Data Essentials for Successful Solution of Pump Problems

Ampco Pumps Company
4424 W. Mitchell Street, Milwaukee, WI 53214
Phone (414) 643-1852 Fax (414) 643-4452

Required Data for Proper Pump Selection and Application

The successful application of pumps can only be achieved when there is a thorough understanding of the specific requirements by user and producer. Information supplied by user should be given in standard hydraulic terms, units and pump, and pump parts nomenclature. When possible inquires should include answers to the following questions:

1. What rating is required?
- A. Gallons per minute.
- B. Total dynamic head in feet segregated into dynamic discharge head and suction lift or suction sealing head.
- C. Does total dynamic head vary? If so, through what limits?
- D. Give actual "NPSH" if less than 19 feet.

2. What are the hydraulic specifications of the liquid to be handled?
- A. Specific gravity.
- B. Viscosity if greater than 100 SSU.
- C. Operating temperature.
- D. Describe abrasives and solids present.

3. What are the corrosive characteristics of the liquid to be handled?
- A. Name and/or composition.
- B. Concentration (% strength, PH, etc.).
- C. What impurities are expected?
- D. What aeration exists? Is an excess amount of O_2 present.
- E. Name other gases in solution.

4. What material is used in the connecting pipe lines?

5. Is metal contamination objectionable? If so, what maximum percentage or PPM pickup of Fe, Ni, Cu, etc. is permissible?

6. Type of Pump and Drive desired.
- A. If close-coupled pump, give complete motor specifications.
- B. If frame pump for base mounting – Specify whether bare frame, frame with base and coupling for customer's drive (describe drive), or complete unit consisting of frame, base, coupling and motor. Also specify motor characteristics.

WARRANTY

Ampco Pumps Company will furnish without charge F.O.B. Milwaukee, Wisconsin, for a period of one year after shipment, replacement part(s) or will repair parts(s) found to have been defective at time of shipment.

The specified rating is guaranteed. However the characteristic shape of performance curves may vary from published standards. The capacity head and efficiency guarantees are based on actual shop tests handling clear cold water; hence the rating shall be specified in equivalent units of clear cold water.

Ampco pumps Company will not be responsible nor liable because of a breach of warranty or negligence for any consequential damage, or for any cost incurred by the Purchaser through the use of, inability to use, or sale of defective or unsatisfactory material.

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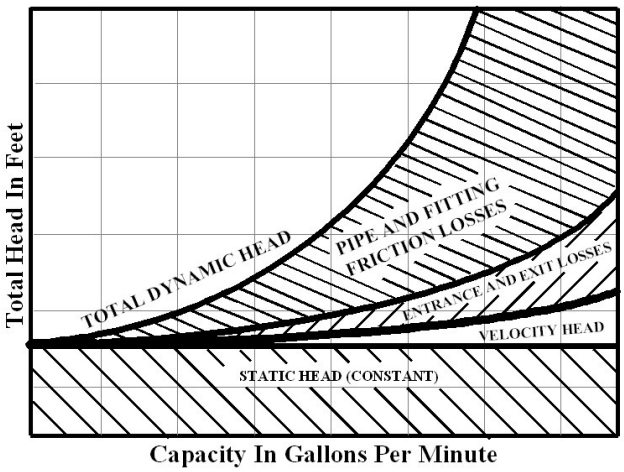
Fundamentals, Factors, and Functions

Centrifugal pumps transfer a volume of liquid during some unit of time usually expressed as "Gallons per Minute" against a resistance to flow, expressed as an equivalent vertical height of the liquid pumped. The equivalent vertical height is usually expressed in "Feet" and remains the same regardless of specific gravity.

Pressure developed and horsepower required by the pump vary directly with the specific gravity.

Static head is the vertical distance measured from the surface of the source of supply up to the surface of the discharged solution. It is generally convenient to include all constant pressures in the system as part of the static head.

Total Dynamic Head (T.D.H.) is the sum of static head plus friction losses, velocity head, entrance and exit losses in units of feet when pumping at required capacity.



Individiual component breakdown of Total Dynamic Head.

Dynamic SUCTION Head is the part of TDH accounted for from the source of supply up to the centerline of the pump. The Dynamic Suction Head should be determined independent of TDH and corrected to water equivalents.

The moving of solids in solid-liquid mixtures results in additional hydraulic losses. Kinetic energy applied by pump's impeller does not apply to solids. They are simply carried along by the liquid's velocity energy.

Net Positive Suction Head (NPSH) is the dynamic suction head in feet of liquid ABSOLUTE at the suction nozzle less the vapor pressure of the liquid. Required NPSH is the minimum value of NPSH at which the pump can deliver the indicated rate of flow while avoiding harmful cavitation. Available NPSH is the value of NPSH at which the suction system delivers the liquid to the pump. Required NPSH is a Pump characteristic whereas available NPSH is the system's suction and liquid characteristic.

Conversion Factors

MULTIPLY	BY	TO OBTAIN
Gallons per Day	6.94×10^{-4}	Gallons per Minute
Gallons per Hour	0.0167	
Cubic Feet per Second	448.8	
Liters per Second	15.852	
Cubic Meters per Hour	4.4	
Pounds per Hour (water)	0.002	
Meters of Water	3.281	Feet of Water
Feet of Solution	SP. GR.	
Lbs per square inch (PSI)	2.31	
Inches of Mercury	1.133	
Atmospheres	34	
Kgs. Per square centimeter	32.84	
Cubic Feet	7.481	Gallons
Liter	0.2642	
Imperial Gallon	1.2	
Pound of Water	0.12	

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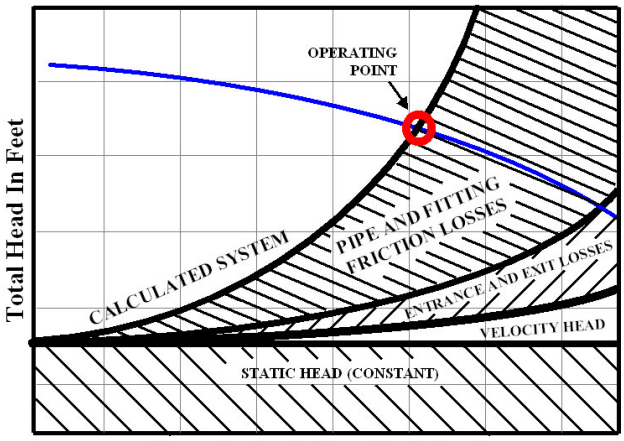
Pump and System Characteristics

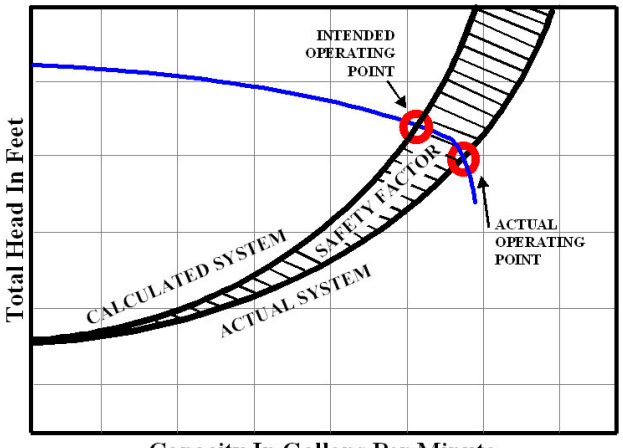
Pump characteristic: Variation of developed head with capacity of a pump operating at constant speed is called the pump characteristic. These variations are represented in a graphic form.

System characteristic: Variations of delivered capacity with imposed head on a system is called the system characteristic.

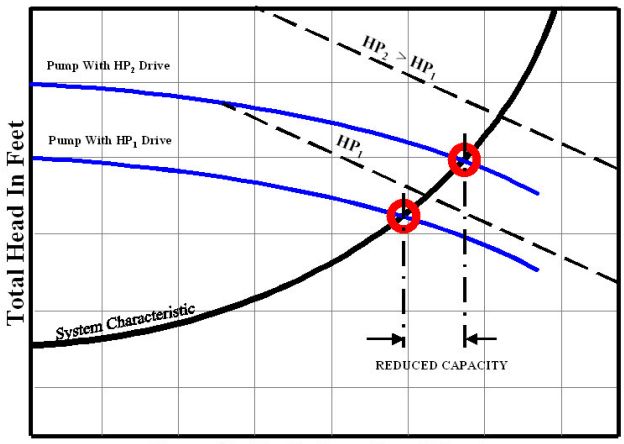
Both the Pump and the System characteristics determine the capacity and head at which the combined system and pump will operate. There is only one capacity and one head value that satisfies both the pump and the system. This common point is graphically represented as the point of intersection of the system and the pump characteristic curves.



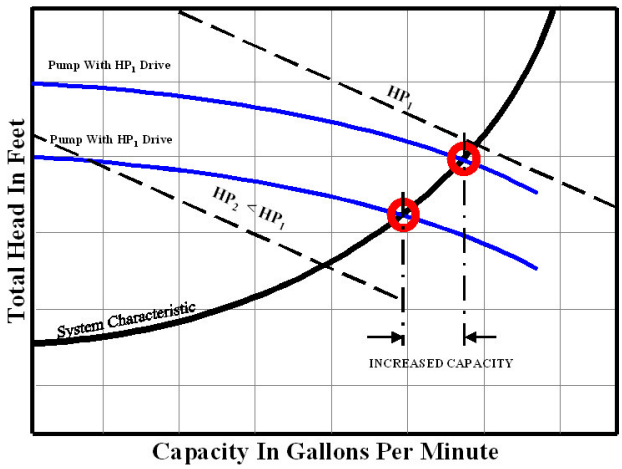
Superimposed characteristics of a pump and its system – illustrating the fixed a variable system head components.



Pump operating beyond maximum capacity (destructive) due to head safety factor.



A small reduction from chosen flow rate may utilize a smaller pump and/or drive.



An increase to chosen flow rate may be had with the same pump and drive.

The advantages in graphically representing the system characteristics instead of specifying a single point of operation are: effects of safety factors, most economic choice of pump, getting the most from a pump and drive, etc.

Obviously it is desirable to develop the system characteristic only in the capacity range that is of interest. Usually the "friction factor" is constant within the capacities considered. Hence, the velocity head, entrance-exit and friction losses of a uniform solution can be combined and assumed proportional to $(GPM)^2$. Knowing the TDH_1 and static head at a rate of flow GPM_1, the TDH_2 for a greater or smaller GPM_2 can be computed by:

$$TDH_2 = \frac{(GPM_2)^2}{(GPM_1)^2} x(TDH_1 - Static\ Head) + Static\ Head$$

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