TERMS AND USABLE FORMULAS

The term "head" by itself is rather misleading. It is commonly taken to mean the difference in elevation between the suction level and the discharge level of the liquid being pumped. Although this is partially correct, it does not include all of the conditions that should be included to give an accurate description.

- **FRICTION HEAD**
  —is the pressure expressed in lbs./sq. in. or feet of liquid needed to overcome the resistance to the flow in the pipe and fittings.
- **SUCTION LIFT**
  —exists when the source of supply is below the center line of the pump.
- **SUCTION HEAD**
  —exists when the source of supply is above the center line of the pump.
- **STATIC SUCTION LIFT**
  —is the vertical distance from the center line of the pump down to the free level of the liquid source.
- **STATIC SUCTION HEAD**
  —is the vertical distance from the center line of the pump up to the free level of the liquid source.
- **STATIC DISCHARGE HEAD**
  —is the vertical elevation from the center line of the pump to the point of free discharge.
- **DYNAMIC SUCTION LIFT**
  —includes static suction lift, friction head loss, and velocity head.
- **DYNAMIC SUCTION HEAD**
  —includes static suction head minus friction head minus velocity head.
- **DYNAMIC DISCHARGE HEAD**
  —includes static discharge head plus friction head plus velocity head.
- **TOTAL DYNAMIC HEAD**
  —includes the dynamic discharge head plus dynamic suction lift or minus dynamic suction head.
- **VELOCITY HEAD**
  —is the head needed to accelerate the liquid. Knowing the velocity of the liquid, the velocity head loss can be calculated by a simple formula Head = $V^2/2g$ in which g is acceleration due to gravity or 32.16 ft./sec. Although the velocity head loss is a factor in figuring the dynamic heads, the value is usually small and in most cases negligible. See table.

BASIC FORMULAS AND SYMBOLS

FORMULAS

$$\text{GPM} = \frac{\text{Lb./Hr.}}{500 \times \text{Sp. Gr.}}$$

$$\text{Eff.} = \frac{\text{GPM} \times \text{H} \times \text{Sp. Gr.}}{3960 \times \text{BHP}}$$

$$\text{H} = \frac{2.31 \times \text{psi.}}{\text{Sp. Gr.}}$$

$$N_s = \frac{N\sqrt{\text{GPM}}}{H^{3/4}}$$

$$\text{H} = \frac{1.134 \times \text{In. Hg.}}{\text{Sp. Gr.}}$$

$$\text{H} = \frac{v^2}{2g}$$

$$h_v = \frac{V^2}{2g} = .0155\,V^2$$

$$V = \frac{\text{GPM} \times 0.321}{A} = \frac{\text{GPM} \times 0.409}{(\text{I.D.})^2}$$

$$\text{BHP} = \frac{\text{GPM} \times \text{H} \times \text{Sp. Gr.}}{3960 \times \text{Eff.}}$$

SYMBOLS

GPM = gallons per minute
Lb. = pounds
Hr. = hour
Sp. Gr. = specific gravity
H = head in feet
psi = pounds per square inch
In. Hg. = inches of mercury
h_v = velocity head in feet
V = velocity in feet per second
g = 32.16 ft./sec.^{2} (acceleration of gravity)
A = area in square inches
ID = inside diameter in inches
BHP = brake horsepower
Eff. = pump efficiency expressed as a decimal
N_s = specific speed
N = speed in revolutions per minute
D = impeller in inches