# Guide To Submersible Pump Selection for Sump, Effluent, and Sewage Systems

This pump selection guide is intended to help you select the right type and size pump for your specific sump, effluent, or sewage application. It provides information for basic residential and light commercial/industrial pump selection/sizing to help you maintain warranty protection and ensure a longer service life for your pump.

## DEFINITIONS

### Sump

Designed to handle water that will not drain by gravity, including foundation drains in homes or buildings; parking lots; rainfall pooling (low land areas); manholes; retention ponds; and truck docks.

### Effluent

Will handle the gray, soiled water from a septic tank. Effluent pumps can handle a maximum of 3/4" or less spherical solids.

### Sewage

Designed to handle sewage waste from home, office, or dewatering applications that include up to 2" spherical solids, such as tissue paper and soiled water. Sewage pumps are not designed to grind up solids. Therefore, sanitary napkins, prophylactics, and nonbiodegradable hygiene products should be avoided.

### Switch Types

Manual or no switch listed— Pump turns on or off by connecting or disconnecting plug from power source.

Integral—Float is wired to pump and set to turn on or off at specified water levels.

Tether—The pump's plug fits into the back end of the float's plug (piggyback style) and the on/off water level is set by the length of tether.

Vertical—Factory-set switch is located in pump head and controlled by float movement.

Diaphragm—Operates without a float. Switch reacts to pressure against the diaphragm and turns pump on or off at set levels.

## PUMP SIZING

### Vertical Lift

The vertical lift (also known as head) is essential to the pump's capabilities and should be verified by measuring from the bottom of the pit to the highest part of the discharge line.

### Horizontal Run

The discharge line must be considered to determine proper friction loss (heat caused by the volume being pumped, which slows down the liquid). Friction loss equates to additional head due to resistance of the volume going through the piping.

### Pipe Size

The pump's discharge size should determine the pipe size. Using a discharge pipe that is smaller than the pump's discharge outlet (e.g. 1½" pump discharge and 1" pipe) is not recommended. Smaller-diameter pipe may result in additional friction loss.

### What's Going Into The Basin

Knowing how much liquid is going into the basin is known as gallons per minute (GPM). Undersizing or oversizing can cause the pump to run too frequently, resulting in excess wear and shorter service life.

### Excess Fittings

When using systems with spring-loaded check valves or ball valves, verify the pressure rating the pump will have to overcome to enable it to pump through the fitting. Pressure will cause an additional amount of head on the entire system and be measured by taking the pressure and multiplying by 2.31 (which will equal the additional head or lift). Example: 5 pounds of pressure x 2.31 = 11.55 ft. of additional lift or head.

## SIZING A SYSTEM

1. Determine what type of pump your application needs: sump, effluent, or sewage.
2. Determine voltage and phase of electrical supply for adequate pump. Note: Most pumps are not dual voltage. The voltage supplied must match the pump's voltage.
3. Determine the required GPM of flow into the system, using velocity or system load. The first method is velocity. In dewatering and sewage applications, velocity is determined with a minimum of 2-ft. per second flow in order to keep the pipeline free of debris and clogging. The following velocities are recommended for use:

| Pipe Size (In.) | Minimum GPM |
|---|---|
| 1½ | 13 |
| 2 | 21 |
| 2½ | 30 |
| 3 | 46 |
| 4 | 78 |

The second method is system load, where the pump's capacity in GPM must exceed the incoming flow into the basin. The following are methods for sizing each system:

Sump:

For sandy soil—Basement's square footage divided by 100 and multiplied by 2.50 will equal the GPM (i.e., basement's sq. ft./100 x 2.50 = GPM).

For clay soils—Basement's square footage divided by 100 and multiplied by 1.25 equals the GPM (i.e., basement's sq. ft./100 x 1.25 = GPM).

Effluent: Consult local codes for specifications.

Sewage: For sewage systems you must add the total fixture units (e.g., toilets, sinks, showers, washing machine, etc.) that will be draining into the basin. Each unit will have a value listed in the table at the right.

Once all fixture units have been accounted for, multiply by 0.5 to get an estimated GPM System Load (e.g., 45 fixtures x .5 = 22.5 GPM). The GPM rate must be greater than the required velocity flow to keep the PVC line free of debris.

**Sewage System Sizing**

| Fixture Description | Fixture Unit Value* |
|---|---|
| Bathtub, 1½" Trap | 2 |
| Bathtub, 2" Trap | 3 |
| Drinking Fountain | 1 |
| Dishwasher, Domestic | 2 |
| Kitchen Sink | 2 |
| Lavatory, 1½" Trap | 1 |
| Laundry Tray | 2 |
| Shower | 2 |
| Sink, Service Type | 3 |
| Swimming Pool (Per 100 Gallons) | 1 |
| Urinal | 4 |
| Washing Machine | 2 |
| Water Closet | 3 |
| Water Softener | 4 |
| Unlisted Fixture, 1½" Trap | 3 |
| Unlisted Fixture, 2" Trap | 4 |
| Unlisted Fixture, 2½" Trap | 5 |
| Unlisted Fixture, 3" Trap | 6 |

(*) Graph data is taken from ASPE Handbook, Uniform Plumbing Code, Cameron Hydraulic Data and Plastic Pipe Institute.

4. The next step in sizing is referred to as Total Dynamic Head (TDH). TDH is the vertical lift added to the friction loss in the piping and the fittings. To estimate TDH, measure the vertical lift to the highest point, using the water line in the basin or the pump's off level. Next, take the total discharge piping length and divide the length by 100. Multiply the equivalent value for the discharge size based on GPM (see table below). Multiply the number of fittings by their equivalent values. Add the height, total friction head, and any additional head due to pressure, to determine the approximate TDH.

Note: The GPM must be figured to find friction loss figures.

| | 2" | | 2½" | | 3" | | 4" | |
|---|---|---|---|---|---|---|---|---|
| GPM | Plastic | Steel | Plastic | Steel | Plastic | Steel | Plastic | Steel |
| **Friction Head in Feet Per 100 Ft. of Schedule 40 Pipe** | | | | | | | | |
| 20 | 0.73 | 1.55 | 0.31 | 0.65 | — | — | — | — |
| 25 | 1.10 | 2.34 | 0.47 | 0.99 | — | — | — | — |
| 30 | 1.55 | 3.28 | 0.65 | 1.38 | — | — | — | — |
| 35 | 2.06 | 4.37 | 0.87 | 1.84 | 0.30 | 0.64 | — | — |
| 40 | 2.64 | 5.59 | 1.11 | 2.35 | 0.39 | 0.82 | — | — |
| 45 | 3.28 | 6.95 | 1.38 | 2.93 | 0.48 | 1.02 | — | — |
| 50 | 3.99 | 8.45 | 1.68 | 3.56 | 0.58 | 1.24 | — | — |
| 60 | 5.59 | 11.80 | 2.35 | 4.99 | 0.82 | 1.73 | — | — |
| 70 | 7.44 | 15.80 | 3.13 | 6.64 | 1.09 | 2.31 | 0.29 | 0.70 |
| 80 | 9.52 | 20.20 | 4.01 | 8.50 | 1.39 | 2.95 | 0.37 | 0.79 |
| 90 | — | — | 4.99 | 10.60 | 1.73 | 3.67 | 0.46 | 0.98 |
| 100 | — | — | 6.06 | 12.80 | 2.11 | 4.47 | 0.56 | 1.19 |
| 125 | — | — | 9.18 | 19.50 | 3.19 | 6.75 | 0.85 | 1.80 |
| 150 | — | — | — | — | 4.47 | 9.46 | 1.19 | 2.52 |
| 175 | — | — | — | — | 5.95 | 12.30 | 1.58 | 3.36 |
| 200 | — | — | — | — | — | — | 2.30 | 4.30 |
| 225 | — | — | — | — | — | — | 2.56 | 5.35 |
| 250 | — | — | — | — | — | — | 3.07 | 6.50 |
| 300 | — | — | — | — | — | — | 4.30 | 9.11 |

| Nominal Pipe Size (In.) | 90° Elbow | 45° Elbow | Tee Through-Flow | Tee Branch Flow | Swing Check Valve | Gate Valve |
|---|---|---|---|---|---|---|
| **Friction Factors for Pipe Fittings in Terms of Equivalent Feet of Straight Pipe** | | | | | | |
| 2 | 5.2 | 2.8 | 3.5 | 10.3 | 17.2 | 1.4 |
| 2½ | 6.2 | 3.3 | 4.1 | 12.3 | 20.6 | 1.7 |
| 3 | 7.7 | 4.1 | 5.1 | 15.3 | 25.5 | 2.0 |
| 4 | 10.0 | 5.0 | 7.0 | 22.0 | 33.0 | 2.3 |

5. Once the TDH and GPM are known, you now can select a pump that falls below or equal to the pump's curve. If there are any complications with the above sizing methods or pump selection, consult the pump manufacturer.