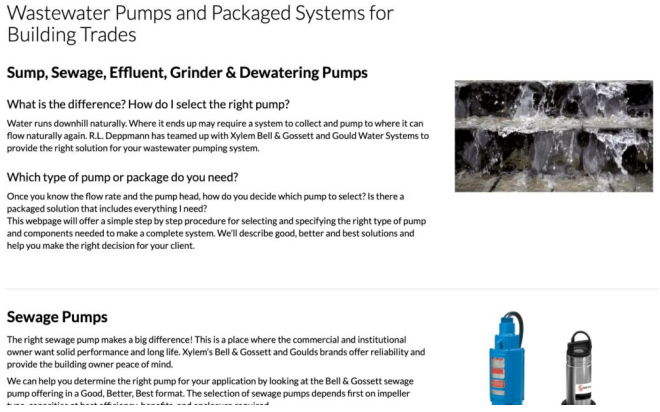
Monday, March 23, 2019

Sump & Sewage Pump Design Calculations: Pump Head for Building Services

Monday Morning Minutes | by Norm Hall, March 23, 2019

Today we want to help you in determining the pump head for sump and sewage applications. Simple or not, it is good to review the information required. It is also great when you find a calculator that helps you find and document the answer.


Wastewater Pumps and Packaged Systems for Building Trades

Sump, Sewage, Effluent, Grinder & Dewatering Pumps

What is the difference? How do I select the right pump?

Water runs downhill naturally. Where it ends up may require a system to collect and pump to where it can flow naturally again. R.L. Deppmann has teamed up with Xylem Bell & Gossett and Gould Water Systems to provide the right solution for your wastewater pumping system.

Which type of pump or package do you need?

Once you know the flow rate and the pump head, how do you decide which pump to select? Is there a packaged solution that includes everything I need?
This webpage will offer a simple step by step procedure for selecting and specifying the right type of pump and components needed to make a complete system. We'll describe good, better and best solutions and help you make the right decision for your client.

Sewage Pumps

The right sewage pump makes a big difference! This is a place where the commercial and institutional owner want solid performance and long life. Xylem's Bell & Gossett and Goulds brands offer reliability and provide the building owner peace of mind.

We can help you determine the right pump for your application by looking at the Bell & Gossett sewage pump offering in a Good, Better, Best format. The selection of sewage pumps depends first on impeller

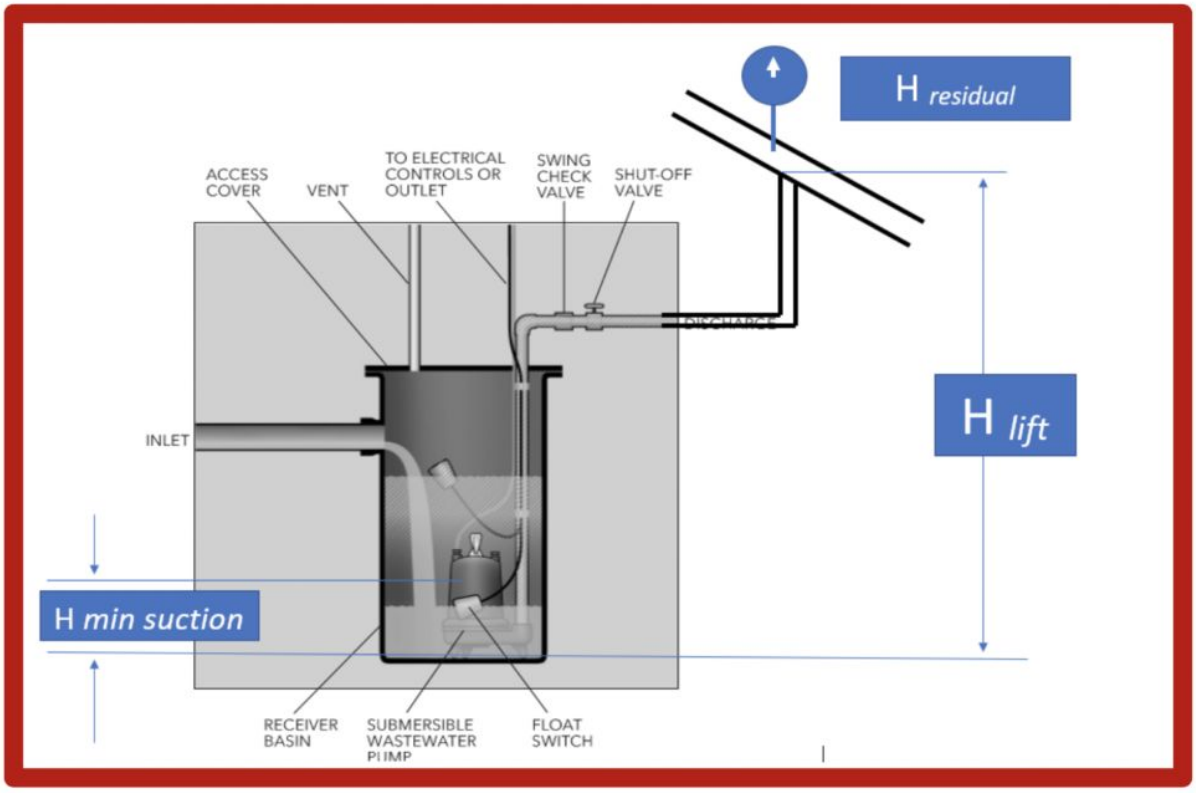
Today's R. L. Deppmann Company Monday Morning Minutes will give you both. We also are introducing our new plumbing Sump and Sewage website page. Make sure to take a look at this great tool.

Required Pump Head Calculation Information

The information required for the sump and sewage pump head calculations are really no different than any other open system. We need the flow rate in gallons per minute (GPM), the elevation or lift required, friction loss, and the pressure of the pipe or system we are discharging into. We assume there is an open basin where the pump is located. The suction pressure is simply the minimum fluid level in the sump.

The calculations will be:

$$H_{total} = H_{lift} + H_{friction} + H_{residual} - HD_{min\ suction} + H_{safety}$$



Our assumption here is that we are piping into a gravity main. Forced main Grinder Pump applications will require a different calculation and friction loss which are not covered in this blog.

DO NOT USE THIS ARTICLE FOR GRINDER PUMP SIZING

Pump Head Calculation: Residual Head $H_{residual}$

Most sump and sewage applications are pumping from a basin up and into a gravity sewer pipe. Those pipes are normally flowing water by gravity and there is no pressure that this pump would have to overcome. If there is any pressure in that sewer pipe, you would have to add that pressure, in feet of head, to the pump head calculations.

Pump Head Calculation: Elevation H_{lift} and HD_{min} suction

This is an open system, so elevation in feet that we must lift the water to get into the return main is important. Don't forget, in a below ground basin, lift (H_{lift}) is from the bottom of the sump and not from the floor level.

The minimum suction elevation of a pump is important. Bell & Gossett publishes minimum pump off levels for their sump and sewage pumps. It is important to verify the actual requirement of the pump your schedule. We provide a table to use for estimating this Bottom float off level on our website.

Pump Head Calculation: Friction Loss $H_{friction}$

Friction loss in the piping depends on the flow rate, the pipe size, and the roughness of the pipe. Let's start with the roughness. The Bell & Gossett (B&G) System Syzer calculator is based on new pipe friction loss or C=150. In our last R. L. Deppmann Monday Morning Minutes; Sump and Sewage Pump Design Calculations: Old Pipe or New Pipe in Head Calculations, we discussed the various pipe roughness values.

This friction loss includes the pressure drop through the pipe, valves, and fittings. Bell & Gossett offers a great tool, The B&G System Syzer to assist you in this application. If you wish to use a different value for roughness, this multiplier chart will get you close.

B&G System Syzer Corrections to PVC for Various Hazen-Williams "C" Values.

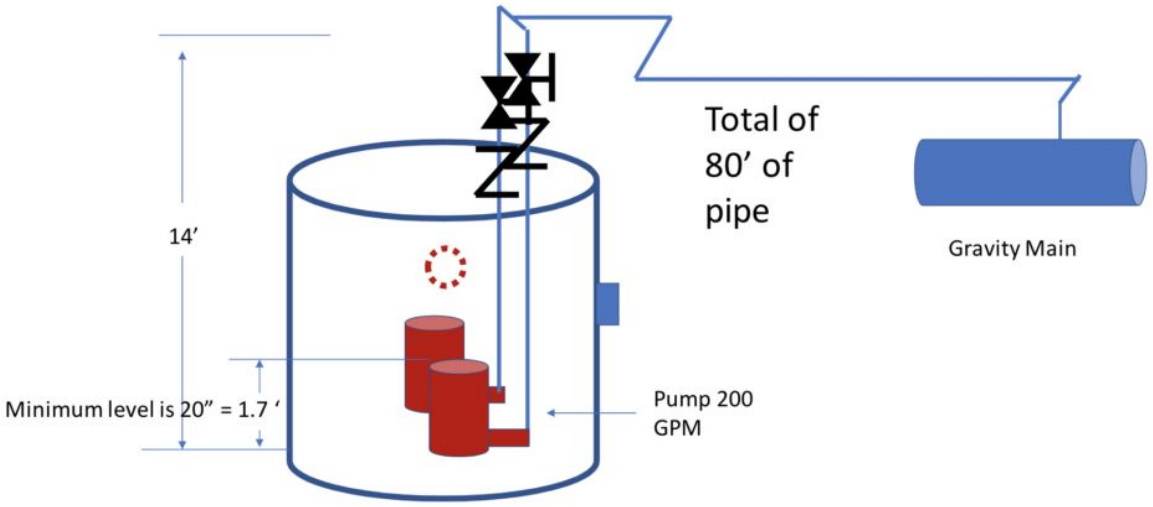
"C" Value	Pipe Description	Correction Multiplier
C=150	New schedule 40 PVC pipe	1.0
C=140	New schedule 40 galvanized pipe	1.1
C=130	New cast iron pipe	1.3
C=120	Average 5-year-old cast iron pipe	1.5
C=100	Average 15-year-old cast iron pipe	2.1

Multipliers are average and rounded to 0.1

B&G System Syzer Pump Head Calculations

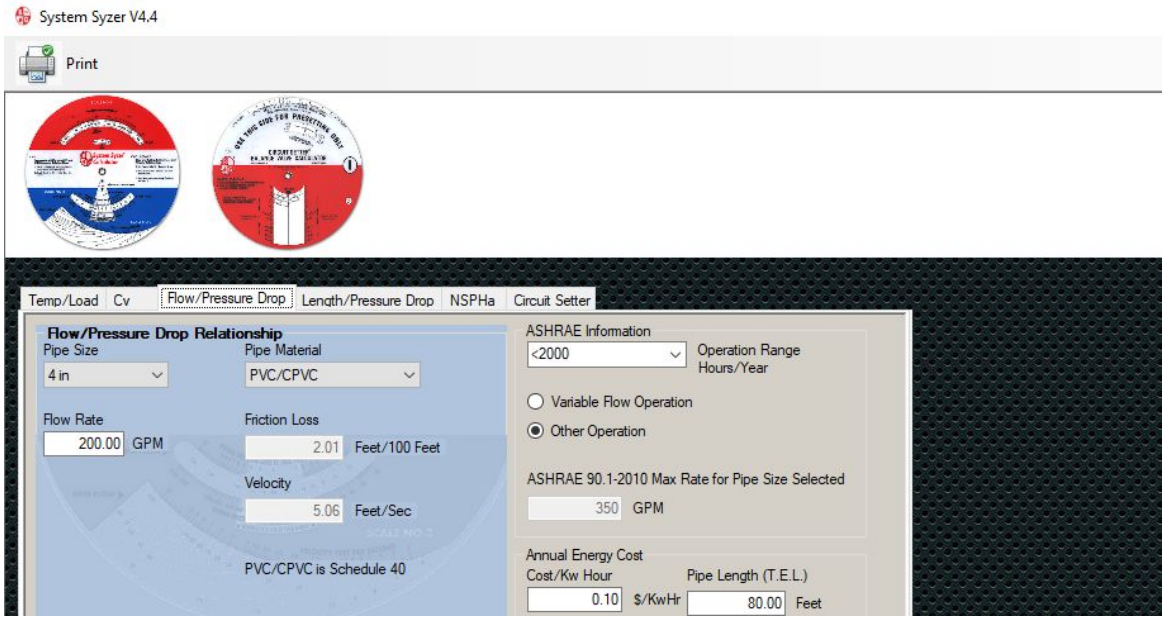
There are two tabs we would use for this application; the **Flow/Pressure Drop tab** and the **Length/Pressure drop tab**.

Let's use the example below and walk through the steps.



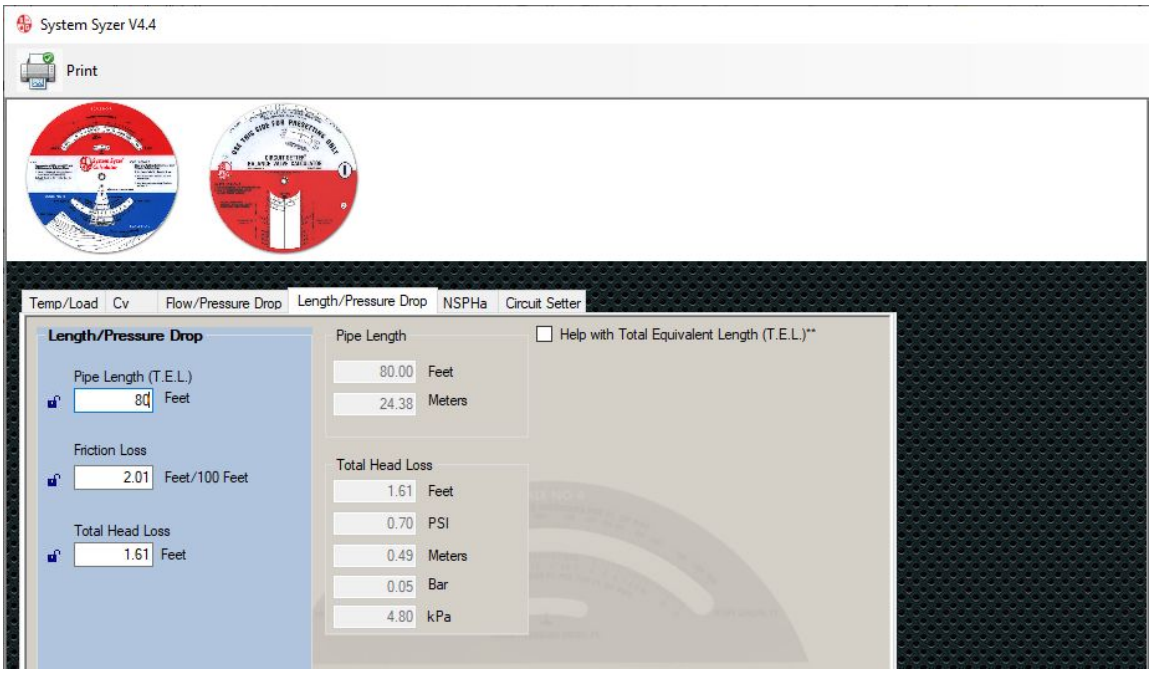
1. Select Flow/Pressure Drop tab

2. In this tab, select pipe materials, pipe size, and enter GPM. Make sure the velocity is above the 2.0 feet/sec scouring minimum. (You can ignore the ASHRAE information since this is not HVAC.)

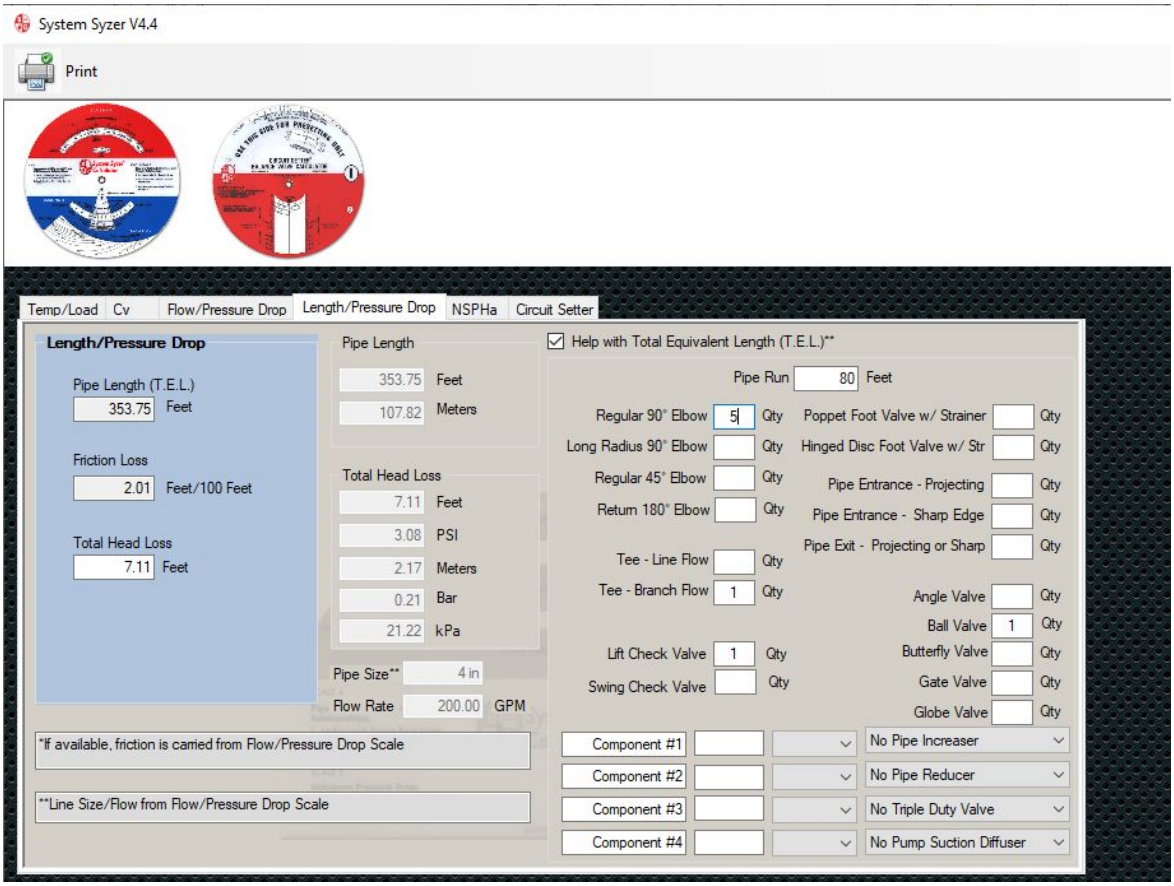


3. Select the Length/Pressure Drop tab

4. Select the “Help with Total Equivalent Length (T.E.L)”



5. Enter the *total pipe length* at the top right and enter the *number of valves*. (Remember if there are two pumps in parallel, we only count the valves for one pump.) Enter the *elbows*, *tees*, and *other fittings*.



6. Read the **Total Head Loss** on the left. The answer is **7.11 feet**

Pump Head Calculation: Safety Factor Head H_{safety}

The safety factor can be a total multiplier or additional head. In the example above, let's make some assumptions. The engineer is a bit nervous about the friction head but confident the elevation is close. Let's assume they want to double the friction loss which is an extra 7 feet. We can also assume she wants to add a couple feet to the lift in case the location of the main is not as shown on the as-builts. The safety head is 7 + 2 = 9 feet.

Example Solution

In the formula:

$$H_{total} = H_{lift} + H_{friction} + H_{residual} - HD_{min\ suction} + H_{safety}$$

We can use the following numbers:

$$H_{total} = 14 + 7.11 + 0 - 1.7 + 9 = 28.4 \text{ feet}$$

It is a good idea to always check the selected pump for operation based on design flow at the scheduled head and the design flow at the minimum head to make sure there will be no issues with curve runout.

Next week, we will look at the Michigan Elevator Sump Pump Options in the R. L. Deppmann Monday Morning Minutes.