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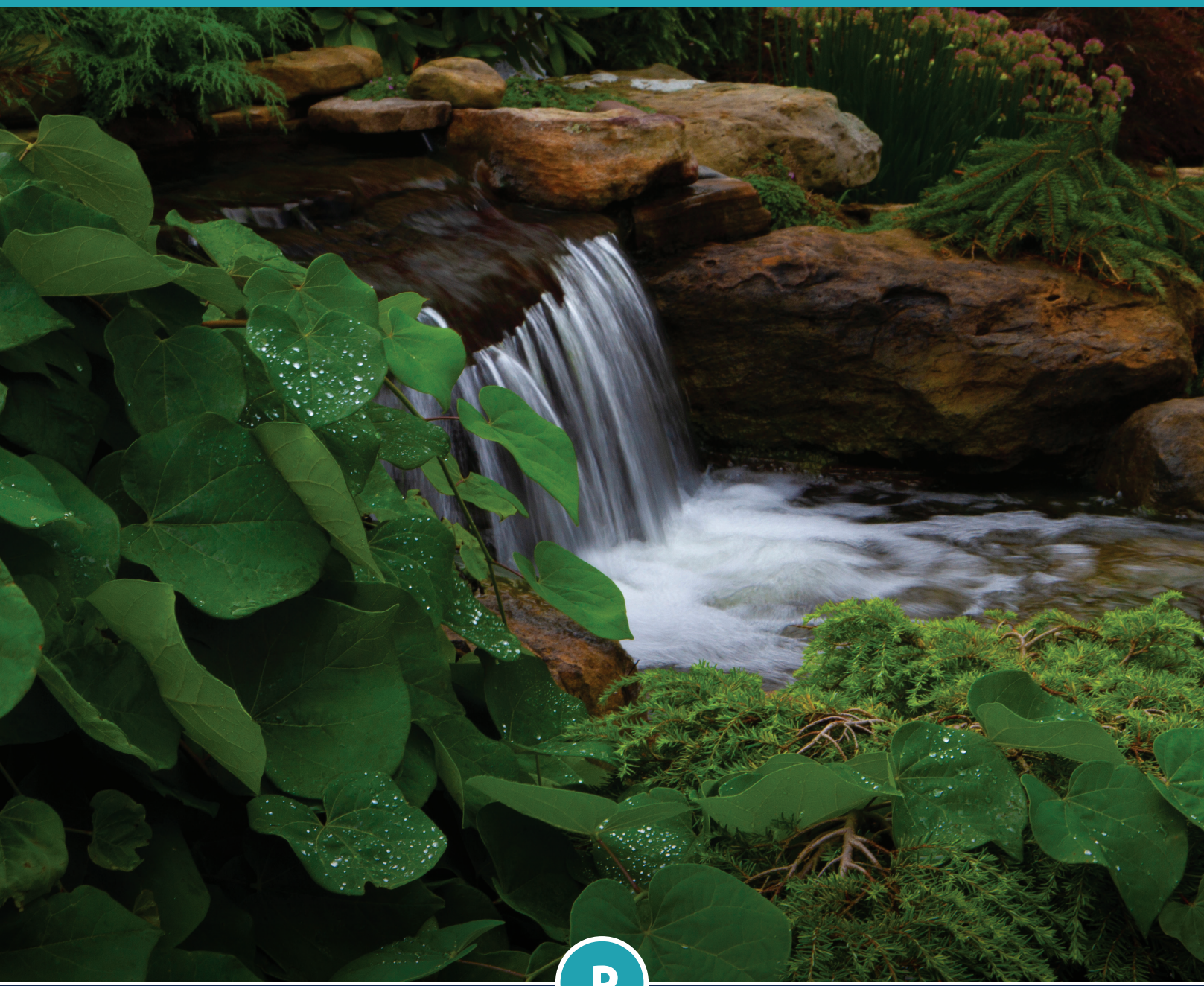
CHOOSING THE PERFECT PUMP



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All pumps have an optimal range, measured in feet of head, in which they run best and last longest. Calculating the Total Dynamic Head enables you to select just the right pump, running in its Best Efficiency Range, to provide the desired flow at the right head.

1. PICK A LOOK & SPECIFY A FLOW

LOW FLOW
≈ 750 GPH PER FOOT

MEDIUM FLOW
≈ 1500 GPH PER FOOT

HIGH FLOW
≈ 2250+ GPH PER FOOT

Choose the appearance you would like for your waterfall from the suggested choices to the left. Multiply the corresponding **GPH Per Foot** by the desired **Width of the Waterfall** to find the **Recommended Flow**.

THE LOOK YOU WANT IN GPH/FT x THE WIDTH OF WATERFALL IN FEET = RECOMMENDED FLOW (GPH)

☐ x ☐ = ☐

2. DETERMINE FRICTION LOSS

CHART A

FRICTION LOSS PER FOOT OF TUBING

FLOW (GPH)	TUBING SIZE						
	½"	¾"	1"	1¼"	1½"	2"	3"
100	0.10	0.01					
200	0.38	0.05	0.01				
300	0.83	0.10	0.02				
400	1.00	0.18	0.04	0.01			
500	2.23	0.27	0.06	0.02			
750		0.50	0.14	0.04	0.02		
1000		0.84	0.21	0.07	0.03		
1250		1.20	0.33	0.10	0.04	0.01	
1500			0.43	0.15	0.06	0.02	
2000			0.94	0.26	0.10	0.03	
3000			2.07	0.52	0.22	0.05	
4000				1.10	0.43	0.09	0.01
5000				1.80	0.67	0.15	0.02
6000					0.96	0.22	0.03
8000					1.77	0.38	0.05
10,000						0.59	0.07
12,000						0.84	0.10
15,000							0.15
18,000							0.25

CHART B

FRICTION IN EQUIVALENT FEET OF STRAIGHT PIPE

PVC FITTINGS	FITTING SIZE					
	¾"	1"	1¼"	1½"	2"	3"
Std Elbow, 90 degree	4.5	5.5	7.0	7.5	8.5	11.0
Std Elbow, 45 degree	1.0	1.5	2.0	2.5	3.0	4.0
Male / Female Adapter	1.5	2.0	3.0	3.5	4.5	6.5
Tee (Straight Thru)	2.5	3.0	5.0	6.0	8.0	12.0
Tee (Thru Branch)	5.5	7.0	9.0	10.0	12.0	17.0
Swing Check Valve	9.0	11.0	13.0	15.0	19.0	27.0

2.1 FIND TUBING SIZE & FRICTION

Find the dark blue cell in the row that corresponds with the **Recommended Flow (GPH)** in CHART A. The column indicates the recommended tubing size and the number in the cell is the **Friction Loss** in every foot of tubing. Keep Friction Loss low for greatest flow.

To find the Friction Loss of existing systems, estimate the flow through the actual tubing size used.

Example: GPH: 3000 Friction Loss: 0.05 Tubing: 2"
*For flows over 20,000 gph or lengths over 100 ft, please contact us.

2.2 ADD FRICTION IN FITTINGS

Add the equivalent lengths of all the fittings in the system, from CHART B, to the tubing length from pump to falls to find the **Equivalent Tubing Length.**

Example: 8.5 (90°) + 4.5 (M/FA) + 19.0 (Check Valve) = 32 (Fitting Length in Feet)

FITTING LENGTH IN FEET + TUBING LENGTH IN FEET = EQUIVALENT TUBING LENGTH IN FEET

☐ + ☐ = ☐

2.3 CALCULATE FRICTION HEAD

Multiply the **Equivalent Tubing Length** in feet by the **Friction Loss** in the dark blue cell from CHART A to find the **Friction Head** of the system.

EQUIVALENT TUBING LENGTH IN FEET x FRICTION LOSS FROM CHART = FRICTION HEAD IN FEET

☐ x ☐ = ☐

3. FIND THE TOTAL DYNAMIC HEAD

Add the Friction Head in Feet to the Vertical Head to find TDH. Vertical Head is the height in feet from the surface of the water the pump will be sitting in, to the highest point the water is pumped to.

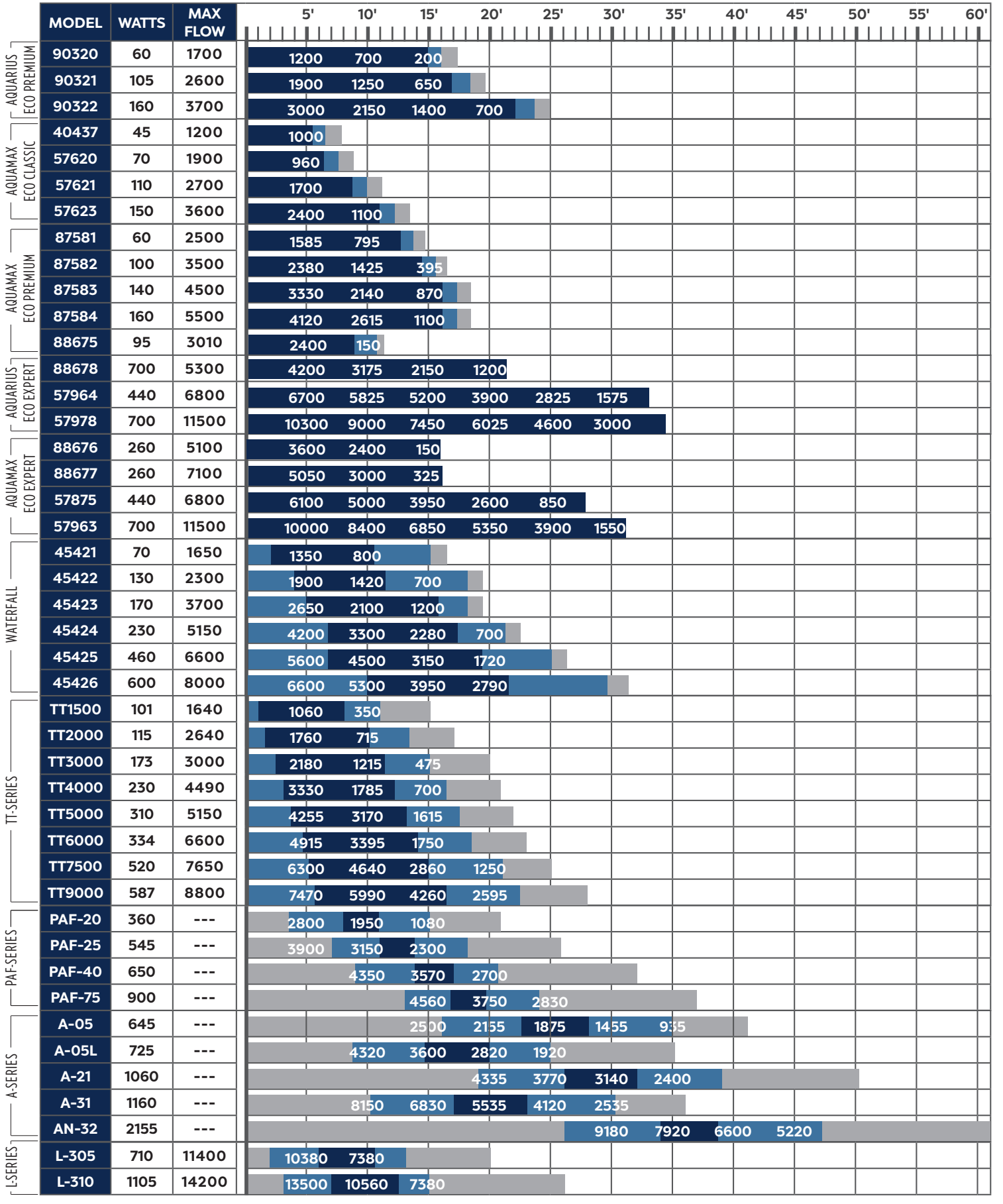
FRICTION HEAD IN FEET + VERTICAL HEAD IN FEET = TDH

☐ + ☐ = ☐

4. CHOOSE YOUR PUMP

Locate the column representing the **Total Dynamic Head (TDH)** on the pump chart (opposite page). Find the pump that provides the required flow at that TDH. If the chart gives you a choice of more than one pump, check for the type that best fits your application, then check for the lowest wattage, to save on operating costs.

COMPREHENSIVE PUMP CHART



*All flows in gallons per hour (GPH)

Recommended Operating Range | Best Efficiency Range | Do Not Operate Range

WHAT YOU NEED TO KNOW ABOUT PUMPS & PLUMBING

FLOW, PRESSURE & THE BEST EFFICIENCY POINT

All pumps have an optimal range of flow, measured in GPH, and pressure, measured in feet of Head. Pumps operating within their Recommended Operating Range will run better and last longer. Pumps forced to run outside their operating range will tend to fail sooner. Every waterfall needs a certain amount of flow at a certain amount of pressure to achieve a desired effect. Knowing the feature's Recommended Flow in GPH, and its Total Dynamic Head in feet, lets you select the right pump, running in its optimal range, providing the desired flow at the right head.

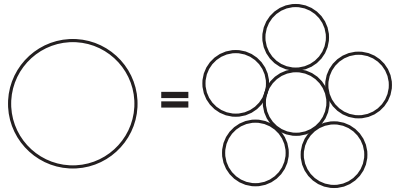
AREA VS. CIRCUMFERENCE

Though it might seem that two 1.5" pipes would deliver the same amount of water as one 3" pipe, appearances are deceiving. Flow is a function of area; calculating their areas proves FOUR 1.5" pipes equal one 3" pipe.

But friction is a function of circumference. Four 1.5" pipes have TWICE the surface area of the 3" pipe, and consequently, twice the friction loss. To deliver equal flow, the pipes must have equivalent friction losses.

At 8000 GPH, friction loss through 3" pipe is .05 feet of head per foot of tubing. Through four 1.5" pipes at 2000 GPH each, friction doubles to .10. It takes SIX 1.5" pipes at 1333GPH to lower the friction coefficient to .05 and deliver the same amount of water as the 3" pipe.

Though 3" flex PVC is expensive, it costs less than six lengths of 1.5" pipe and takes less time to install. Whenever possible, larger diameter pipe pays off.



One 3" pipe = Six 1½" pipes

AREA OF PIPE:

1½" = 1.77 in² **($0.75^2\pi$)**

3" = 7.07 in² **($1.5^2\pi$)**

CIRCUMFERENCE OF PIPE:

1.5" Pipe = 4.71"

3" Pipe = 9.42"

FRICTION LOSS:

8000 gph through 3" = 0.05 ft of head loss per foot of tubing

1333 gph through 1.5" = 0.05 ft of head loss per foot of tubing

DECREASING TDH FOR LOW HEAD PUMPS

Total Dynamic Head is the combination of Friction Head, the restriction caused by the plumbing, and the Vertical Head, the height the water is pumped to. The lower the TDH, the higher the flow will be. The height of the feature is fixed, but eliminating friction is an easy way to increase flow without buying a bigger pump. Restrictive plumbing adds friction head, robs flow and tends to shorten pump life. Low head pumps should typically be plumbed with generous tubing to reduce friction and increase both flow and pump life. The Friction Loss Chart provides the optimal size tubing to eliminate excess Friction Head.

LOWER THE TDH = MORE FLOW

LARGER PLUMBING = LESS TDH

INCREASING TDH FOR HIGH HEAD PUMPS

Lowering TDH is not always desired. Unlike low head pumps, high head pumps usually require a minimum amount of head to function. Too little TDH will lead to overspeeding, overheating and cavitation, which can destroy both motor and impeller. If the pump you want to use will be happier at a higher TDH, install a ball valve on the discharge line to restrict the flow and raise the head pressure into the recommended operating range. (Note that Head is the same as pressure; every one foot of Head equals .433 psi, but Head Height is a lot easier to visualize than pounds per square inch!)

COST TO RUN A PUMP

Take what you pay per kilowatt per hour, multiply that by the wattage of the pump and divide by 1000. For the monthly cost, multiply the hourly cost by 720, 24 hours per day times 30 days in a month. For more information, visit the College of Pumps in our online University, www.atlantic-oase.com/university.

COST PER HOUR = $ _____ kW x _____ Watts ÷ 1000 = _____ x 720 = _____ COST PER MONTH

Example: Electric costs $0.10 per kW, the pump draws 100 Watts, so $0.10 kW x 100W ÷ 1000 = $0.01/hr x 720hrs/mo = $7.20/month

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