



Waukesha Cherry-Burrell

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There is a separate performance *curve available for each:

- model size
- standard available inlet size
- nominal motor speed:
1750 rpm/3500 rpm for 60 Hz
1450 rpm/2900 rpm for 50 Hz

* All information on the curves is based on lab tests with water at 70°F (21°C) and is corrected to nominal rpm (1450, 1750, 2900 or 3500 rpm.) Industrial (unpolished) models perform the same as sanitary models.

HOW TO READ AND USE CENTRIFUGAL PUMP CURVE PERFORMANCE DATA

See EXAMPLE on Page 3

A IMPELLER SIZE

Each performance curve has a series of 4 to 6 heavy curved lines illustrating pump performance for various impeller diameters (as noted at the left end of the line.) Alternate impeller sizes between the maximum and minimum are available in increments of 1/16 inch. The impeller curves illustrate pump performance in terms of CAPACITY as noted on the horizontal axis (top and bottom) and HEAD as noted on the vertical axis (sides.)

B CAPACITY

Capacity is listed in volumetric terms of US gallons per minute (bottom) and cubic meters per hour (top.) Convert weight based data (such as pounds or kilograms per hour) to volumetric terms before using performance curves.

$$(\text{Lbs/Hr} \times 0.002) \div \text{Specific Gravity} = \text{US GPM}$$

$$(\text{Kg/Hr} \times 0.001) \div \text{Specific Gravity} = \text{Cubic Meters/Hr}$$

C HEAD

Head is the pressure that the pump generates in terms of an equivalent column of the liquid being pumped. Head is listed in terms of feet (left side) and meters (right side.) It represents TDH (total dynamic head) which is the discharge head minus the suction head. To convert to pressure in terms of "force per unit area" (psi or kg/cm²) use the formulas shown at the bottom of the performance curve.

D HORSEPOWER

Nominal horsepower ranges are shown on the performance curve as diagonal dashed lines. Pumping water-like fluids, any operating point to the left or below a line is possible using the hp indicated. Operating points to the right or above the line require a higher hp motor.

Actual (or brake hp) for any specific operating point may be determined by one of two methods. The first is to estimate by proportion between the dashed nominal hp lines. This estimated value must also be multiplied by fluid specific gravity if other than 1.0 (water-like.) The second is to use the efficiency data and calculate brake hp using the formula;

$$\text{BHP} = (\text{US GPM} \times \text{Head in Feet} \times \text{Specific Gravity}) \div (3960 \times \text{efficiency})$$

Efficiency is a % value and must be entered into the formula in decimal form (e.g. 55% = 0.55)

D HORSEPOWER - continued

NOTE: When selecting motor hp, always consider the application and whether a NON-OVERLOADING motor is required. The flow rate of a centrifugal pump varies depending on system conditions encountered. If lower system pressure is encountered, the flow rate and hp requirement increase. In some instances the flow rate may increase all the way to the extreme right end of the impeller curve. Under these conditions, the pump must be selected with a motor size sufficient for the end-of-curve conditions. This is known as a “non-overloading” motor selection.

E EFFICIENCY: The operating efficiency of the pump (not including motor efficiency) is shown with a series of curved light weight lines. Values between lines may be estimated by proportion. Pump efficiency values may be used to calculate brake horsepower as described in the preceding section.

F NPSHR: “Net Positive Suction Head Required” is the net pressure energy required at the pump inlet for proper operation. As flow rate, pump speed and/or product viscosity increase, higher inlet pressure is required to prevent pump starvation and cavitation.

NPSHR is shown as a single curved line in the smaller graph at the bottom of the performance curve. To find NPSHR, align pumping capacity with the NPSHR curve, then read horizontally across (left for feet, right for meters) to read the NPSHR value.

NPSHA: “Net Positive Suction Head Available” is a function of the system. It may be calculated as follows:

$$\text{NPSHA (feet)} = (\text{SP} \pm \text{EL} - \text{FR} - \text{VP})$$

SP = feet of absolute pressure at liquid supply surface (atmospheric pressure or pressure/vacuum of enclosed vessel).

EL = feet of elevation of liquid supply surface above (plus value) or below (minus value) pump inlet.

FR = friction loss from liquid supply to pump inlet (in feet).

VP = feet of vapor pressure of fluid (increases with liquid temperature; at boiling point vapor pressure equals atmospheric pressure).

NPSHA must be equal to or greater than NPSHR or the pump will be “starved” and cavitate.

Cavitation causes reduced pump performance or complete stoppage of pumping in extreme cases. Cavitation also causes extreme physical forces which are damaging to pump components.

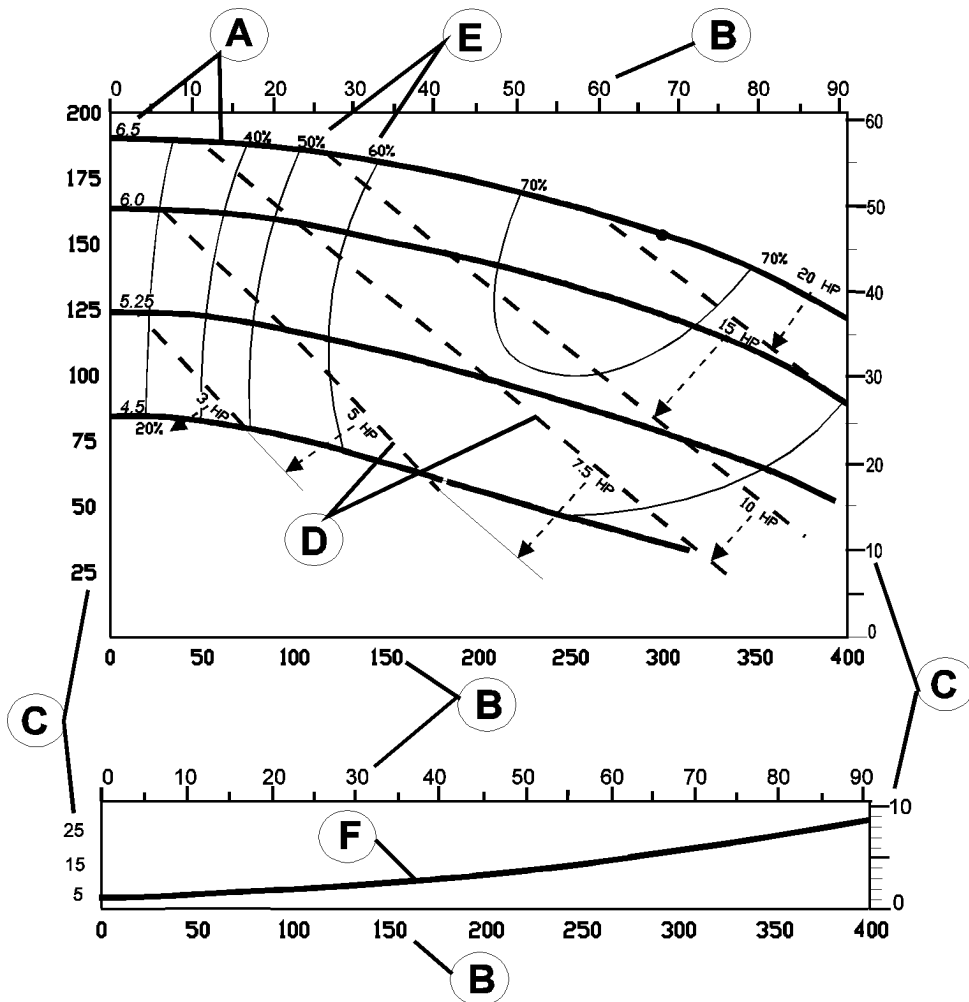
FLUID CHARACTERISTICS: Fluid characteristics (specific gravity, viscosity, undissolved solids and entrained gas) can have a big effect on centrifugal pump performance. **Contact *Waukesha Cherry-Burrell Application Engineering* if you need assistance dealing with fluid characteristics.**

Specific Gravity (a liquid’s weight/volume ratio compared to water) is a direct multiplier to horsepower. It also must be considered when converting units such as psi pressure to feet of head, or lbs/hr capacity to gpm. Water based liquids with dissolved solids such as syrups or salt solutions usually have specific gravity greater than water. Liquids which are oil or hydrocarbon solvent based usually have specific gravity less than water.

Viscosity is a measure of a fluid's resistance to flow. The effect of increasing viscosity on centrifugal pump performance is a marked increase in horsepower required, a decrease in flow rate and a decrease in head output. Fluids with viscosity up to 1000 to 1500 cps can be pumped using centrifugal pumps; however, 500 cps is often a practical limit due to very high horsepower requirements.

Undissolved solids: Fluids with undissolved solids are known as slurries. As the concentration of solids increases, the effective viscosity and specific gravity usually increases also. Slurries require special consideration to ensure that the solids do not settle or "pack" within close clearance areas of the pump or system. The size and type of solids also must be considered. Large solids may not be able to pass through; stringy solids may clog; abrasive solids may cause an unacceptable rate of wear.

Entrained gas: Most fluids have a very small amount of entrained or dissolved gas which has little or no affect on pump performance. At levels of approximately 1% by volume pump performance will be affected (lower flow and lower head.) At levels of approximately 3%-6% the pump can "air bind" and stop pumping completely. Fluids which are know to contain gas, such as in fermentation or carbonization processes, require special consideration.



EXAMPLE



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