$$kW = \left(\frac{Flow_{gpm} \times Head_{ft.w.c.}}{3{,}960 \times \eta_{Pump} \times \eta_{Motor} \times \eta_{VSD}} \right) \times .746$$

Where:

kW = Input to the system to produce the flow and head.

Flow = Flow rate in gallons per minute. Generally speaking, we try to use a pump test for at least one condition for this. If that is not available we will use a value from a tab report. Lacking that we will use a design m the original drawings or an equipment submittal.

Head = The pump head in ft.w.c. water column, which we usually try to identify from field measurements and pump Lacking those measurements we will use a value derived from a TAB report or the design value.

3,960 = A units conversion constant that is good for water between 40°F and 220°F.

η_{Pump} = Pump efficiency. We usually try to get this number from the pump curve or from the pump's rated bra power (bhp), flow and head. Lacking that, we will make a geometrically similar pump selection (same flow impeller diameter, and speed) using manufacturer's software and use that efficiency. Lacking that is is assume that for a pump rated for 300 gpm or less the efficiency might be in the range of 45-60%. For between 300 gpm and 1,500 gpm, efficiencys might range from 60% to 75%. For pumps over 1,500 gpm, might range from 75% to as high as 87%. Generally, efficiency will improve with pump size.

η_{Motor} = Motor efficiency. We usually try to get the motor performance curve and select the efficiency from th the bhp that the pump impeller is extracting from it. If we can't get the motor curve, we use a similar from MotorMaster^{TM} International. In all cases we adjust the efficiency for the motor operating point the motor's rated nameplate efficiency. Lacking anything else, it is reasonable to assume that the moto will improve by 1-2% over the nameplate efficiency when the pump is at 65-85% of its rated load, drop b nameplate efficiency at around 50% load, and then drop sharply towards 0 at 20-30% of rated load.

η_{VSD} = Variable speed drive efficiency. Where possible, we try to get the manufacturer's data for this. But th difficult to obtain and not consistent in its development. Lacking manufacture specific data, we use gene as published by the Department of Energy on their Industrial Best Practices web site. Lacking any othe it is reasonable to assume there will be at least 4-6% loss in the drive with it at full speed with a gradua 80% efficiency at about 20% load.

.746 = Horsepower to kW conversion constant.