CHEMPUMP
A DIVISION OF TEIKOKU USA INC.

ENGINEERING DATA SHEET

G Series Pump Selection		
Date	**Supersedes**	**No.**
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PUMP SELECTION

The following is a summary of the items listed on Chempump's proposal forms. For more specific information refer to the specific applicable Engineering Data sheets.

The selection of any centrifugal is based on the following factors:
- Total System Head
- Capacity required
- NPSH available and required
- Physical and chemical characteristics of the fluid pumped

The following definitions will explain these factors:

- Fluid is the chemical name as recognized. If the chemical name is a trade name or generic, the chemical formula may be necessary to properly identify the fluid.

- Total Systems Head (H) - (or Total Dynamic Head) - is the total discharge head (hd), minus the suction head (hs) if positive, elevation or plus if suction lift.

- Total Discharge Head (hd) is the sum of:
  1. The static discharge head
  2. All pipe and fitting function losses on the discharge side
  3. Pressure in discharge vessel (if closed vessel)
  4. Losses at sudden enlargements
  5. Exit losses at liquid discharge

  The above may is usually stated in feet, but may be also stated in meters - conversion is 1 meter equal 3.281 feet.

- Capacity is the desired flow rate from the pump. This is usually expressed in gallons per minute but may be stated in cubic meters per hour (M^3/HR) to obtain gallons per minute - conversion is 1 M/hr = 4.403 GPM. Other conversions will require reference to published conversion data.

- Specific Gravity is the ratio of the mass of the liquid to an equal mass of water at some standard temperature. Usually 68°C (20°).

- Viscosity is the resistance offered by a fluid to relative motion of its components. The most common unit is the centipoise (poise/100) which is the viscosity of water at 68°F (20°C).

- Kinematic Viscosity is the viscosity divided by the density (specific gravity). This is called the centistoke.

$$\text{Centistroke} = \frac{\text{Centipoise}}{\text{S.G.}}$$

- Temperature is the process temperature of the fluid which is being pumped. The application data should include the minimum process temperature and the maximum temperature expressed in degrees Fahrenheit (°F) or Centigrade (°C).

$$\text{Conversion } °F = (°C \times 9/5) + 32$$

- Vapor Pressure is the pressure at which a liquid can exist in equilibrium contact with its vapors at a specified temperature. A plot of these pressures against the corresponding temperatures is known as a vapor pressure curve.

- Specific Heat is the ratio of amount of heat required to raise a unit mass of material one (1) degree to that required to raise the same unit mass of water one (1) degree at a specified temperature.

- Suction Pressure is the pressure at the eye of the impeller expressed in pounds per square inch or Kilopascals. (k Pa.)

$$\text{Conversion } 1\text{kPa} = 0.15 \text{ PSI}$$

- Discharge Pressure is the total discharge pressure develop by the pump expressed in pounds per square inch (PSI) or Kilopascals (k Pa).

- Differential Pressure is the difference between the discharge pressure and suction pressure. This is pressure developed by the pump and should be converted to feet or meters. Shown on the proposal form as TDH.

$$\text{Conversion: } TDH = \frac{PSI \times 2.314}{S.G.}$$

- NPSH avail (NPSHa) is the absolute total suction head in feet (meters) of liquid at the pump centerline or impeller eye, less the absolute vapor pressure in feet (meters) of the liquid being pumped. It must always have a positive value.

- NPSH required (NPSHr) is determined by the pump manufacturer and depends upon factors such as, impeller inlet, impeller design, pump flow, speed, fluid etc. The NPSHa must always be equal to or greater than the NPSHr.

- Materials of Construction The fluid being pumped will dictate the materials of construction of the pump and drive section. The stator and rotor liners or containment shell must be nonmagnetic, the minimum material is 316SS. These components may also be Hastelloy-C, Monel, Inconel, 304SS, or other special materials depending upon the availability and the proper thickness and shape. The pump casings, impellers, bearing housings may be steel, 316SS, Ca-20 or Hastelloy C. Other metals are also available depending upon availability in the proper forms (cast, wrought, plate, tubing, sheet, etc).

- Motor Data The standard canned motor is wound for 460 volts, 60 Hz, 3 phase operating at 3450 RPM (2 pole speed). Other voltages can be supplied such as 208 volts, 230 volts, and 575 volts. 1750 rpm Motors are available. Chempumps are not available with single phase motors.

- Motor insulation, as standard, is Class R (NEMA Rating) rated for operation at 220°C (425°F). Special insulation for high temperature applications is available (Class C) which will operate at 750°F (400°C). The fluid temperature for standard circulating pump limits are as follows:

  1. Class “R” insulation (dry stator) - 250°F maximum Fluid Temperature
  2. Class “R” oil filled - 300°F maximum Fluid Temperature
  3. Class “R” water cooled (oil filled) - 350°F maximum Fluid Temperature
  4. Class “C” insulation (dry stator) - 750°F maximum Fluid Temperature
  5. Class “R” oil filled “T” Model - 1000°F maximum Fluid Temperature

  For dry stators derating of the motor may be necessary. Consult the factory or refer to published data on the high temperature insulation.

- Frame size This is the designation for the size range of the motors. The following frames are used in Chempumps.

GA, GB, GC, GVBS	1, 1½, 3 and 5K	56 frame
GVD, GVE, GVHS, GG	5, 7½, 10, 15 and 20K	180 frame
GVM	5, 7½, 10 and 15L	215 frame
GK, GKS	30, 40 and 50K	250 frame
"J" Series	1, 1½, 3 and 5K	56 frame
"C" Series	1½, 3K	140 frame
	5, 7½, 10, 15, 20 and 30K	210 frame

- Speed Although the standard speed is 3450 RPM (2 pole) the motors can be wound for 1750 RPM (4 pole) in all sizes.

- Hertz When 50 hertz is required, either a standard motor may be used or a special winding may be required. A 460V, 3ph, 60Hz motor can be used directly on 380V, 3ph, 50Hz system. A 230V, 3ph, 60Hz motor can be used directly on 190V, 3 ph, 50 Hz system. In both cases the speeds will be directly proportional to the ratios of hertz, thus the 50 hz motors will run at 2880 RPM and 1450 RPM respectively. The affinity laws again must be used to adjust the performance of the pump.

- Thermal Switch The standard thermal cut out switch used in the Chempump motor is a bimetallic, normally closed switch set to open at 415°F ± 16°F. The contact will close when it cools to 338°F ±16°F. Other temperatures settings are available.

- Enclosure The canned motor is a "Totally Enclosed Liquid Cooled" -TELC- Motor. The motor windings are hermetically sealed by welding so that no gaskets or static seals are used. All motors meet the requirements of the National Electric code (NEC) Classification for Class 1, Group D or Group C and D, Division 2. In the case of Group C and D, Division 2 a lower temperature thermal cut out switch (320°F for G Series and 356°F for NC Series) must be used. UL approved canned motor pumps are discussed in Engineering Data Sheet 33E.

All Chempump motors are designed and manufactured by Chempump for use in canned motor pumps. All motors are engineered for maximum efficiency, minimum heat rise and largest horsepower for a given frame size.

The "G" Series performance was obtained from testing in the laboratory using clean water at 20°C. The tests were conducted by measuring the amount of work done by the pump and comparing this to the amount of electrical energy input necessary to achieve this work. Thus the efficiencies shown on the Chempump curves are overall efficiency. It includes any losses in the motor due to the fluid passing through it.

In establishing the various data should on a Chempump curve, the following formula should be used in selecting the correct motor:

$$KW_{(in)} = \frac{.189 \times GPM \times \text{Head (in feet)} \times S.G.}{1000 \times \text{efficiency (from curve)}}$$

The KW input should be determined at both the design point and at the end of the curve to assure the motor size selection is not overloading for the application.

When selecting a "G" Series ("J" is selected in the same manner), follow the procedure for locating the capacity and head required on the appropriate performance curve. Select the impeller diameter and motor size directly from the curve. Then check the impeller selected at the far right of the curve to see if it still is below the motor load line.

For example, assume the following conditions:

Head - 80 Feet
Capacity - 30 GPM
Fluid - Water

From the model GA curve, A-70059, a 4¾ inch impeller is selected with a 1K motor (1.5 KW rated). The efficiency at this design point is 34%. However, the 4¾" impeller curve at the end of the curve shows overload on the 1K motor. Thus, the selection must be the 1½ K motor.

The motor KW required at this design point is:

$$KW_{(DES)} = \frac{.189 \times 30 \times 80 \times 1}{1000 \times .34}$$

$$= 1.34\ KW$$

The motor KW required at the end of the curve is:

$Head_{(EOC)} = 65$
$GPM_{(EOC)} = 50$
$eff_{(EOC)} = 34\%$

$$KW_{(EOC)} = \frac{.189 \times 50 \times 65 \times 1}{1000 \times .34}$$

$$= 1.81\ KW$$

The 1K motor has a full load rating of 1.5KW. A 1.5K motor, which has a full load KW rating of 2.5 KW should be selected.

This confirms the selection of model GA-1 1/2K with a 4¾ inch impeller. When S.G. is other than 1.0 and viscosity is more than 30 CPS, these factors must be included in the selection. Refer to EDS #4E and #5E.

Remember also to check the NPSH required versus the NPSH available, pumping temperature, Maximum System Pressure and Fluid Compatibility (refer to the Fluid Data Sheets).

Note: The "J" Series is selected using the same method.