

Wind Power

Do you have a good wind site?

Wind powered battery charging systems can be cost-effective if the average wind-speed is **TWELVE** miles per hour or more at the site where the wind generator will be located. (19 kilometers per hour or more). If you are using a wind generator in combination with photovoltaic power, it may be cost effective if you have enough wind only during part of the year. The power available from wind is proportional to the cube of the wind speed. When the wind speed doubles the power delivered is eight times as great. Most wind generators are designed to deliver maximum power at a wind speed of 30 mph (48 kph). At 15 mph (24 kph), they will deliver about 1/8 their rated power. A wind generator should be mounted at least 30 feet higher than any obstruction, regardless of direction, within **300 feet** to avoid turbulence, which will cause the turbine to oscillate from side-to-side and dramatically reduce power output.

Measuring The Wind

When considering buying a wind generator, many people think they have a site with good wind potential. This, more often than not, proves to be wishful thinking rather than an actual fact. It is best to do a wind site survey, conducted over a minimum of one year's time, to determine if a wind generator is actually feasible at your site. Measuring wind velocities and their duration is a slow but important process. This may save you much expense and effort if your site proves to be less than required to justify buying and installing a wind generator.

You can use one of the measuring devices listed on these pages to determine wind speed at your location. The Wind Data Logger acts like an odometer in a car, giving you the total wind passage over time. It provides you with the most complete information on the power producing potential of your designated site. The Kestrel wind speed indicator is like a speedometer, displaying wind speed at the time you are looking at it, but it does not record any information for further reference. It can be mounted on a tower to give you an idea of wind speed where the generator will be located.

If you measure wind speed at ground level, you can expect about 1.5 times the wind speed 30 feet up, which equates to about three times the power. At 120 feet above the ground, wind speed may be twice what is measured at ground level and power output will be more than twice the output at 30 feet.

Wiring

It is important to avoid excessive loss of power from voltage drop in a wire from the wind generator to the batteries. It is not necessary to use a wire size that minimizes voltage drop for maximum generator output. It will be more economical to choose a wire size that gives a 2% voltage drop at the average generator output for your site. But remember, **even large size wire is comparatively cheap** when considering that for a few dollars more you can probably eliminate the 2% loss altogether.

Check out the wire loss chart on page 80 of this catalog to decide on wire size. Use a wire designed to carry 1/2 the rated current of the generator you are using, but remember, three conductors (wires) are required.

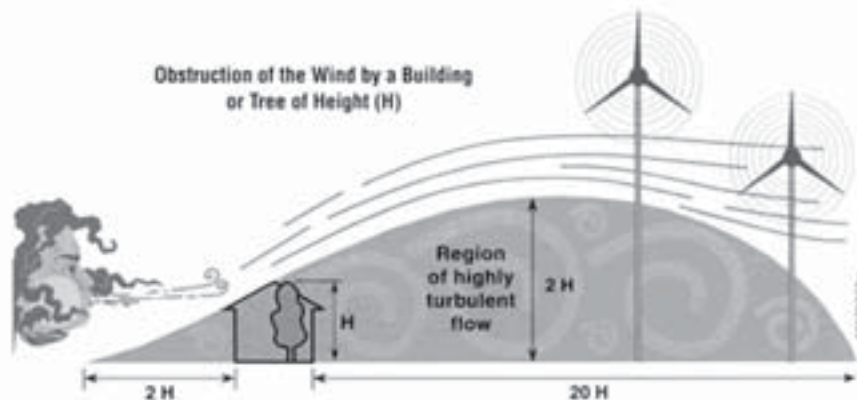
Towers

Mounting wind generators on a building should include vibration isolators, like the kits listed on page 19. We do not recommend doing this with turbines larger than 500 watts as noise and vibration will be a problem. Larger wind generators can cause severe damage to a building. Free standing towers, guyed towers or guyed poles or pipes are the best choices for installing any wind turbine—regardless of size.

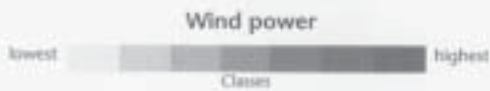
Freestanding towers designed for antennas can be used. They require a large, engineered concrete base for support, but since they do not require guy wires, they can be installed in the smallest space. Guyed steel truss towers, also designed for antenna mounting are less costly, but require a large area for guy wire placement.

A tilt-up pole tower is the most economical and the easiest to install. Wiring and mounting of the wind generator are done before the tower is erected. No climbing is necessary. Four or five inch steel tubing can be bought locally to save freight charges.

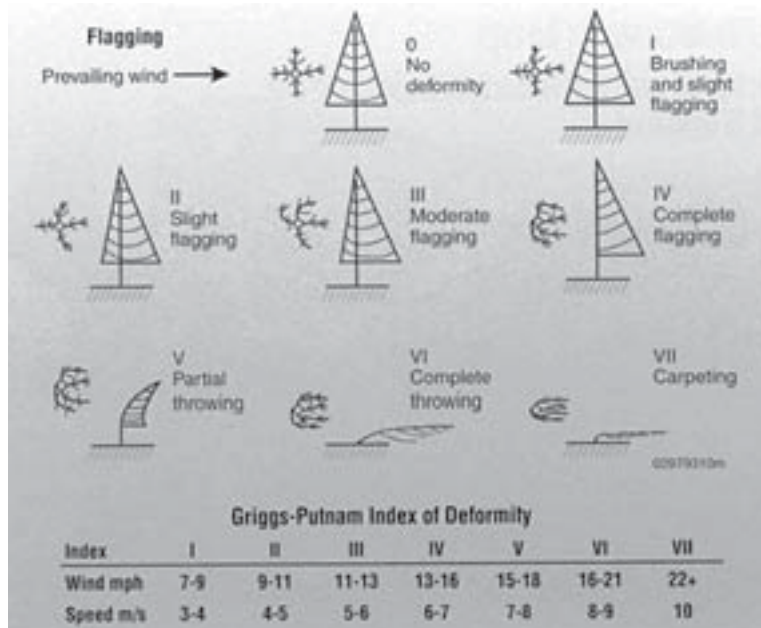
Some areas with zoning bylaws may not allow installing a tower over a certain height. If your location is within the glide path of an airport or public landing strip, this may also be the case. Check with your local zoning commission or airport authority before buying and erecting a wind generator tower of any kind. Hazard warning beacons may also be required atop a tower and at intervals along its length.



Wind Power



The ever-changing and invisible forces of wind are difficult to measure and even more difficult to depict. But two scientists with a passion for breezes, Robert Benoit and Wei Yu of Environment Canada, have analyzed short-term wind forecasts for the past four years and mapped the continent's windiest places.



Griggs-Putnum Wind Energy Index

Wind Power

Kestral 1000 Pocket wind Meter



The Kestral 1000 pocket wind meter is accurate, tough and affordable. It requires no setup—just hold it up to measure the wind speed whenever needed. It can track maximum and average wind speeds along with current readings and allows you to choose the measurement units which suit your application. The Kestral 1000 measures wind speed with a precision ultra light impeller which turns on jewel bearings, providing excellent accuracy (+/- 3%) and the ability to measure the slightest breeze (0.3 M/S). The impeller and protective housing pop out for easy and inexpensive replacement, ensuring that the Kestral's high accuracy can be maintained even if the impeller mechanism becomes damaged or worn. The Kestral 1000 is built to withstand daily use in tough outdoor conditions. The slip-on hard case buttons and protects the impeller and LCD display from damage in your pocket or toolbox. The user replaceable battery provides 400 hours of use. The Kestral 1000 is also protected by a full one-year warranty.

16-511	Kestral 1000 Pocket Wind Meter	\$129
16-512	Replacement Impeller	\$28

Solar Powered Wind Data Logger



The Wind Data Logger is designed to provide an affordable and easy-to-use solution for wind site evaluation and wind generator performance. It records wind speed, as well as the time and date directly to a Secure Digital (SDTM) card to provide convenient data downloads. An inexpensive 128 megabyte SDTM card will store weeks of data at 30 second intervals and months of data at longer logging intervals. Microsoft Excel, OpenOffice.org, or practically any spreadsheet program can be used to view, graph, and analyze your wind data. Web-based software that makes your analysis even easier is provided. Simply upload your data and our software will automatically plot the data as well as provide basic statistics.

The Wind Data Logger comes in a waterproof enclosure with a 10-watt module and 7 amp-hour battery. Order side-of-pole mount for solar module separately if needed.

Wind Data Logger

\$1269

16-525

Wind Turbines

Skystream 3.7

The Southwest Windpower Skystream 3.7 is a residential wind generator that hooks up to your home to reduce or eliminate your monthly electrical bill. It's the first all-inclusive UL Listed wind generator (with controls and inverter built in) designed to provide quiet, clean electricity in very low winds. The Skystream is ideal for residential homes and small businesses connected to the power grid.

Skystream connects directly to your home. When the wind is blowing, your home is powered (in part) by Skystream; when it's not, your home is seamlessly powered by your utility, as usual. During periods of strong winds, Skystream can actually produce excess electricity. Depending on your utility, your meter will spin backwards – giving you credit for a later date. Estimated energy production is 400 kWh per month in a 12 mph wind.

If your site fits the following criteria, Southwest Windpower's Skystream 3.7 may work for you:

- At least 10 mph average wind speed (best results at 12 mph or more)
- Your property is at least a half acre and has unobstructed views
- The local zoning allows a structure that is at least 42' tall
- Your utility has an existing interconnection agreement for homeowners

With a rated capacity of 1.9 kW, Skystream can provide anywhere from 40 to 100 percent of the total energy needs of a household or small business. Its sleek, distinctive 12-foot diameter swept-wing blades and elegant form make Skystream an attractive addition to any home. With a guyless tower, Skystream blends in like a neighbourhood street lamp. And because it operates at a low rpm, Skystream is as quiet as the trees blowing in the wind.

An optional two-way remote display unit lets you control your Skystream from up to 1000 feet (300 meters) away. You can also monitor performance and download energy performance data to your personal computer via USB converter.

5-year limited warranty.

16-301	Skystream 3.7 Land	\$7589
16-304	Skystream 3.7 Marine	\$8449



Wind Turbines

Southwest Windpower

AIR X 400W and AIR Breeze 200W Wind Generators

The AIR Breeze, introduced in 2007, is the next generation of the AIR X turbine. Both the AIR Breeze and the AIR X come in 12- and 24-volt versions. The AIR X is also available in 48-volt. Both are available in land and marine versions. The quieter AIR Breeze features newly designed blades and higher power output at wind speeds below 12 mph. Because of its increased efficiency at lower wind speeds and advanced blade design, the AIR Breeze is the best choice for small wind applications unless average wind speed is well over 12 mph.

The Marine versions are corrosion-proofed for use in coastal and nautical applications. A white powder-coated housing and sealed electronics prevent damage from salt spray.

All units weigh 13 lbs, have a 46-inch rotor diameter and come with a 3-year warranty. The AIR Breeze is rated at 200 watts at 28 mph wind and the Air X is rated at 400 watts at 28 mph wind.

Features:

- Durable composite blades
- Delivers 33kWh/mo @ 12 mph avg wind speed (Air Breeze)
38kWh/mo @ 12 mph avg wind speed (Air-X)
- start up wind speed: 6 mph (Air Breeze)
7 mph (Air-X)
- survival wind speed: 110 mph

16-130	AIR X/AIR Breeze Land, w/built in regulator	\$ 895
16-131	AIR X/AIR Breeze Marine, w/built in regulator	\$1149
53-650	Stop Switch	\$ 150
16-167	Roof Mount Kit with Seal	\$ 179
16-168	27' AIR Guyed Tower Kit (does not include poles & anchors)	\$ 269
16-169	45' AIR Guyed Tower Kit (does not include poles & anchors)	\$ 465



Whisper Wind Generators

Whisper wind turbines feature a patented side furling angle governor to protect the turbine in high winds by turning the alternator and blades out of the wind. Other features include field adjustable voltage, a four bearing spindle for efficiency, upgraded yaw shaft and a new bushing for smoother operation. Voltage is factory set at 24 Vdc and is adjustable to 12/36/48 Vdc. High voltage versions of the Whisper 200 and 500 produce 220 Vac transmitting to a step down transformer that changes it to nominal system voltage (transformer sold separately). High voltage versions are used in applications where there is a long distance from the turbine to the batteries.

Every Whisper 100 and 200 comes with the Whisper Charge Controller except for HV and pump models. The SCR-based shunt type controller, housed in a single unit, is dedicated to wind only. LED lights indicate regulation operation and Power ON. Other features include individually rectified phases, battery/turbine shunt isolation, quiet diversion-powered fan, a large heat sink and easy access block connectors for turbine and battery wires.

The marine versions, designed for coastal and offshore applications, feature powder coating for corrosion protection, stainless steel hardware, marine-grade wire and watertight housings. 5-year warranty.

16-205	WHI-100 w/Controller	\$ 3,249
16-206	WHI-200 w/Controller	\$ 3,889
16-207	Optional Controller Display (for WHI-100/WHI-200)	\$ 175
16-208	WHI 500w & EZ Wire (24V or 48V incl. Controller)	\$ 9,985

Tower Kits for the WHI 100, WHI 200& WHI500

Does not include pipe and anchors.

16-155	24' Tower Kit	\$ 415
16-156	30' Tower Kit	\$ 659
16-157	50' Tower Kit	\$ 929
16-158	65' Tower Kit	\$1,249
16-159	80' Tower Kit	\$1,479
16-160	36" Galvanized Augers (for 24')	\$ 219
16-161	48" Galvanized Augers (for 30', 50')	\$ 248
16-162	60" Galvanized Augers (for 65', 80')	\$ 319
16-163	30' Tower Kit (WHI 500)	\$1,239
16-164	42' Tower Kit (WHI 500)	\$1,339
16-165	70' Tower Kit (WHI 500)	\$1,949



WHI 500



WHI 100/200

Small DC Hydroelectric Turbine Generators

Canada has an abundance of the world free-flowing surface water. Springs, creeks and rivers are potential water flow sources for independently owned and operated small hydroelectric systems. Acquiring water use rights for a hydroelectric generation site must be established before any installation works begin. Water rights vary from province to province in Canada, and can generally be successfully negotiated, as long as certain governmental criteria are met.

Many sites have hydroelectric potential, without anyone realizing it exists. One must first determine how much water flow (volume) and fall (head) a water source has. These two factors will tell if you have a potential hydroelectric site, and if so, whether it will sustain a large AC installation or a smaller DC generating system.

We offer small hydroelectric generator sizes that are designed to be 12, 24 or 48 volt battery chargers, operating with relatively small volumes of water. They charge batteries 24 hours per day and power is drawn from the battery as needed. As little as 100 gallons per minute falling 10 feet through a pipe can make 80 watts of battery charging power. This is nearly 2 kilowatt hours per day. The same amount of power made from eight non-tracking PV modules in a sunny summer day. Where there's a long rainy season and a usable water source, a small hydroelectric system works well with solar modules, both charging the same battery. When it's cloudy and rainy and the solar modules are putting out little power, the hydroelectric system may be at its peak.

By contrast, a typical AC power hydroelectric system designed to deliver ready-to-use 120/240 VAC power, may not be practical because a constant water supply large enough to supply the peak power demands will be required. A minimum of several thousand watts. This requires hundreds or even thousands of gallons of water per minute, depending upon the pressure available. Besides requiring large amounts of water, these turbines require large diameter pipes and expensive electronic regulation that can maintain proper AC 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 gallons per minute 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 as a multiplier for efficiency representing 30%. Thirty percent is the low average figure for the efficiencies of most micro-hydro electric generators—though this may often be higher. A simple formula for a more typical 53% efficiency is to multiply GPM x head in feet and divide by 10 to achieve Watts.

Pipelines

A hydroelectric turbine operates from pressure at the bottom end of a pipeline. The 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 is available with pressure ratings from 160 to 350 PSI and steel pipe can withstand 1000 PSI or more. Check with your local plumbing supplier for pipe pressure 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 the water is not flowing is called static pressure. When water is flowing through the outlet or nozzle of a turbine, the pressure at the outlet is the dynamic pressure or running head. See next page over for pipe friction loss chart.

If you install a gate valve on the pipeline just above the turbine and a pressure gauge on the "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 turbine nozzle(s). We will supply a Harris turbine with the proper sized nozzle(s) for your site, depending on the head, flow and length and diameter of the pipe.

Let us help you design the system

If you think you have a suitable site for a hydroelectric system, big or small, call us or write to us and we can help you determine the best unit for your situation. Determine the following information about your site before you contact us:

1. **Head**—The total vertical elevation from the place where the water enters the pipeline to the point where the turbine will be located, in feet or meters.
2. **Flow**—The number of gallons or liters per minute that is available.
3. **Distance**—The length of pipe that will be necessary to carry the water
4. **Location**—How far will the turbine be from the house or place where the battery or power use site is located.

Hydroelectric Turbines

HI-Power

Low-Voltage LV Hydroelectric Generators

HI-Power is now offering a low-voltage brushless permanent magnet generator. This user-friendly unit requires no adjustments and is more efficient than car alternator types over a wider range of head and flow.

- Head range: 40 to 400 feet
- Flow range: 5 to 400 gpm
- Maximum power: 1200 watts
- Efficiency: 30% to 70%
- Battery voltage options: 12V, 24V, 48V, 96V

Available in the four voltages above for direct battery charging. The 48- and 96-volt units allow the use of smaller gauge wire between the generator and the battery. An MPPT charge control, like the OutBack FM-60, can be used to efficiently step the voltage down for charging and regulating 12-, 24- or 48-volt batteries.

The sealed permanent magnet alternator is mounted on a Harris housing with the bronze Harris Pelton wheel. The external rectifier is water-cooled and all fasteners are stainless steel. It comes with an induction meter and 3 feet of 1" flexible hose per nozzle.

Order multiple nozzles for convenient adjustment to varying flows. Alternator has 2 sealed 6203 bearings which should be changed every 5-10 years, depending on use.

When ordering, specify battery voltage, transmission line length and size, flow, pressure, pipe size and length



17-101	LV Hydro w/1 Nozzle	\$2,029
17-102	LV Hydro w/2 Nozzles	\$2,099
17-103	LV Hydro w/3 Nozzles	\$2,139
17-104	LV Hydro w/4 Nozzles	\$2,199

Higher Voltage HV Hydroelectric Generators

HI Power Hydroelectric generators are ideal for sites where water is far from power needs (up to 10,000 feet) or when greater power is required. High transmission voltage can be sent over a mile before being 'stepped down' to battery voltage. It comes complete with step-down transformer, rectifier, fuses and amp meter. Use a diversion-type regulator with these units.

- Head range: 60 to 500 feet
- Flow range: 10 to 400 gpm
- Maximum power: 3600 watts
- Efficiency: 30% to 60%
- Transmission voltage: 110V to 440V
- Battery voltage: 12V, 24V, 48V

These hydroelectric generators use brushless alternators for reliability and versatility. They produce 110V, 220V, or 440V "wild" (unregulated) AC, which is then stepped down with the supplied transformer and rectifier.

The heavy-duty brushless alternator is housed on the Harris housing and uses the Harris Bronze Pelton Wheel for flows up to 200 gpm and the ESD Turgo Wheel and housing for flows of 200 to 400 gpm. Available in 4 sizes ranging from 600 to 3600 watts. The HV600 is available with 2 or 4 nozzles. The larger units come with 4 nozzles.

2-year warranty. Specify battery voltage when ordering.



17-121	HV 1200 - 1200 watt 4 nozzle	\$ 5,199
17-122	HV 1800 - 1800 watt 4 nozzle	\$ 6,079
17-123	HV 3600 - 3600 watt 4 nozzle	\$ 9,899
17-129	High-Power turgo nozzle	\$ 849

Hydroelectric Turbines

Harris Hydroelectric

Pelton Turbines

This hydroelectric battery charger uses a cast bronze Pelton wheel and a brushless permanent magnet alternator on a white powder-coated aluminum housing.

- 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

They are available with one, two or four nozzles, depending on water flow and power requirements. (PVC manifold with one shut-off valve on two-nozzle machines and 3 shut-off valves on 4-nozzle machines is available). These turbines can be fitted with nozzles up to 1/2" in diameter. Each hydroelectric system is custom-built to match your site specifications. Please tell us your head, flow, pipe size and length, electrical transmission line length and battery voltage when ordering. The new permanent magnet (PM) brushless alternator pictured here is 15-30% more efficient than the automotive alternator used in the past; and they last longer. Allow 5 to 6 weeks for delivery. 1-year warranty



17-151	Harris PM 1 Nozzle	\$2,689
17-152	Harris PM 2 Nozzle	\$2,849
17-154	Harris PM 4 Nozzle	\$3,089
17-159	Fan Kit (recomm. for over 500W)	\$ 119

PVC Pipe Loss Table - Head Loss in Feet per 100 Feet of Schedule 40 PVC Pipe

Flow GPM	Pipe diameter										
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"
1	2.08	0.51	0.1	0.03							
2	4.16	1.02	0.55	0.14	0.07						
3	8.7	2.2	0.68	0.19	0.08	0.03					
4	14.8	3.7	1.15	0.31	0.13	0.05	0.03				
5	23.5	5.73	1.72	0.44	0.22	0.07	0.04				
7	43	10.5	3.17	0.81	0.38	0.11	0.05	0.02			
10		20.1	6.02	1.55	0.72	0.21	0.09	0.03			
15		42.5	12.8	3.28	1.53	0.45	0.19	0.07			
20			21.8	5.59	2.61	0.76	0.32	0.11			
25			32.9	8.45	3.95	1.15	0.49	0.17	0.04		
30			46.1	11.9	5.53	1.62	0.68	0.23	0.06	0.03	
40				22	9.43	2.75	1.16	0.4	0.11	0.04	
50				30.5	14.3	4.16	1.75	0.6	0.16	0.05	0.02
60				45.6	20	5.84	2.346	0.85	0.22	0.07	0.03
70					28.6	7.76	3.27	1.13	0.3	0.1	0.04
80					36.7	9.94	4.19	1.44	0.38	0.13	0.05
100						15.1	6.33	2.18	0.58	0.19	0.08
150						34.8	13.4	4.63	1.22	0.4	0.16
200						59.3	25.0	7.08	2.88	0.69	0.28
250							37.8	11.9	3.15	1.05	0.43
300							46.1	18.4	4.41	1.46	0.6
400								40.1	7.52	2.49	1.01
500										3.76	1.53

Hydroelectric Turbines

Aquair Submersible HydroFlow Generator

If you have a fast flowing stream that is at least 13 inches deep you can install a Submersible Generator without having to build a dam or install piping therefore not requiring water use rights.

The Aquair submersible generator is a special low-speed high output alternator, mounted in a oil-filled cast aluminum housing. It was developed to charge lighting batteries on barges being towed in the North Sea.

One of these generators was tested mounted in a stream flowing 9 mph (14.5 km/h), it charged a 12 volt battery at 8 amps, or 2.4 kilowatts hours per day. It can produce 1.5 kilowatt hours per day in a stream moving 6 mph (9.7 km/h).

The propeller is made of ductile aluminum, which can be hammered back into shape if it is hit by floating debris. Replacement propellers are available in case of severe damage.

Installation requires secure mounting, such as on a vertical pole from a bridge or on a cantilever beam from one side of the stream. If your stream is subject to violent flows due to thunder storms or flood control releases, you should have some method of raising the generator out of the way.

The Aquair is 14.5 inches long. The generator is 8-3/8" in diameter and the propeller is 12-1/2" in diameter. It weighs 30 pounds (13.6 kg).

A diversion charge control like the Xantrex C-35 or C-40, may be used for overcharge protection.

17-175	Aquair Submersible - 12 V	\$2,149
17-176	Aquair Submersible - 24 V	\$2,149
17-177	Spare Propeller	\$ 219
17-178	Propeller Guard	\$ 375
17-179	Aquair UW Mounting Pole	\$ 95



Propeller Guard



Aquair UW Mounting Pole