to be certain of proper functioning.

The graph shows normal lifts. Maximum possible lifts under favorable conditions would be about 1.2 meters higher, but this would require slower pumping and would probably give much difficulty in "losing the prime."

Check predictions from the graph by measuring lifts in nearby wells or by experimentation.

Example:

Suppose your elevation is 2,000 meters and the water temperature is 25[degrees]C. The graph shows that the normal lift would be four meters.

Source:

Baumeister, Theodore. Mechanical Engineer's Handbook, 6th edition. New York: McGraw-Hill Book Co., 1958.

SIMPLE PUMPS

Chain Pump for Irrigation