Micro Hydro Electric Generators

Harris Pelton Turbines || ES and D Turgo Generators ||
Pressure Drop in Pipe || Flow Rate Through Various Nozzles

We offer a variety of small hydroelectric generators that are designed to be 12, 24, or 48 volt battery chargers, operating off a relatively small volume of water. They charge batteries 24 hours per day and the power can be drawn from the battery as needed. As little as 100 gallons per minute (GPM) falling 10 feet through a pipe or 5 gallons per minute falling 200 feet through a pipe can supply enough power to comfortably run a small household. In areas where there is a long rainy season, and there is a mountain stream that can be used, a small hydroelectric system can work well with solar modules, both charging the same battery. When it is rainy and the solar modules are putting out less power, the hydroelectric system will be at its peak.

By contrast, typical AC power hydroelectric systems, designed to deliver ready-to-use 120/240 VAC power, are not practical for most people because they need a constant water supply large enough to supply the peak power output that will be required, usually a minimum of several thousand watts, requiring hundreds or even thousands of gallons per minute, depending upon the pressure available. Besides requiring large amounts of water, these turbines require large pipe diameters and expensive regulating systems that can maintain proper frequency and voltage at all times.

How much power can you generate?

The amount of power available depends on the dynamic head, the amount of water flow and the efficiency of the turbine/generator combination. To get an idea about available **power in watts**, multiply the **head** in feet, times **flow** in GPM, times **0.18** times **efficiency**. Turbine efficiency ranges from 25% to 50%, with higher efficiency at higher heads. To get a rough idea, use 0.30 (representing 30%) as a multiplier for efficiency.

Pipelines

A hydroelectric turbine operates from the pressure at the bottom end of a pipeline. This pressure, usually measured in pounds per square inch (PSI) is directly related to the head, or vertical distance from where the water goes into the pipe at the top of the pipeline, to the turbine located at the bottom of the pipeline. The pressure at the lowest point of a pipeline is equal to 0.433 times the vertical distance in feet, called head. Pressure is important because it is a determining factor in how much power is available and in what type of pipe is required. Polyethylene pipe can be used for pressures up to 100 PSI, PVC pipe is available with pressure ratings from 160 to 350 PSI and steel pipe can withstand 1000 PSI or more. Check with you local plumbing supplier for pipe ratings.

Pipe diameter is very important. All pipelines will cause the water flowing in them to lose some energy to friction. The pipe must be large enough for the maximum quantity of water it will carry. The pressure at the bottom of a pipeline when water is not flowing is called static pressure. When water is flowing through the outlet or nozzle of the hydroelectric turbine, the pressure at the outlet is the dynamic pressure or running head.

If you install a gate valve on the pipeline just above the turbine and a pressure gauge on a "T" fitting just above the gate valve, you will read the static pressure on the gauge when the valve is closed and the dynamic pressure when the valve is opened. The maximum power that can be delivered by a pipeline will occur when the dynamic pressure is approximately 2/3 of the static pressure. The actual flow rate of the water in a hydroelectric system is determined by the diameter of the nozzle. We will supply a turbine with the proper size nozzle for your site, depending on the head, flow and length and diameter of the pipe.

We carry hydroelectric generators made by Energy Systems and Design and the Harris Hydroelectric company. Use the descriptions on the product pages to help determine which turbine will work best for your site and power requirements.

If you think you have a suitable site, acquire the **Residential Micro-hydro Power Video** with Don Harris, it is very helpful in the design process. Then call us or write to us and we can help you determine the best unit for the situation. The following information about your site will be required when you contact us:

1. **Head** - The total vertical elevation from the place where the water enters the pipe to the point where the turbine will be located.
2. **Flow** - The number of gallons per minute that are available.
3. **Distance** - The length of pipe that will be necessary to carry the water from the pickup to the turbine. If the pipe is already installed, what is the type and diameter?
4. **Location** - Distance from turbine to batteries.
5. Use the formula above to determine if the available power is worth the expenditure

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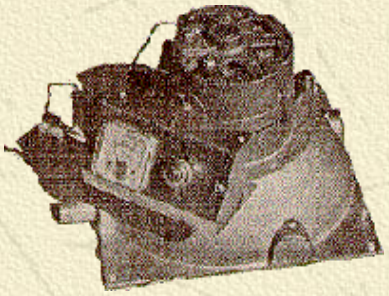
Harris Heavy Duty Pelton Turbine

Specifications	
Head Range:	20 to 600 feet
Flow Range:	4 to 250 GPM
Maximum 12 Volt Power:	700 Watts
Maximum 24 Volt Power:	1400 Watts
Maximum 48 Volt Power:	2500 Watts



This hydroelectric battery charger uses a cast bronze pelton wheel and an 80 amp Ford alternator in a powder coated aluminum housing. We can supply the turbine with one, two or four nozzles, depending on water flow and power requirements. These turbines can be fitted with nozzles up to 1/2" in diameter.

Each hydroelectric system is specially constructed to match your site. Please tell us your head, flow, pipe length and battery voltage when ordering. Allow two to three weeks for delivery.

17106	**Harris turbine with 1 nozzle**	**$950**	S hip Weight 30 lbs
17107	**Harris turbine with 2 nozzles**	**$1235**	Ship Weight 40 lbs
17-109	**Harris turbine with 4 nozzles**	**$1395**	Ship Weight 45 lbs
17-119	**Harris 48 volt option**	**$200**	
17-120	**Extra Harris Turbine Nozzle**	**$10**	Ship Weight 1 lbs

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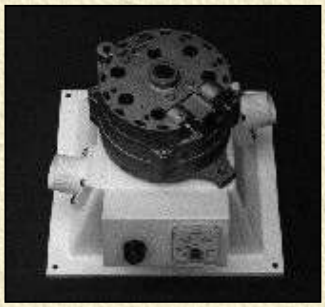
ESD Turgo Generators



Specifications	
Head Range:	5 to 200 feet
Flow Range	40 to 400 GPM
Maximum Power:	1000 Watts
Voltage:	User-set from 12 to 48 VDC

Energy Systems and Design hydroelectric battery chargers use a cast bronze turgo runner to drive a long-life, brushless permanent magnet alternator. A simple change of wiring in the junction box allows this turbine to charge 12, 24 and 48 volt battery systems. These turbines can use nozzles with jet sizes up to 1", allowing a very large flow in low head situations. They can operate on heads as low as 5 feet with a flow of 40 GPM.

17-302	**Turgo Turbine with 2 nozzles**	$1695	Ship Weight 35 lbs
17-304	**Turgo Turbine with 4 nozzles**	$1845	Ship Weight 37 lbs
17-321	**Extra Nozzle for Turbines**	$29	Ship Weight 1 lbs

Harris Bronze Pelton

This is a silicon-bronze cast Pelton wheel with a 4" pitch diameter and an arbor threaded for most Ford and Delco alternators. It is the runner used on the Harris Hydroelectric turbines. **17-410 Bronze Pelton Runner $275.00 Shipping Weight 6 Lbs**

E.S.&D. Bronze Turgo Wheel

This is the runner in the Energy Systems and Design turbines above. It is made of cast bronze and it threads onto a Delco or 80 amp Ford alternator. The pitch diameter (the place where the center of the jet of water should be aimed) is 4". It can be used with a jet of water up to 1". The nozzle should be tilted at a 20 degree angle from the horizontal surface of the wheel. **17-435 Bronze Turgo Runner $705 Shipping Weight 6 lbs**

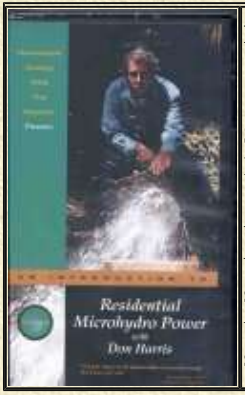
E.S.&D. Pelton Wheel

This is the polyurethane casting of the famous Pelton design. It has a 4" pitch diameter and can be used with up to a 1/2" jet of water. Center hole is 1/2". You must fabricate an arbor to mount it on your alternator shaft. **17-420 Plastic Pelton Runner $113 Ship Weight 3 lbs**

Pressure Gauges

It is a good idea to install a pressure gauge at the turbine, before the shutoff valve, so that the gauge reads if the valve is on or off. This will allow you to read static pressure with the valve off and dynamic pressure with the valve on. It will be a great help in troubleshooting. There are 0.433 PSI per foot of head. Order a pressure gauge that is high enough to read full pressure in your pipeline. They fit 1/4" pipe thread. Ship Weight 1 lb

76-100 0-100 PSI Gauge $10
76-200 0-200 PSI Gauge $10
76-300 0-300 PSI Gauge $10



Residential Micro-hydro Power Video
With Don Harris

$39.95 (includes USA shipping), VHS/NTSC format, 44 minutes
Don Harris has been designing and manufacturing small hydro systems for well over a decade. He has manufactured over 1,000 systems and personally installed over 200 in 20 different countries. He gives you the benefit of this vast experience in this tape, answering the most common questions, including: what type of water resource do you need, how do you measure water flow, what is the power potential of a site, Pelton wheel vs. turbo runner systems, AC vs. DC hydro, site factors, pipe size, filter systems, parts of a turbine, nozzle systems, installation, and maintenance. If you have a stream or river running through your property, you should consider micro-hydro as a potentially cost-effective way to produce clean, environmentally safe energy! Ship Weight 1 lb

Pressure Drop in Pipe | Flow Rate Through Various Nozzles

Pressure Drop in Pipe
(head loss in feet of pipe in PVC Class 160 plastic type pipe)

	Nominal pipe diameter (inches)						
Flow (GPM)	**1**	**1.25**	**1.5**	**2**	**2.5**	**3**	**4**
1	0.05	0.02	0.00				
2	0.14	0.05	0.02				
3	0.32	0.09	0.05				
4	0.53	0.16	0.09	0.02			
5	0.81	0.25	0.12	0.05			
6	1.13	0.35	0.18	0.07	0.02		
7	1.52	0.46	0.23	0.07	0.02		
8	1.94	0.58	0.30	0.09	0.05		
9	2.42	0.72	0.37	0.12	0.05		
10	2.93	0.88	0.46	0.16	0.07	0.02	
12	3.51	1.04	0.53	0.18	0.07	0.02	
14	4.11	1.22	0.65	0.21	0.09	0.02	
16	5.47	1.64	0.85	0.28	0.12	0.05	
18	7.02	2.10	1.09	0.37	0.14	0.05	
20		2.61	1.34	0.46	0.18	0.07	0.02
22		3.16	1.64	0.55	0.21	0.09	
24		3.79	1.96	0.67	0.25	0.09	0.04
26		4.43	2.31	0.79	0.30	0.12	0.05
28		5.15	2.66	0.90	0.35	0.14	0.05
30		5.91	3.05	1.04	0.42	0.16	0.11
35			3.46	1.18	0.46	0.18	0.12
40			4.62	1.57	0.62	0.23	0.13
45				1.99	0.79	0.30	0.15

50	2.49	0.79	0.30	0.20
55	3.03	1.20	0.46	0.25
60	3.60	1.43	0.55	0.30
65		1.66	0.65	0.35
70		1.94	0.74	0.40
75		2.22	0.85	0.45
80		2.52	0.97	0.50
85		2.84	1.09	0.60
90		3.19	1.22	
100			1.36	0.80
150			1.50	1.60
200			1.66	2.70
300				5.80
400				9.90

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Flow in Gallons per Minute Through Various Sizes of Nozzles

Power output of a hydroelectric generator is determined by the pressure of the water at the nozzle and the amount of water flowing out of the nozzle. The larger the nozzle, the greater the flow will be. The nozzle must also be sized small enough to keep your pipeline full and keep the speed of the water in the pipe below 5 feet per second. This table shows water flow through various size nozzles at given pressures. Use it to determine what size nozzles you need to accommodate the flow of water you have and deliver the amount of power you need.

Pressure at the turbine in PSI (Feet = 2.31 x PSI								
Nozzle Size	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**100**
1/8"	2.0	2.6	3.0	3.3	3.6	3.9	4.2	4.7
5/32"	3.3	4.0	4.6	5.2	5.7	6.1	6.5	7.3
3/16"	4.7	5.8	6.6	7.4	8.1	8.8	9.4	10.5
7/32"	6.4	7.9	9.0	10.1	11.1	12.0	12.7	14.2
1/4"	8.4	10.2	11.8	13.2	14.5	15.7	16.7	18.7
9/32"	10.5	13.0	14.9	16.6	18.3	19.8	21.1	23.5
5/16"	13.0	16.0	18.4	20.6	22.6	25.1	27.6	31.0
11/32"	15.7	19.3	22.2	24.8	27.2	29.4	31.4	35.0
3/8"	18.8	23.0	26.6	29.6	32.5	35.1	37.6	42.0
13/32"	22.0	27.2	31.2	34.8	38.2	41.3	44.1	48.3
7/16"	25.5	31.2	36.0	40.4	44.4	48.0	50.4	56.8

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