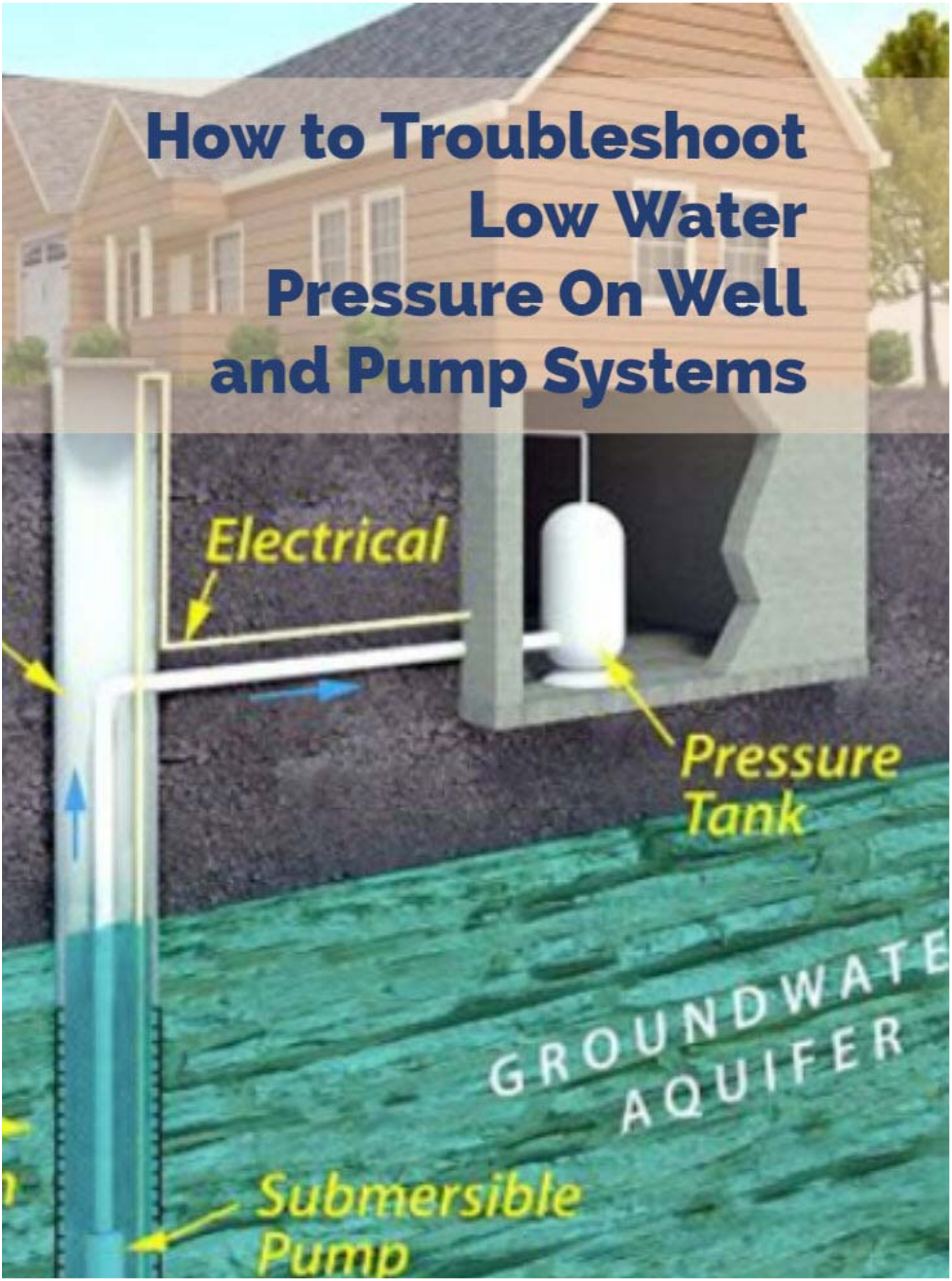
How to Troubleshoot Low Water Pressure On Well and Pump Systems



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How to Troubleshoot Low Water Pressure On Well and Pump Systems

What is Water Pressure?

Water in your home pluming is "under pressure". That is, it is pressurized by either gravity or a pump to give you the flow and pressure you need.

In the U.S. and Canada, the pressure is typically measured in Pounds Per Square Inch, which is referred to as PSI.

Pressure is how many pounds per square inch your water is under, so for example, if you had a storage tank 100 feet in elevation about your house, you would have 43 PSI. So for every 10 feet its higher (referred to as Head) you will have 4.3 PSI.

The pressure would be the same if you had a million gallon storage tank, or a 1000 gallon storage tank on a hill above your house, that is the Elevation is most important, which creates Head.

Gravity Pressure:

100 Feet of Elevation = 43 PSI

PSI = Pounds Per Square Inch

For many residential well systems, a submersible pump is used to build up water pressure. The higher the pressure you have, the more flow (up to a point) can flow through a pipe of a given size.

Most modern homes and appliances like to have at least 30 PSI minimum, however, 50 to 60 is much better. Generally, most appliances don't like to see more than 70 PSI.

Water pressure is easy to measure, with a pressure gauge. Most home well systems will have at least one pressure gauges, usually somewhere on the pipe near your pressure tank.

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How to Find Out Your Flow Rate & Pressure is at the Well

The flow rate in gallons per minute is how many gallons (or liters) of water can flow through a pipe in one minute.

Here is a link that easily shows how to do this:
https://www.cleanwaterstore.com/resource/calculators/how-to-determine-pump-flow-rate-on-systems-with-pressure-tanks/

Pumps are turned on by your pressure switch, which is set to typically turn on at one pressure automatically and off at a higher pressure 20 PSI higher than the low pressure. Example: turns on at 30 PSI and off at 30 PSI.

You can use this method below to check standard submersible well pumps or booster pumps that are single speed. Some folks use a 'constant pressure system' where it maintains a constant pressure in the home, and these use variable speed motors and do not fluctuate between a high and low. This method won't work for measuring flow on constant pressure systems.

If you measure the drawdown from your pressure tank in gallons and determine how fast the well pump refills it, you can easily know what the flow rate is in gallons per minute:

1. Measure the number of gallons drawn down from the pressure tank until the well pump turns on.
2. When you hear the pump turn on, immediately close the hose bib.
3. Time the period in seconds it takes for the well pump to build back up to pressure that is, between the cut- in and cut- out of the pressure switch. The pressure switch turns on the pump at a lower pressure and turns off the pump when it reaches a higher pressure.
4. The formula for determining the flow rate is gallons drawn down (that were measured above), divided by the seconds required for recovery, then multiplied by 60: (Gallons / Seconds) x 60 = Gallons per Minute (GPM) flow rate..

For example, if 20 gallons are drawn down and it takes 120 seconds to build pressure back up, then: 20 divided by 120 = .166. Then multiply .166 x 60 = 10 gallons per minute flow rate. So you have 10 GPM flow rate

Pressure Calculations for Water Treatment

Pressure/Feet of Head

Lbs. Per Sq. In.	Feet Head	Feet Head	Lbs. Per Sq. In.
1	2.31	1	.43
2	4.62	2	.87
3	6.93	3	1.30
4	9.24	4	1.73
5	11.54	5	2.17
6	13.85	6	2.60
7	16.16	7	3.03
8	18.47	8	3.46
9	20.78	9	3.90
10	23.09	10	4.33
15	34.63	20	8.66
20	46.18	30	12.99
25	57.72	40	17.32
30	69.27	50	21.65
40	92.36	60	25.99
50	115.45	70	30.32
60	138.54	80	34.65
70	161.63	90	38.98
80	184.72	100	43.31
90	207.81	110	47.65
100	230.90	120	51.97
110	253.98	130	56.30
120	277.07	140	60.63
125	288.62	150	64.96
130	300.16	160	69.29
140	323.25	170	73.63
150	346.34	180	77.96
160	369.43	190	82.29
170	392.52	200	86.62
180	415.61	225	97.45
190	438.90	250	108.27
200	461.78	275	119.10
225	519.51	300	129.93
250	577.24	325	140.75
275	643.03	350	151.58
300	692.69	400	173.24
325	750.41	500	216.55
350	808.13	600	259.85
375	865.89	700	303.16
400	922.58	800	346.47
500	1154.48	900	389.78
1000	2309.00	1000	433.09

A column of water 1 inch square by 2.31 feet high weighs 1 pound. Therefore, one pound of pressure per square inch (PSI) is equal to 2.31 feet of head.

A pressure of .433 pounds per square inch will support a column of water 1 inch square by 1 foot high. Therefore, one foot of head is equal to .433 PSI.

To convert pressure in pounds per square inch (PSI) to head in feet: multiply by 2.31.

To convert head in feet to pressure in pounds per square inch (PSI): multiply by .433.

Storage Capacity of Well Casing and Vertical Tanks

Diameter	Gal. Per Ft.	Diameter	Gal. Per Ft.
2 in.	.16	8.5 ft.	424.50
3 in.	.37	9 ft.	475.90
4 in.	.65	9.5 ft.	530.20
5 in.	1.00	10 ft.	587.50
6 in.	1.50	11 ft.	711.00
8 in.	2.60	12 ft.	846.00
10 in.	4.10	13 ft.	993.00
12 in.	5.90	14 ft.	1151.00
16 in.	10.40	15 ft.	1322.00
18 in.	13.20	16 ft.	1504.00
20 in.	16.30	17 ft.	1698.00
24 in.	23.50	18 ft.	1904.00
30 in.	36.70	19 ft.	2121.00
36 in.	52.90	20 ft.	2352.00
42 in.	72.00	21 ft.	2591.00
48 in.	94.00	22 ft.	2845.00
54 in.	119.00	23 ft.	3109.00
60 in.	147.00	24 ft.	3384.00
66 in.	177.80	25 ft.	3672.00
72 in.	211.50	26 ft.	3971.00
78 in.	248.20	27 ft.	4283.00
84 in.	287.90	28 ft.	4606.00
90 in.	330.50	29 ft.	4941.00
96 in.	376.00	30 ft.	5288.00

Flow of Water/Gravity or Tank Pressure

The approximate flow of water in GPM through a length of pipe due to the force of gravity can be easily determined by the formula: $\frac{D \times 100}{L}$

Determine the vertical distance in feet (D) between the pipe inlet and the pipe outlet. Multiply this distance by 100 and divide that amount by the total length of the pipe in feet (L).

Refer to the appropriate friction loss table for the size and type of pipe. Read down the appropriate column to the number of feet as determined by the formula above. Read across to the left to determine the approximate flow rate through the pipe. The flow at the lower end of the pipe will be at zero pressure.

Example:
a 300' length of 1" plastic pipe runs from an inlet point to a point to discharge 40 feet lower. The approximate flow rate would be 40 x 100 divided by 300 = 13.3. Referring to the friction loss tables gives a flow rate between
14 and 16, or about 15 GPM.
For pressure tanks the formula is the same, except that the pressure in the tank should be converted to vertical feet of head and added to the vertical distance if any. Again the flow at the end of the pipe will be at zero pressure.

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Troubleshooting Pressure Problems Check List

☐ Low flow coming from the well pump.

This can be caused by aging well pump wearing out, clogged well screens, or a partially stuck check valve, broken well pipe, or corroded well pipe. For well water problems it is best to consult a well professional. We recommend the national groundwater association, www.wellowner.org to locate a professional in your area.

☐ Pressure switch set too low, or bad pressure switch.

For standard systems, one question we get is: can I turn up the pressure switch, or adjust the pressure switch to get higher pressure? Yes, you can adjust the pressure switch, however, you have to be careful because when you adjust it, it decreases the amount of drawdown in the pressure tank. Your well pump may not be able to build higher pressure than what your pressure switch is set to, so adjusting it higher won't work.

Pressure switches may need to be cleaned and inspected to make sure there are no ants or insects present. This is best done by a professional as there are live wires inside.

☐ Failed pressure tank or low pressure in the captive air bladder or diaphragm in your pressure tank.

Your pressure tank has a captive air bladder or diaphragm, which holds a certain pre-charged amount of air pressure. It needs to be set to 3 PSI less than the cut-in or low pressure setting on your pressure switch. To check it, turn off the well pump power, and drain out any water pressure in the tank by opening a hose bib or faucet. Use an air pressure gauge.

☐ Clogged piping.

You might need a plumber or well contractor to identify this, but one way to tell if it is your plumbing is to take out a section of the pipe and look inside. Is it filled with orange sludge, or scale or sediment? This can cut way back on your water pressure.

☐ Partially clogged or stuck gate valves.

Gate valves and ball valves need to turned on and off periodically. Sometimes gate valves get stuck and cannot open or close, especially if they have not been used for a long time. Replace these types of bad valves. If the valve is full of sludge it can be cleaned, but generally replacing it is better.

☐ Clogged or malfunctioning pressure regulators.

You may have a pressure regulator on the main pipe coming into the home. These can go bad or become fouled with sediment or rust over many years and may need to be replaced.

☐ Clogged aerators, shower heads, faucets or fixtures.

Remove faucet aerators and shower heads and see if those are plugged with scale or sediment. You might have good water pressure and flow but have partially clogged aerators. These can be cleaned with vinegar or citric acid or replaced to restore pressure.

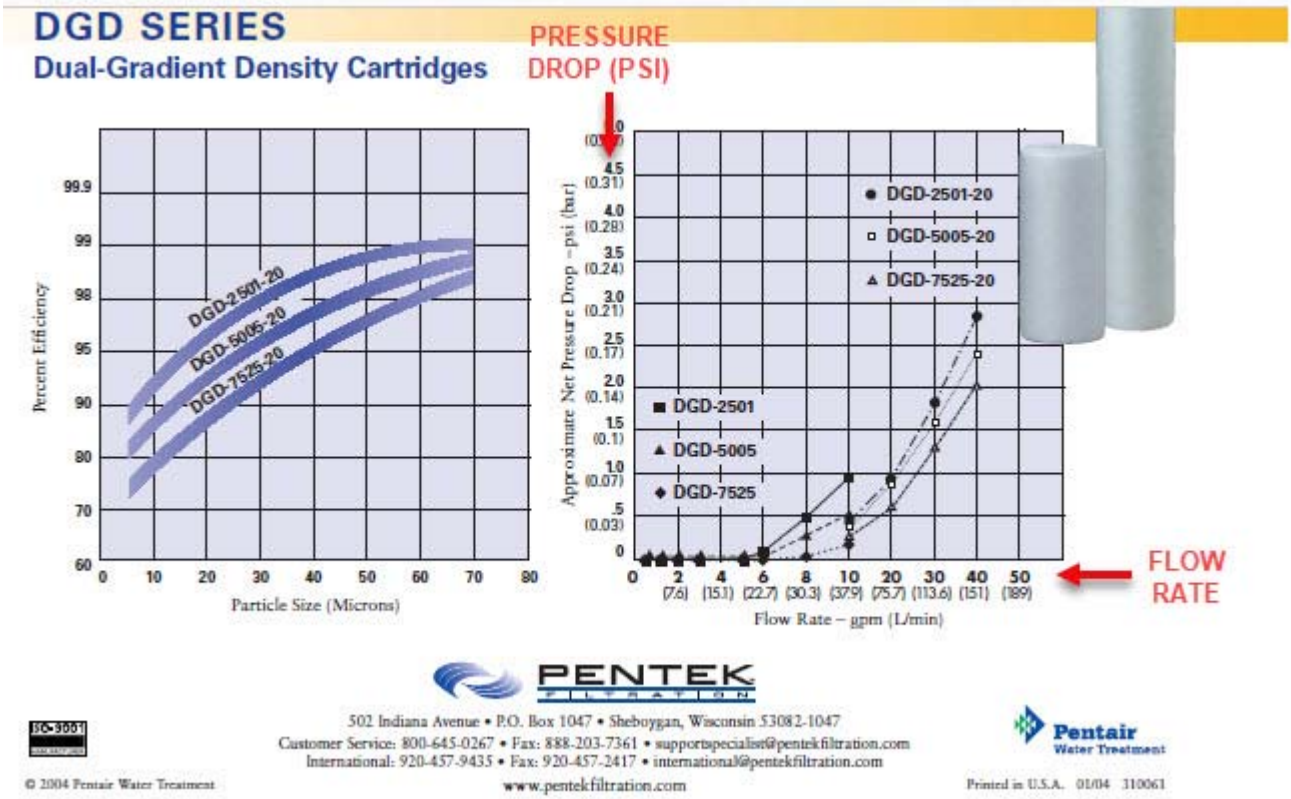
☐ Poorly sized or clogged or malfunctioning filter cartridges, water softener or iron filters etc.

Check and change filter cartridges and inspect your backwashing filters and water softeners if you have them. Check pressure before and after to troubleshoot if you have a problem with pressure loss through your filter system.

How to Read a Filter Pressure Drop Chart and Pump Curve

Filter Pressure Drop Chart:

When you reference these charts, you can easily see how many gallons or liters per minute can flow at a given water pressure.

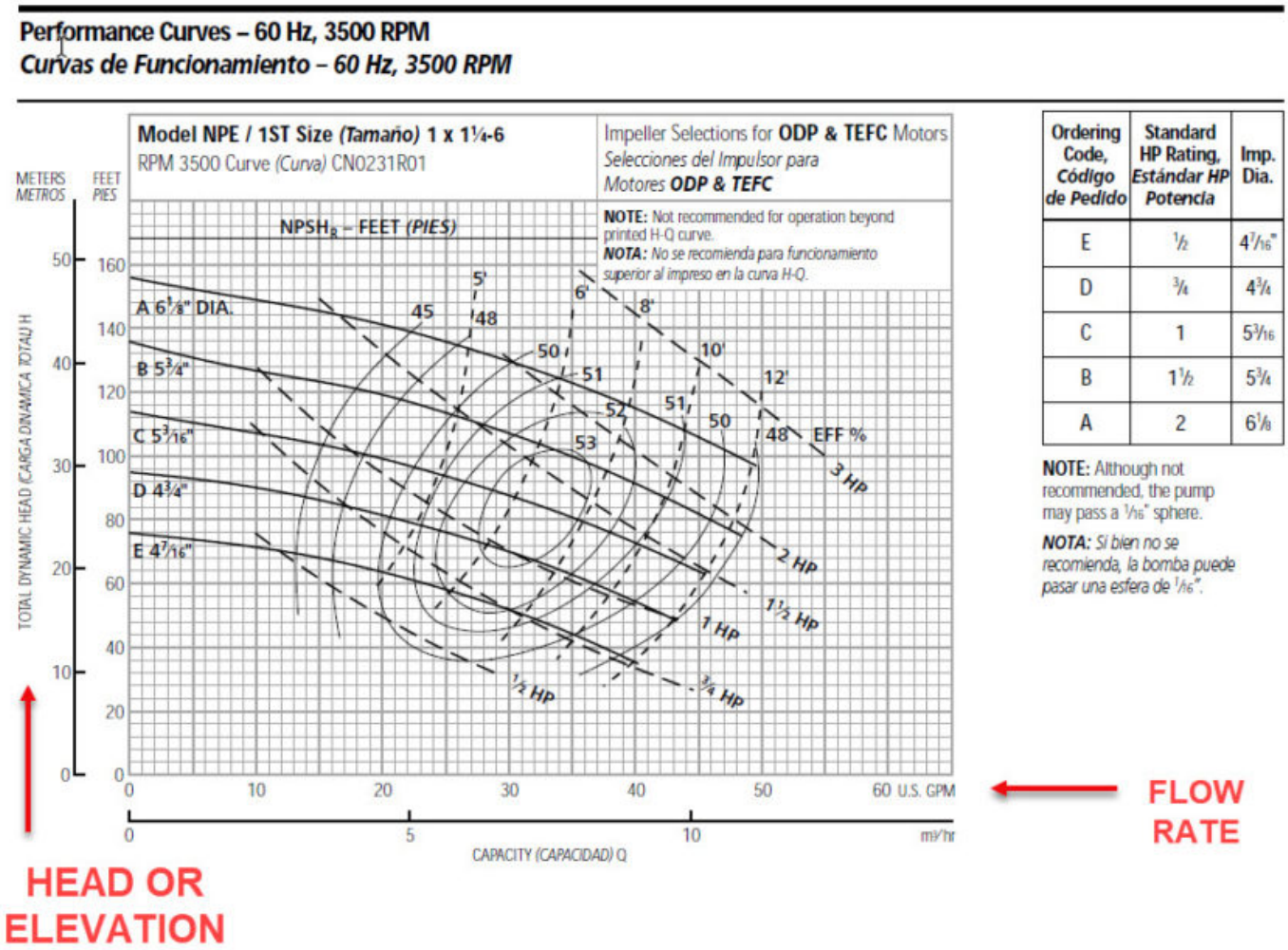


This one above from Pentek is a pretty simple chart or coordinate grid, with the lines running across the bottom showing the flow rate in gallons or liters per minute (referred to as the X-axis) and the lines running up the left side showing the approximate pressure drop (referred to as the Y-axis).

To read it, simply choose your model filter cartridge and follow the line up the chart.

For example, at 10 gallons per minute, the model DG-2510 filter cartridge will give you a 1.0 PSI drop when the filter cartridge is new.

Here is a Pump Curve Chart for a Goulds Pump:



Ordering Code, Código de Pedido	Standard HP Rating, Estándar HP Potencia	Imp. Dia.
E	½	4⁷⁄₁₆"
D	¾	4¾
C	1	5³⁄₁₆
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a ⁷⁄₁₆" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ⁷⁄₁₆".*

You can see in the chart, the flow rate is at the bottom and the elevation (head) in feet and meters up the left side.

The point on the chart where the flow rate and head intersect, can you tell how many gallons per minute that pump can do at a given pressure.

To translate the head in feet to PSI, just multiply the feet times 0.43. For example, 100 feet will get you 43 PSI.

How to Size Automatic Backwash Filters and Softeners to Avoid Pressure Problems

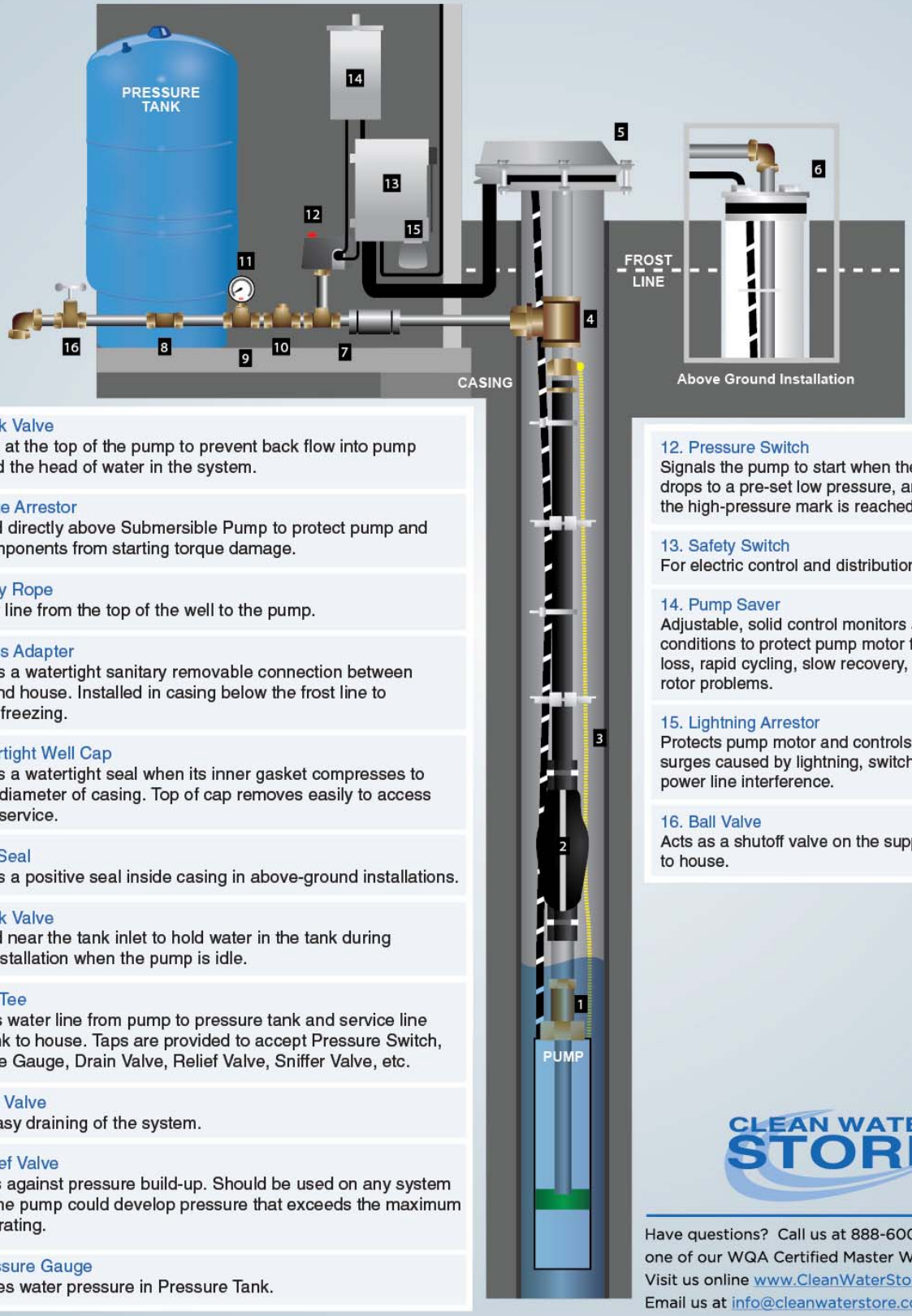
- The first and important point is to follow the manufacturer's recommendations for flow rate and sizing.
- They will often tell you what the maximum flow rate is, in gallons per minute.
- Another point is, don’t use a filter or softener that will cut back on the size of the pipe.
- So if you have a large home, or need to fill a swimming pool or commercial application, generally, you don’t want to put a filter that has a ¾” pipe size, on plumbing that uses 1” or say 1-¼” piping.
- You want something that can filter and treat your water without restricting your flow rate and be cutting back on water pressure.
- The chart on the following page shows you the service flow rate of various filter media.
- One common way to size filter and softeners is based on the square footage or surface area of the top of the tank.

Filter Tank Sizing & Backwash Tables

Tank Diameter Inches	Tank Diameter Square Feet Bed Area	Cu. Ft. Per Inch of Height	Backwash rate in GPM Per square foot				
			5 GPM	8 GPM	10 GPM	15 GPM	20 GPM
6	0.20	0.02	1	1.6	2	3	4
7	0.27	0.02	1.4	2.2	2.7	4.1	5.4
8	0.35	0.03	1.8	2.8	3.5	5.3	7
9	0.44	0.04	2.2	3.5	4.4	6.6	8.8
10	0.55	0.04	2.8	4.4	5.5	8.3	11
12	0.79	0.07	4	6.3	7.9	11.9	15.8
13	0.92	0.08	4.6	7.4	9.2	13.8	18.4
14	1.07	0.09	5.4	8.6	10.7	16.1	21.4
16	1.40	0.12	7	11.2	14	21	28
21	2.41	0.2	12	19.2	24	36	48
22	2.64	0.22	13.2	21.1	26.4	39.6	52.8
24	3.14	0.26	15.7	25.1	31.4	47.1	62.8
30	4.91	0.41	24.5	39.2	49	73.5	98
36	7.07	0.59	35.4	56.6	70.7	106.1	141.4
42	9.62	0.8	48.1	77	96.2	144.3	192.4
48	12.57	1.05	62.9	100.6	125.7	188.6	251.4
54	15.90	1.33	79.5	127.2	159	238.5	318
60	19.63	1.64	98.2	157	196.3	294.5	392.6
66	23.76	1.98	118.8	190.1	237.6	356.4	475.2
72	28.27	2.36	141.4	226.2	282.7	424.1	565.4

Media	Pounds Ft 3	Service Rate GPM/Sq. Ft.	Backwash Rate GPM/ Sq. Ft.	Bed Depth Inches	Bed Expansion %
BIRM (regular)	50	3.5-5	10 to 12	30 to 36	35 to 50
Mang. Greensand	85	5	8 to 12	30 to 36	35 to 50
Carbon	35	5	8 to 10	26 to 30	30 to 40
Filter Ag.	25	5	8 to 10	24 to 36	35 to 50
Calcite	100	3 to 6	8 to 12	24 to 30	35
Corosex	100	5 to 6	8 to 12	24 to 30	35
Resin (Reg)	50	20 to 30	3 to 8	24 to 30	50
Resin (Fine mesh)	50	15 to 20	2.5 to 4	20 to 30	5
Pro-OX	114	5 to 10	15 to 20	24 to 30	15 to 30
Pyrolox	125	5	25 to 30	24 to 30	15 to 30
KDF	171	15	30	10+	10 to 15
Chem Sorb	55	15 to 20	18 to 20	24 to 30	30 to 50
MTM	45	5	8 to 10	24 to 36	20 to 40

Well Pump & Pressure Tank Diagram



1. Check Valve
Located at the top of the pump to prevent back flow into pump and hold the head of water in the system.

2. Torque Arrestor
Installed directly above Submersible Pump to protect pump and well components from starting torque damage.

3. Safety Rope
A safety line from the top of the well to the pump.

4. Pitless Adapter
Provides a watertight sanitary removable connection between pump and house. Installed in casing below the frost line to prevent freezing.

5. Watertight Well Cap
Provides a watertight seal when its inner gasket compresses to outside diameter of casing. Top of cap removes easily to access well for service.

6. Well Seal
Provides a positive seal inside casing in above-ground installations.

7. Check Valve
Installed near the tank inlet to hold water in the tank during pump installation when the pump is idle.

8. Tank Tee
Connets water line from pump to pressure tank and service line from tank to house. Taps are provided to accept Pressure Switch, Pressure Gauge, Drain Valve, Relief Valve, Sniffer Valve, etc.

9. Drain Valve
Drain easy draining of the system.

10. Relief Valve
Protects against pressure build-up. Should be used on any system where the pump could develop pressure that exceeds the maximum system rating.

11. Pressure Gauge
Measures water pressure in Pressure Tank.

12. Pressure Switch
Signals the pump to start when the water system drops to a pre-set low pressure, and to stop when the high-pressure mark is reached.

13. Safety Switch
For electric control and distribution to the pump.

14. Pump Saver
Adjustable, solid control monitors system load conditions to protect pump motor from dry well flow loss, rapid cycling, slow recovery, air lock and locked rotor problems.

15. Lightning Arrestor
Protects pump motor and controls from voltage surges caused by lightning, switching loads and power line interference.

16. Ball Valve
Acts as a shutoff valve on the supply line from tank to house.

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How to Calculate Your Ideal or Desired Optimum Flow Rate in Gallons Per Minute Using a Fixture Count

If you would like to find out what your ideal flow rate in gallons per minute should be, you can use a Fixture Count Chart.

1. Start by finding your fixtures below, and number of fixtures.
2. Multiply the number of fixtures by the Fixture units to arrive at your total Fixture Units.
3. Next use the chart on the next page to find out needed (or ideal) flow rate in gallons per minute.

FIXTURE TYPE	**NUMBER OF FIXTURES**	**MULTIPLY BY FIXTURE UNIT**	**FIXTURE UNITS**
BAR SINK		x 1	0
BATH TUB OR COMBINATION BATH/SHOWER		x 4	
BATHROOM SINK		x 1	
SHOWER HEAD (EACH HEAD)		x 2	
BIDET		x 1	
CLOTHES WASHING MACHINE		x 4	
DISHWASHER		x 1.5	
HOSE BIBB OR SILL COCK (STANDARD TYPE)		x 2.5	
KITCHEN SINK		x 1.5	
LAUNDRY SINK		x 2	
WHIRLPOOL BATH OR COMBINATION BATH/ SHOWER		x 4	
TOILET (GRAVITY TANK)		x 3	
SUPPLY OUTLETS NOT LISTED ABOVE SHALL BE COMPUTED AT THEIR MAXIMUM DEMAND.			
3/8 INCH OUTLETS		x 1	
1/2 INCH OUTLETS		x 2	
3/4 INCH OUTLETS		x 3	
TOTAL FIXTURE UNIT:			

Fixture Count (Continued)

Now that you have your number of fixture counts, you can find out what the optimum gallons per minute ("GPM") would be necessary for your system.

Read chart vertically until you intersect the correct curve, then read the chart horizontally until you read your water flow demand in G.P.M.