

Monday, December 21, 2020

# Net Positive Suction Head (NPSH) Part 3 of 5 –NPSH Available

**Monday Morning Minutes** | by Norm Hall, December 21, 2020

The available cooling tower pump NPSH or net positive suction head is a function of the pan elevation, friction, and temperature. Sometimes the combination of these things will hurt you. Today, the R. L. Deppmann Monday Morning Minutes looks at calculating the available pressure at the pump.

This article will start by looking at the formula for calculating the available NPSH for an open or closed system during design. Then we will show you an easy method using the Bell & Gossett System Syzer calculator.



$$NPSHA = HA \pm HZ - HF - HVP$$

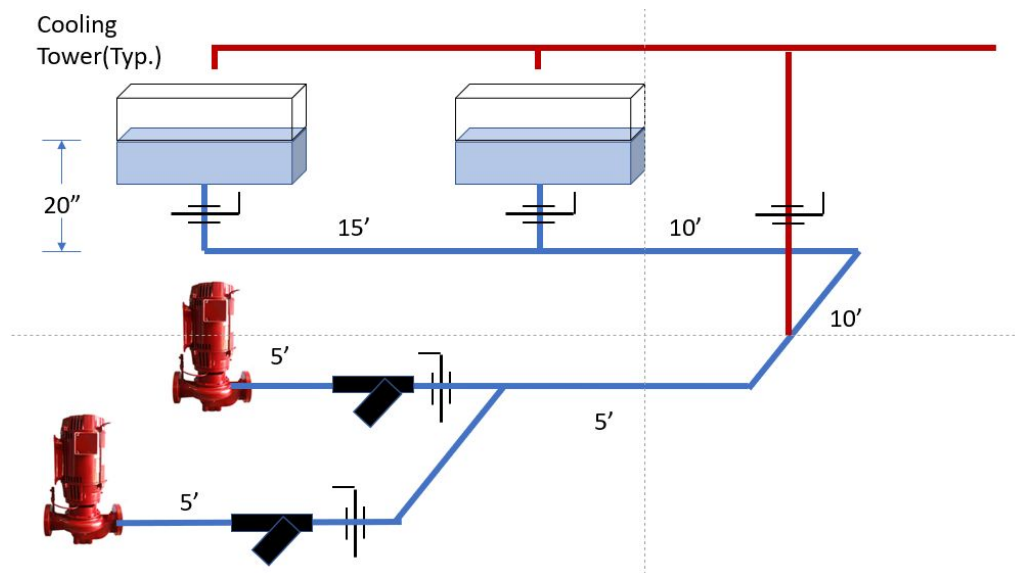
## Net Positive Suction Head Available Formula

- **HA** is the available **absolute** pressure in feet at the tower or condensate water surface or, in a closed hydronic system, the expansion tank pressure.

- **HZ** is the elevation of the water surface or expansion tank above (+) or below (-) the pump suction **in feet**.
- **HF** is the piping and fitting friction loss **in feet** from the water surface or expansion tank to the pump suction.
- **HVP** is the absolute vapor pressure of the fluid **in feet** at the pump suction temperature.

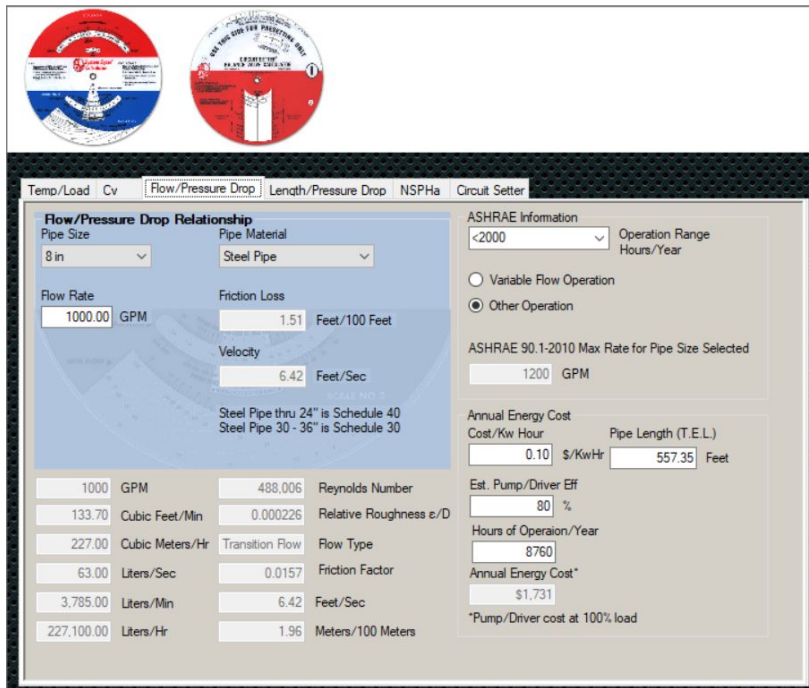
Bell & Gossett has a nice explanation of this in the article [Determining NPSHA](#).

## Using the B&G System Syzer for NPSHA



Look at the simple system piping example shown above. This example will use the 1000 GPM at 40' pump from part 2 of this series. The pump NPSH required with allowances and safety factors was 23 feet. Use the system syzer to determine the NPSHA.

**Step 1:** Use your chosen pipe size and flow rate at the proper temperature and enter them under the **flow/pressure drop** tab.



Temp/Load Cv | **Flow/Pressure Drop** | Length/Pressure Drop | NSPHa | Circuit Setter

**Flow/Pressure Drop Relationship**

Pipe Size: 8 in | Pipe Material: Steel Pipe

Flow Rate: 1000.00 GPM | Friction Loss: 1.51 Feet/100 Feet

Velocity: 6.42 Feet/Sec

Steel Pipe thru 24" is Schedule 40  
Steel Pipe 30 - 36" is Schedule 30

1000	GPM	488.006	Reynolds Number
133.70	Cubic Feet/Min	0.000226	Relative Roughness c/D
227.00	Cubic Meters/Hr		Transition Flow
63.00	Liters/Sec	0.0157	Friction Factor
3,785.00	Liters/Min	6.42	Feet/Sec
227,100.00	Liters/Hr	1.96	Meters/100 Meters

ASHRAE Information: <2000 | Operation Range Hours/Year

Variable Flow Operation:  Variable Flow Operation |  Other Operation

ASHRAE 90.1-2010 Max Rate for Pipe Size Selected: 1200 GPM

Annual Energy Cost: 0.10 \$/KwHr | Pipe Length (T.E.L.): 557.35 Feet

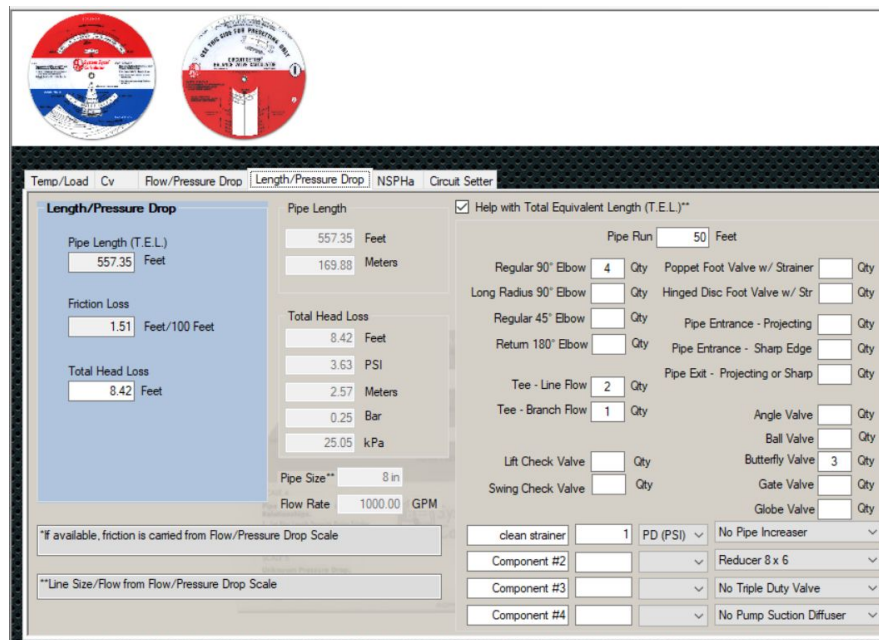
Est. Pump/Driver Eff: 80 %

Hours of Operation/Year: 8760

Annual Energy Cost\*: \$1,731

\*Pump/Driver cost at 100% load

**Step 2:** Enter the pipe lengths and fittings in the Length/Pressure Drop tab.



Temp/Load Cv | Flow/Pressure Drop | **Length/Pressure Drop** | NSPHa | Circuit Setter

**Length/Pressure Drop**

Pipe Length: 557.35 Feet | 169.88 Meters

Friction Loss: 1.51 Feet/100 Feet

Total Head Loss: 8.42 Feet | 3.63 PSI | 2.57 Meters | 0.25 Bar | 25.05 kPa

Pipe Size: 8 in | Flow Rate: 1000.00 GPM

Help with Total Equivalent Length (T.E.L.)\*\*

Pipe Run: 50 Feet

Regular 90° Elbow	4	Qty	Poppet Foot Valve w/ Strainer		Qty
Long Radius 90° Elbow		Qty	Hinged Disc Foot Valve w/ Str		Qty
Regular 45° Elbow		Qty	Pipe Entrance - Projecting		Qty
Return 180° Elbow		Qty	Pipe Entrance - Sharp Edge		Qty
Tee - Line Flow	2	Qty	Pipe Exit - Projecting or Sharp		Qty
Tee - Branch Flow	1	Qty	Angle Valve		Qty
Lift Check Valve		Qty	Ball Valve		Qty
Swing Check Valve		Qty	Butterfly Valve	3	Qty
			Gate Valve		Qty
			Globe Valve		Qty

\*If available, friction is carried from Flow/Pressure Drop Scale

\*\*Line Size/Flow from Flow/Pressure Drop Scale

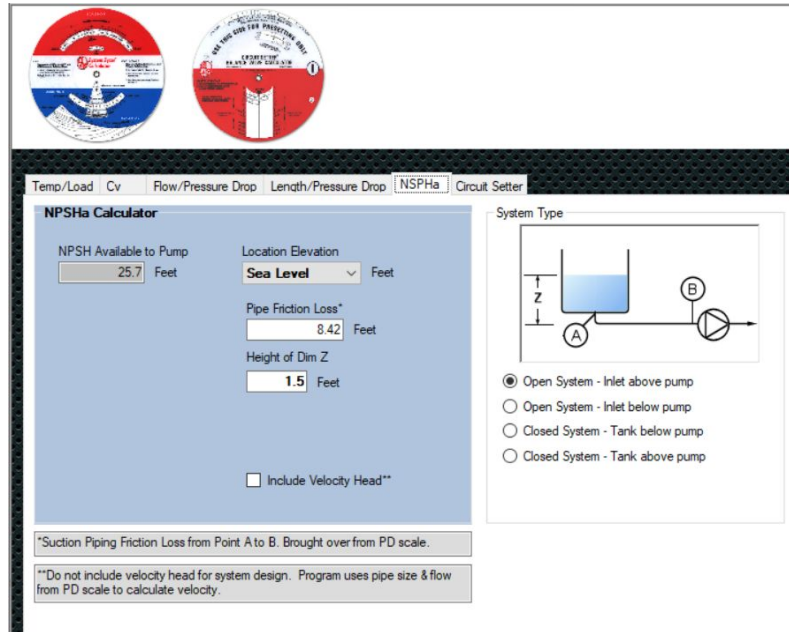
clean strainer: 1 | PD (PSI) | No Pipe Increaser

Component #2: | Reducer 8 x 6

Component #3: | No Triple Duty Valve

Component #4: | No Pump Suction Diffuser

**Step 3:** Enter the elevation from the minimum tower basin water level to the centerline of the pump suction in NPSHa tab.



Temp/Load Cv Flow/Pressure Drop Length/Pressure Drop **NPSHa** Circuit Setter

**NPSHa Calculator**

NPSH Available to Pump: 25.7 Feet

Location Elevation: Sea Level Feet

Pipe Friction Loss\*: 8.42 Feet

Height of Dim Z: 1.5 Feet

Include Velocity Head\*\*

System Type

Open System - Inlet above pump

Open System - Inlet below pump

Closed System - Tank below pump

Closed System - Tank above pump

\*Suction Piping Friction Loss from Point A to B. Brought over from PD scale.

\*\*Do not include velocity head for system design. Program uses pipe size & flow from PD scale to calculate velocity.

This pump selection required a modified NPSHR required of 23 feet. This pump installation has an available NPSH of 25.7 feet. This application will work fine.

It is VERY IMPORTANT for the engineer to spend the time to detail the suction piping and verify elevations. What would happen if the contractor used 8" pipe but reduced down to 6" for the valves and strainer at the pump suction? The friction loss would jump to 16 feet. The NPSHA drops to 18.2 feet. The pump would now be in trouble.

**Check out the rest of the Net Positive Suction Head (NPSH) Series:**

**Part One – [Terms and Definitions](#)**

**Part Two – [NPSH Safety factors](#)**