The LH1000

Low Head Propeller Turbine

Personal Hydropower

Owner's Manual

<u>**PLEASE READ CAREFULLY**</u>

Made in Canada

by

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Congratulations on your purchase of a new *LH1000*! With a proper installation and a little routine maintenance, your LH 1000 will provide you with years of trouble-free operation. This manual will help you to install your LH 1000 as well as assist you in trouble-shooting and problem solving. Of course, you may contact Energy Systems & Design Ltd. if you run into trouble.

May your RE adventures prove successful!

PLEASE READ CAREFULLY

It is very important to keep the alternator rotor from contacting the stator (the stationary part under the rotor). If this occurs, serious damage may result.

Whenever you are operating the machine with a small air gap (distance between alternator rotor and stator) you should check the gap whenever an adjustment is made!

Do this by inserting a shim 0.020" (0.5mm) thick, in the gap when the rotor is stationary (most business cards are 0.010" (0.25 mm) thick, therefore, using two cards of this thickness could be used to check the air gap). Check all the way around the rotor. This is also a way to check for bearing wear on a monthly basis. If you **cannot** easily insert the shim into the gap, either all or in part, it is necessary to adjust the rotor upward (see *Output Adjustment* in this manual). DO NOT USE steel feeler gauges as they will be attracted to the magnets.

When making air gap adjustments, make sure the larger bolt is tightened (clockwise) against the shaft and the smaller bolt is also tightened (clockwise); so as to lock both parts in place.

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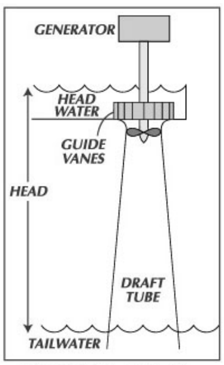
INTRODUCTION

This manual describes the **LH 1000**, which is manufactured by **Energy Systems & Design LTD**. The installer must have some knowledge of plumbing and electrical systems, as should the end-user of the system. These machines are small, but can generate very high voltages. Even 12-volt machines can produce high voltages under certain conditions. Practice all due safety. Electrical systems must be installed in accordance with local laws by a qualified person.

It is important to consult with local officials before conducting any watercourse alteration. ES&D advises following all local laws and ordinances regarding watercourses.

Electricity is produced from the potential energy in water moving from a high point to a lower one. This distance is called "head" and is measured in units of distance: meters (or feet) or in units of pressure: kilograms per square centimeter (or pounds per square inch-psi). "Flow" is measured in units of volume: liters per second - l/s (or gallons per minute-gpm), and is the second portion of the power equation: power [watts] = head x flow.



LH1000 Installation

The **LH1000** is designed to operate over a range of heads from two to ten feet (0.6-3 meters). The **LH1000** uses a permanent magnet type alternator. This design eliminates the need for brushes and the maintenance that accompanies them, while increasing efficiency. The **LH1000**'s output can be optimized by simply adjusting the rotor's clearance from the stator. A low-volume runner is also being offered for the machine that allows it to operate on about half the flow and generate about half of the power.

SITE EVALUATION

Certain information must be determined concerning your site, in order to use its potential for maximum output. Head and flow must first be determined. The other factors are plumbing specifications, transmission distance, and the system voltage. These factors determine how much power can be expected.

Power is generated at a constant rate by the **LH1000** and stored in batteries as direct current (DC). Power is supplied, as needed, by the batteries, which store energy during periods of low consumption for use in periods where consumption exceeds the generation rate. Appliances can be used that operate directly from batteries, or alternating current (AC) power (at regular domestic specifications) can be supplied through an inverter, converting DC to AC power.

HEAD MEASUREMENT

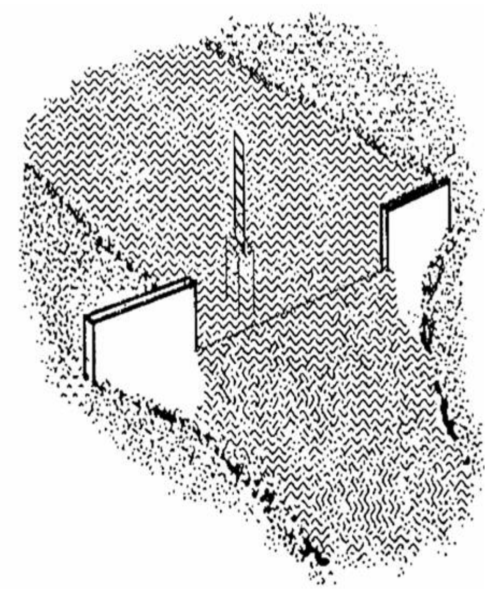
Head may be measured using various techniques. A garden hose or length of pipe can be submerged with one end upstream and the other end downstream. Anchor the upstream end with rocks or have an assistant hold it; water should flow out the low end, especially if the pipeline is pre-filled. Once water is flowing, raise the downstream end until it stops. Do this slowly since the water tends to oscillate. When the flow has stabilized, measure the distance down to the level of water in the stream with a tape measure. This will give a very accurate measurement of that stream section. Mark the spot and then repeat the procedure until the entire distance is covered.

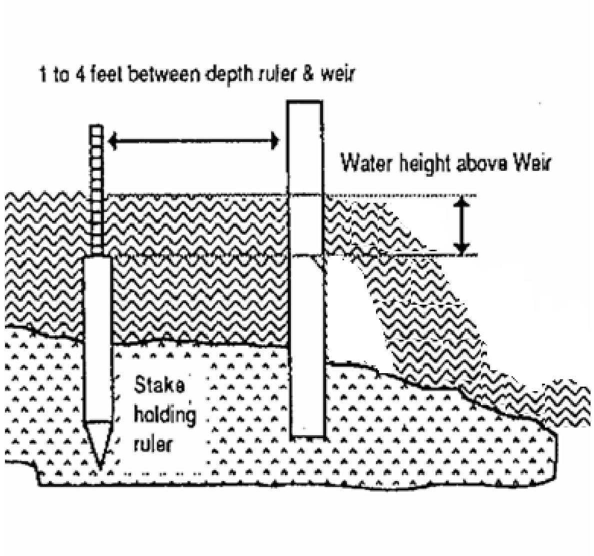
Another technique is to use a surveyor's transit. This method can also be approximated using a carpenter's level using a measuring stick or a "story pole." This technique is also done in a series of steps to arrive at the overall head. Note that with this reaction type machine, the entire head is used. No head is lost as with an impulse machine.

FLOW MEASUREMENT

The weir method can be used for the higher flows used with this machine. This technique uses a rectangular opening cut in a board or piece of sheet metal set into the brook like a dam. The water is channeled into the weir and the depth is measured from the top of a stake that is level with the edge of the weir and several feet upstream.

Measuring the flow at different times of the year helps you estimate maximum and minimum usable flows. If the water source is seasonally limited, you may have to depend on some other source of power during dry times (solar, wind). Keep in mind that a reasonable amount of water must be left in the stream (Don't take it all, that water supports life forms).





WEIR MEASUREMENT TABLE

Table shows water flow in gallons/minute (gpm) that will flow over a weir one inch wide and from 1/8 to 10-7/8 inches deep.

Inches		1/8”	¼”	3/8”	½”	5/8”	¾”	7/8”
0	0.0	0.1	0.4	0.7	1.0	1.4	1.9	2.4
1	3.0	3.5	4.1	4.8	5.5	6.1	6.9	7.6
2	8.5	9.2	10.1	10.9	11.8	12.7	13.6	14.6
3	15.5	16.5	17.5	18.6	19.5	20.6	21.7	22.8
4	23.9	25.1	26.2	27.4	28.5	29.7	31.0	32.2
5	33.4	34.7	36.0	37.3	38.5	39.9	41.2	42.6
6	43.9	45.3	46.8	48.2	49.5	51.0	52.4	53.9
7	55.4	56.8	58.3	59.9	61.4	63.0	64.6	66.0
8	67.7	69.3	70.8	72.5	74.1	75.8	77.4	79.1
9	80.8	82.4	84.2	85.9	87.6	89.3	91.0	92.8
10	94.5	96.3	98.1	99.9	101.7	103.6	105.4	107.3

Example of how to use weir table:
Suppose depth of water above stake is 9 3/8 inches. Find 9 in the left-hand column and 3/8 in the top column. The value where they intersect is 85.9 gpm. That's only for a 1-inch weir, however. You multiply this value by the width of your weir in inches to obtain water flow.

LH1000 POWER OUTPUT CHART

Head (feet)	Flow Volume (GPM)	Watts (approximate)	Pipe Size (minimum)
1	320	25	8”
2	450	70	8”
3	550	150	10”
4	635	250	10”
5	710	350	10”
6	775	465	12”
7	840	585	12”
8	895	715	12
9	950	850	12”
10	1000	1000	12”

Head in feet can be converted to meters by multiplying feet by 0.3048.

Flow in gallons per minute can be converted to litres per second by multiplying gpm by 0.063.

If there is not enough water volume for the available head, the head can sometimes be reduced to match the available volume of water. The head can be reduced by adjusting the vertical drop for the diversion inlet and/or the length of the draft tube. If the site cannot produce the water volume necessary for the head, the turbine will not have enough water to operate, causing air to be sucked into the machine. This situation will reduce the power output considerably. If the water flow exceeds what is required to operate the machine, consider adding additional turbines.

A low volume runner is available for the machine that can be used if there is not enough water to support the use of the standard runner. The machine will then operate on about half of the water flow and produce about half the power than is shown in the above chart.

INTAKE, PIPELINE, AND TAILRACE

All hydro systems require a waterway. Even systems operating directly from a dam require at least a short plumbing run. It is important to use the correct type and size of plumbing to minimize restrictions in the flow. When possible, pipelines should be buried; this stabilizes the line and prevents animals from chewing on it.

At the inlet of the plumbing, a filter should be installed. An open sluice can be constructed that is made of wood, metal or plastic (or any suitable material) to carry the water instead of a pipeline. If a pipeline is used, it is important to have a bell mouthed intake like the end of a trumpet in order for the water to enter easily. A screened box can be used with the pipe entering one side, or add a section of pipe drilled full of holes wrapped with screen or small holes and used without screen. A mesh size of about ¾" (20 mm) and smaller can be used as debris of this size and will pass through the machine. However, it is important to keep sticks out of the intake as they may become jammed in the machine. This may require a smaller mesh size.

A settling basin should be used with this machine. This is a pool of low velocity water that enables the grit to settle so that it will not enter the machine and wear the edge of the propeller and the guide vane housing.

See LH1000 installation illustration at back of manual

The turbine can be mounted in the "waterbox," through a 17-cm (7") hole with the draft tube extending to the tail waters below. The small tabs (supplied) are mounted to the base of this to retain the machine. It is often helpful and **recommended to add a brace** to the top of the machine. The draft tube is connected to the machine using a rubber sleeve and hose clamps. These are standard plumbing items. If the head is greater than about six feet (two meters), PVC pipe of 6"(150 mm) diameter with a 0.160"(4 mm) wall thickness like sewer pipe can be used between the guide vane assembly and the draft tube to extend the length and another rubber sleeve is needed. Some sewer pipe is this size. Using thin wall pipe will allow for a more streamlined flow as it can slip over the guide vane stub pipe. Install the rubber sleeve at the lower end of the guide vane tube so as to create a smooth transition from one to the other. It is recommended to have the LH1000 in a small enclosure or under some cover to keep it dry and provide a place for auxiliary equipment. Mounting the machine in concrete is also possible (you may wish to try a temporary wood mounting first). The draft tube **must** be supported. This can be done with straps from the top down or it can rest on "feet" that are positioned on the stream bed.

PIPE FRICTION LOSS - PVC Class 160 PSI Plastic Pipe

Pressure Loss from Friction in Feet of Head per 100 Feet of Pipe

Flow US GPM	6"	8"	10"
500	1.45	0.42	0.14
550	1.75	0.48	0.16
600	2.05	0.58	0.18
650	2.37	0.67	0.23
700	2.71	0.76	0.25
750	3.10	0.86	0.30
800	3.50	0.97	0.32
850	3.89	1.08	0.37
900	4.32	1.20	0.42
950	4.79	1.34	0.46
1000	5.27	1.45	0.51

BATTERIES, INVERTERS & CONTROLLERS

System Voltage

A small system with a short transmission distance can be designed to operate at 12 volts. Larger systems can also be 12 volts, but if higher power is desired or the transmission distance is long, then a system of 24 volts or higher may be preferable. This is especially true if all loads are inverter-powered. In a 12-volt system operating at a low power level, it may be advantageous to operate all loads directly from batteries. Many 12-volt appliances and small inverters are available. In 24-volt systems, it may also be preferable to operate the loads directly (although not as many appliances are available).

In higher power systems, it is usually better to use an inverter to convert battery voltage to regular 120 volt AC power at 60Hz (cycles per second), or 240 volt 50Hz in some countries. This has been made feasible with the advent of reliable high power inverters. Thousands of home power systems are in operation with only AC loads.

Sizing Battery Bank

A typical hydro system should have about one or two days of battery storage capacity. This will generally keep lead-acid cells operating in the middle of their charge range where they are the most efficient and long-lived.

Batteries should be located outside of any living space, or adequate ventilation should be provided, as a rising charge level tends to produce both hydrogen gas and corrosive fumes. Also, distilled water should be added as needed to maintain the electrolyte level.

Charge Control

Unlike solar systems, a hydro system must always be connected to a load even when the batteries are fully charged. If the output power does not have a load, system voltage can rise to very high levels. This situation provides an opportunity to do something with the excess power like water or space heating.

As the batteries become fully charged, their voltage rises. At some point, the charging process should stop and the excess power be diverted to the dump load. Most charge controllers permit different charge levels such as bulk, absorption, and float. Literature supplied with the controller should be consulted to determine the set points of the charge controller. Be sure to set the controller for hydro diversion.

Watt-Hour meters are available that monitor the battery state of charge.

An ammeter that monitors turbine output should always be installed in a high traffic or living space so difficulties with the machine can be easily detected. If a drop in output is noticed, the machine should be inspected. This could be caused by air in the pipeline, or a blocked or partially blocked nozzle. More importantly, a drop in output could be the beginning of bearing failure. Bearing failure will cause serious damage to the machine. Early detection of problems with the bearings is vital.

WIRING AND LOAD CENTER

Every system requires wiring to connect the various components. Load centers are available as a complete package that easily facilitates the connection of loads and power source(s). All circuits in the system should use wire of adequate size and have fuses or breakers of sufficient capacity to carry the expected load current. The LH1000 must be fused since it can suffer from a short or similar fault just like anything else in the system.

DESIGN EXAMPLE

This example shows how to proceed with a complete installation. The parameters of the example site are:

-six feet (two meters) of head over a distance of 50 feet (15 meters)
-a flow of at least 1000 gpm (63 l/s)
-100 feet (30 meters) distance from the house to the hydro machine
-24 volt system

The first thing to do is determine the pipe size. Given that there is friction between water and the pipe in which it flows, this friction can be reduced by increasing the size of the pipe to minimize the friction to acceptable limits. Therefore, pipe size must be optimized based on economics and performance.

Note that with this machine, the flow is determined by the head, as there is nothing to adjust that changes the flow. A head of two metres requires a flow of about 800 gpm (50 l/s).

The pipe flow charts show us that eight-inch (approx. 20cm) diameter PVC pipe has a head loss of 0.97 feet of head per 100 feet (30m) of pipe at a flow rate of 800 GPM (50 l/s). This is about 0.5 feet (15cm) of loss for 50 feet (15m) of pipe.

Next, we subtract the head losses from the measured head (often referred to as the static), or gross head (Abbreviated Hg), in order to determine the actual, operating head (often referred to as the dynamic), or net head (Abbreviated Hn).

6 feet (two meters) head -0.5 feet (150 mm) head losses = 5.5 feet (1.85m) actual head

It is now known that the **LH 1000** will be operating at an actual or net head of 5.5 feet (1.85m) or Hn. By referring back to the output chart, it can be determined that the LH1000 can, realistically, be expected to produce approximately 400w.

COPPER WIRE RESISTANCE

Wire Gauge	Diameter Inches	Ohms per 1000'	Ohms per Mile
0000	0.460	0.05	0.26
000	0.410	0.06	0.33
00	0.364	0.08	0.42
0	0.324	0.10	0.52
2	0.258	0.16	0.84
4	0.204	0.25	1.34
6	0.162	0.40	2.13
8	0.128	0.64	3.38
10	0.102	1.02	5.38
12	0.081	1.62	8.56
14	0.064	2.58	13.6
16	0.051	4.10	21.6
18	0.040	6.52	34.4

Since we require 24 volts and the transmission distance is short, we can generate and transmit 24 volts using the **LH1000**. This **LH1000** could also be used for other voltages like 12 and 48, or even 120 or 240V, and power could be transmitted longer distances. We need to go 100'(30m) with 400 watts at our site. The amperage can be determined using the formula: volts x amperage = watts. So, a 24v system usually operates at an actual voltage of about 30v at the generator, therefore: 400/30 = 13.3 amps. The machine will need to be wired series delta for this site.

This will be about 13.3 amps at 30 volts at the generator. Note that there will be some voltage drop in the line and batteries require somewhat higher voltages than nominal to become charged. So the 13.3 amps must pass through 200'(60m) of wire for the distance to the batteries and back which completes the circuit. As there is friction between water and the pipe that carries it, causing losses, so there is resistance between electricity and the conductor that carries it, and is measured in units called ohms. Resistance losses should be kept as low as economics permit, just like the pipeline losses. Let's assume that a 5% loss is acceptable at this site, resulting in the loss of 25 watts.
The formula to calculate resistance losses is I (amps) x I (amps) x R (resistance) = w (watts). We put our known figures into the formula to learn the resistance that we require in a copper conductor to achieve this.

13.3 x 13.3 x R = 25w
177 x R = 25w
R = 0.14 ohms

It has been calculated that a copper conductor with losses of 0.1 ohms over a total distance of 200 feet (60m) will result in a 5% loss. The Wire Loss Chart shows losses per 1000' (300m) of wire, so:

1000'/200' x 0.14 ohms = 0.7 ohms per 1000'

The chart shows 8 ga. wire has a resistance of 0.64 ohms per 1000', so:

200'/1000' x 0.64 ohms = 0.128 ohms

This is close enough to the desired level. With a little more investigation we can determine whether this will result in acceptable power losses:

13.3 amps x 13.3 amps x 0.128 ohms = 22.6 watts of loss

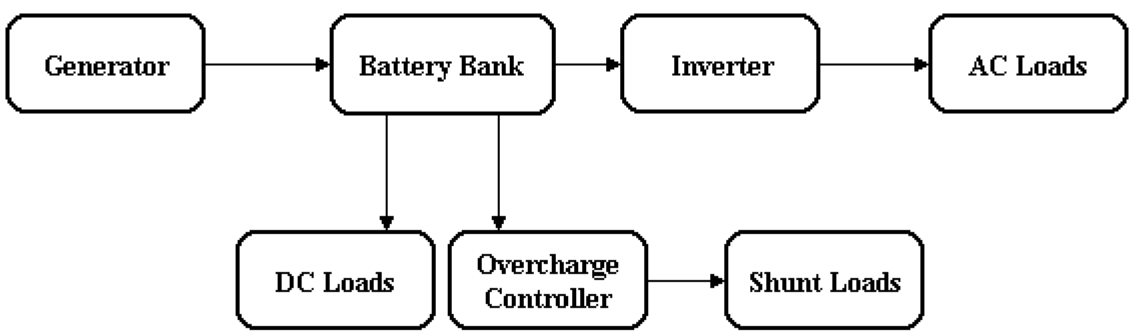
Increasing the wire size can further reduce the losses, but can also increase costs, as larger wire is usually more expensive. Resistance in a length of wire results in power loss that is seen as a voltage drop from one point in the line to another. For example, if your voltage, as measured at the generator, is 30vdc, then it could be assumed that if the voltage were measured along the line to the batteries, it would be lower as you got further from the generator: Voltage drop= I (amps) x R (ohms resistance in your circuit). So:

Voltage drop = 13.3 amps x 0.0128 ohms = 1.70 volts

Hence, if your battery voltage is 28.3vdc, your generator voltage will be 30vdc. Keep in mind that it is always the batteries that determine the system voltage, as they are the stabilizing force in your system. All voltages in the system will rise and fall corresponding to the battery voltage, or the battery's state of charge. At the site, we would be generating 13.3 amps continuously. Typically, a battery bank is sized to have two days storage capacity. If we choose lead acid batteries and wish to have two days of storage capacity, then we use the formula: amps x hours x days = amp/hrs capacity. So:

13.3 amps x 24 hrs x 2 days = 638 amp. hrs. capacity

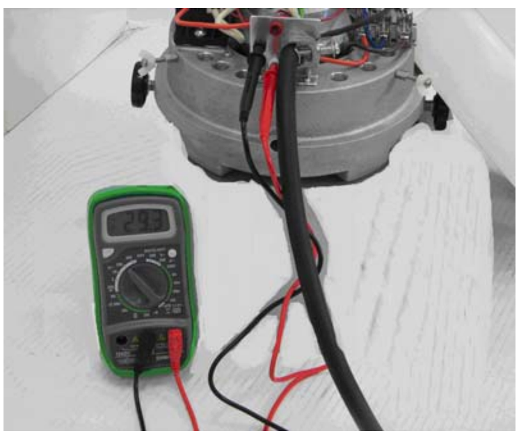
The Trojan L-16 has a rating of 6vdc and 350 amp/hr. Using these you would require at least eight batteries; there would be two strings paralleled, with each string consisting of four batteries in series to give the 24vdc system voltage we have chosen. This would give 700 amp/hrs at 24vdc capacity, which is about two days storage. An inverter and charge controller are usually used in the system. The diagram for such a system would look like this:



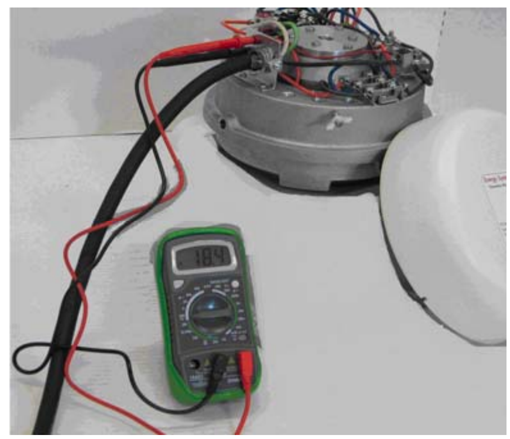
OUTPUT ADJUSTMENT

The Easy Tune LH1000 has the unique feature of being adjustable for maximum power while it is running!

When the machine is fully installed and running, it can be easily adjusted for maximum power. This is done by measuring the output current or amps while the machine is generating power. Simply use your digital multi-meter to determine the highest output reading and set the machine at that point. In a battery system, the current is measured by connecting the meter that is supplied with the machine to the red and black jack as shown in the photo. The weather cover is lifted off after backing off the wingnuts that retain it. With the meter set for 200 DC millivolts (nine o' clock position) it will read directly in amps. The DC output voltage can be read by setting the meter on the DC volts position (20, 200 volts) and using the black and white jacks as shown in the photo.

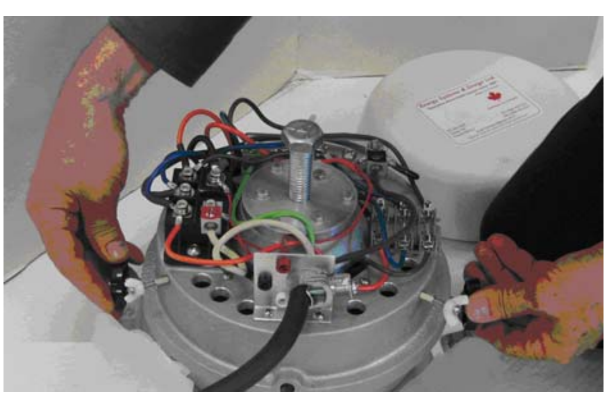


Reading amps

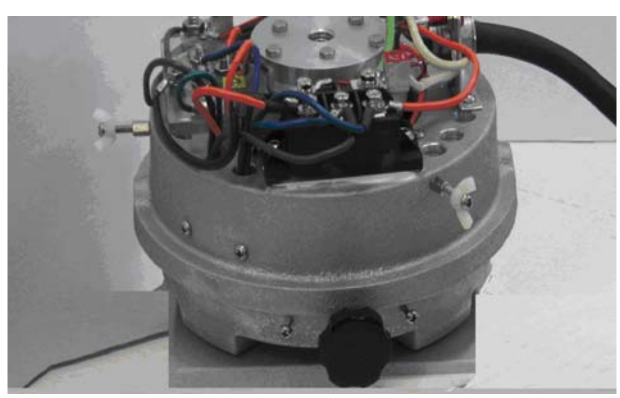


Reading volts

Once the meter is connected and the machine is operating, the upper body of the machine is rotated slightly using the two big knobs on the sides of the machine. First these are loosened and then the body of the machine can be moved while you are observing the output as shown in the photo. What you are looking for is the highest number on the meter. When this is found, the knobs can be tightened and no further adjustment is necessary. Note that there are two small screws that limit the movement of this adjustment that correspond to maximum and minimum magnetic engagement.



Backing off the adjustment knobs



Showing the position of the limit screws

High Voltage AC Transmission

When the machine is used to generate high voltage AC for long distances, the output can be maximized by using the procedure for output adjustment. The meter leads are inserted into any two of the jacks provided. The multimeter is set on the AC scale and the machine is adjusted for the highest AC voltage.

BEARINGS, SERVICE & ASSEMBLY

In order to remove the generator to access the ball bearings undo the four 7/16” (11 mm) nuts that attach the generator to the finned, aluminum base. These are located under the generator base. Next, unscrew the white plastic spinner (nose cone) from the base of the unit, located inside the guide vane assembly, at the end of the shaft in a counter-clockwise or left hand direction.

Proceed to remove the propeller by removing the ¾ inch (19mm) brass nut and slide the propeller from the shaft. Now, the generator and shaft assembly may be pulled up, and out of the generator base and shaft housing. The best way to remove the shaft from the generator is to tighten the two nuts (one is the bronze one holding the propeller and the other is supplied) against each other on the end of the shaft. Then you can unscrew the shaft while holding the generator rotor with the ¼” pin. Now the generator can be removed from the machine by removing the four nuts (7/16” 11mm) that are on the underside of the housing.

The upper casting is now removed by tightening the 5/8” bolt that is supplied with the machine into the center hole in the top of the machine. Make sure that the adjustment knobs are backed off enough to clear the casting when it is raised for removal. Then tighten the bolt. When the bolt contacts the shaft end it will start to raise the upper part of the generator until it is high enough so that it can be pulled off. When pulling the upper part of the generator away from the bottom do so very carefully and set it closely aside, as the wires from the bottom are still connected.

The upper bearing can now be replaced if required. The bearing is slip fit on the shaft and should come off easily. Remove the center retaining screw and washer and remove the bearing. A puller may have to be used if there is corrosion between the shaft and the bearing. The upper bearing must be removed in order to remove the rotor.

To gain access to the lower bearing, the rotor must first be removed. This is done once the top is off by using the jacking screws that are supplied with the machine. These two screws are ¼” diameter and 2 ½” long. Tighten these evenly and fully and then the rotor can be removed. BE CAREFUL!!! The rotor is made with very strong magnets and will attract any iron or steel pieces that are near it. Once the rotor is removed, the lower bearing carrier can be removed by first removing the six screws on the outer edge of the carrier. This is a slip fit in the housing and should come right out. If there is corrosion it may be necessary to press this out. Then the three screws that hold the stainless steel may be necessary to press this out. Then the three screws that hold the stainless steel retaining plate can be removed and then the bearing can be removed. A new bearing can then be installed and the carrier replaced. We recommend a stainless steel bearing for the lower bearing. The rotor can be replaced by lowering it with the jacking screws. Once this is done, and the screws are removed from the rotor, the top can now be installed by using its one large jacking bolt. Make sure that this bolt is centered so it fits over the bearing bolt before the top is gently lowered into place. Once all this is done, make sure that the wires that go to the lower piece are pulled up so there will not be any slack that could contact the rotor.

Technique for removing rotor showing jacking screws

PLEASE NOTE: The propeller must be installed with the *rounded* edges up. This means that the thicker edge of the blades should be on the upper side.

Propeller Bearing

To replace the propeller bearing (water lubricated cutlass type):

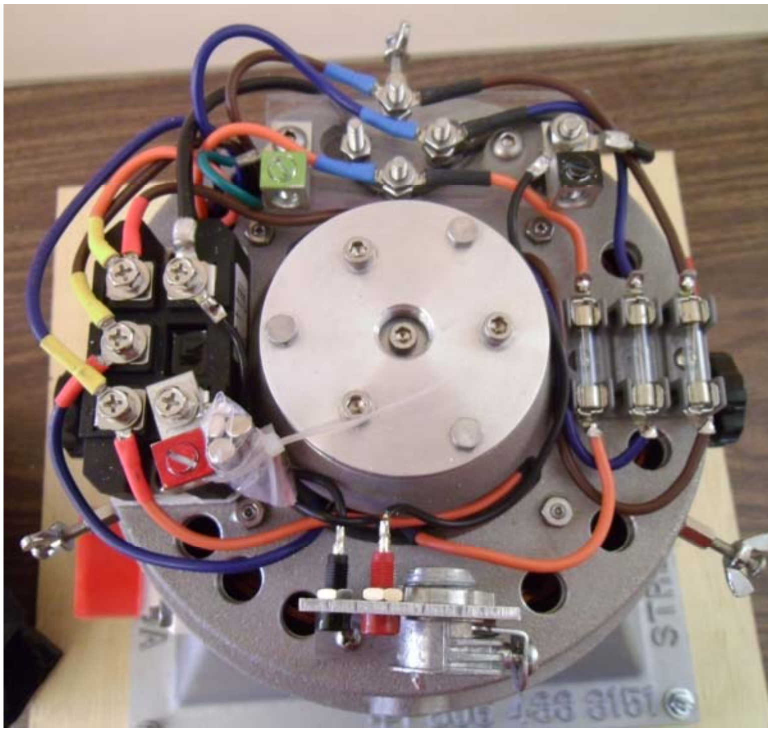
After removing the spinner and propeller, the guide vane and aluminum casting above it can be removed as a unit. Simply unscrew the aluminum casting from the aluminum tube and access to the bearing is possible. This is a bronze piece with a rubber liner. Once the tube is unscrewed from the casting, it should be easily removable. Note the condition of the bronze sleeve on the shaft and there should only be very small clearance between this sleeve and the rubber of the cutlass bearing. Examine the brass wear strip in the plastic guide vane assembly for wear or damage.

WIRING SCHEMES

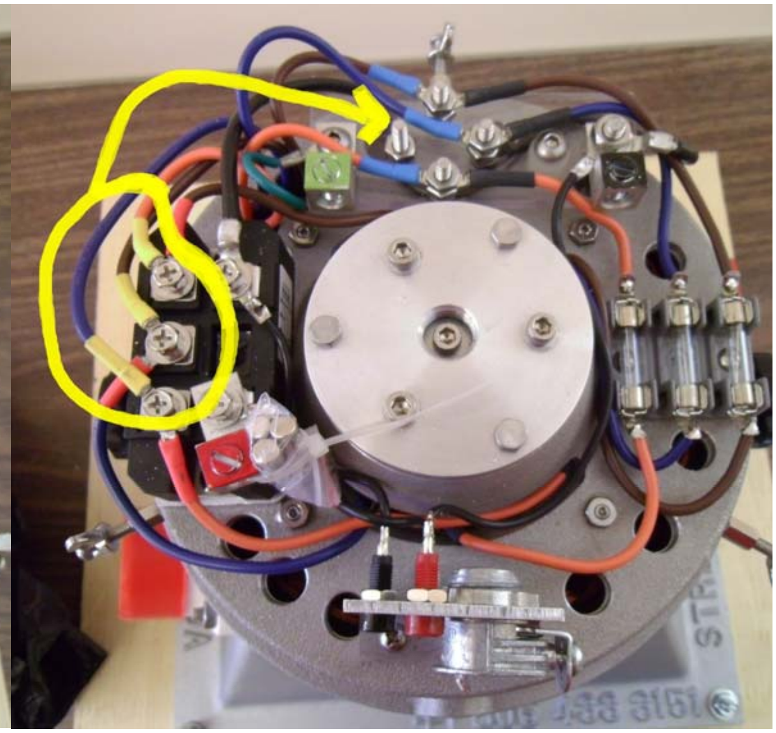
12 VOLTS	24 VOLTS	48 VOLTS
Parallel Delta *All Heads*	**Parallel Y** *3’/1m to 6.5’/2m*	**Series Delta** *3’/1m to 6.5’/2m*
	Parallel Delta *6.5’/2m to 10’/3m*	**Parallel Y** *6.5’/2m to 10’/3m*

Note: At a given site, more than one scheme may work. But one will work best

A Stream Engine Easy Tune® Generator wired delta



Moving the wires with the yellow ends for wye



To change wiring from delta to wye, move the wires (orange, brown, and blue) with the yellow ends on the rectifier to the empty stud on the transparent terminal block. Using the wye connection will raise the voltage and lower the current. Using the delta connection will increase the current and lower the output voltage. This is fine tuning compared to the internal wiring that is discussed later. The wires with the red ends go to the rectifier and the wires with the blue ends go to the terminal block.

There is a ground lug marked with green, for grounding the machine.

The negative output, marked with black, is on the terminal block and is isolated.

The positive output, marked with red, is on the rectifier.

There are three fuses, one for each phase. These fuses protect the internal wiring. If the current goes over the safe limit a fuse may open. If new fuses are needed always replace them with the exact type as supplied with the machine.

INTERNAL WIRING

Inside the machine is additional wiring that determines the output voltage and current of the machine. This can be connected in parallel to give lower voltage and higher current, and series is used to give higher voltage and lower current output. There are two terminal blocks where the wiring changes are made. One serves the upper half of the generator and the other serves the lower half. Both terminal blocks must have the same wiring.

The top part of the generator is removed by inserting and tightening the bolt in the center of the machine as described previously. This gives access to the upper terminal block. The rotor is removed to gain access to the lower terminal block. The procedure is described in the bearing and disassembly section.

Parallel Wiring

Look at the photographs of the wiring for the parallel connections and you will see that only two of the terminal screw connections are used for each section or phase. The terminal blocks are divided into three sections which are separated by the mounting screws that have a flat hex head. Only the two screws at either side are used in the parallel scheme. These screws are also connected to the output wiring so you will see a wire with a ring terminal exiting the terminal block and passing under the magnet wire of the stator. The colored stator wires must be connected to these lead wires too. Note that the extra screws that are needed to series connect the machine are in place if going to series wiring is ever required. So all of the colored stator leads are connected to only two points for each of the three sections. As shown in the photograph, white, blue and yellow wires are connected to one terminal screw and the black, red and green wires are connected to the other screw. This is repeated as shown around the terminal block until all of the connections are the same.

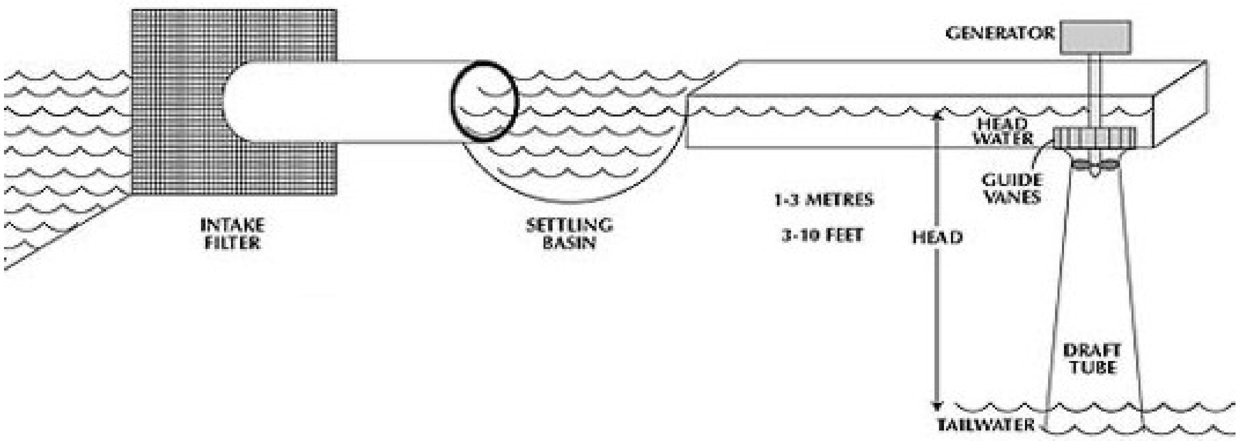
Parallel

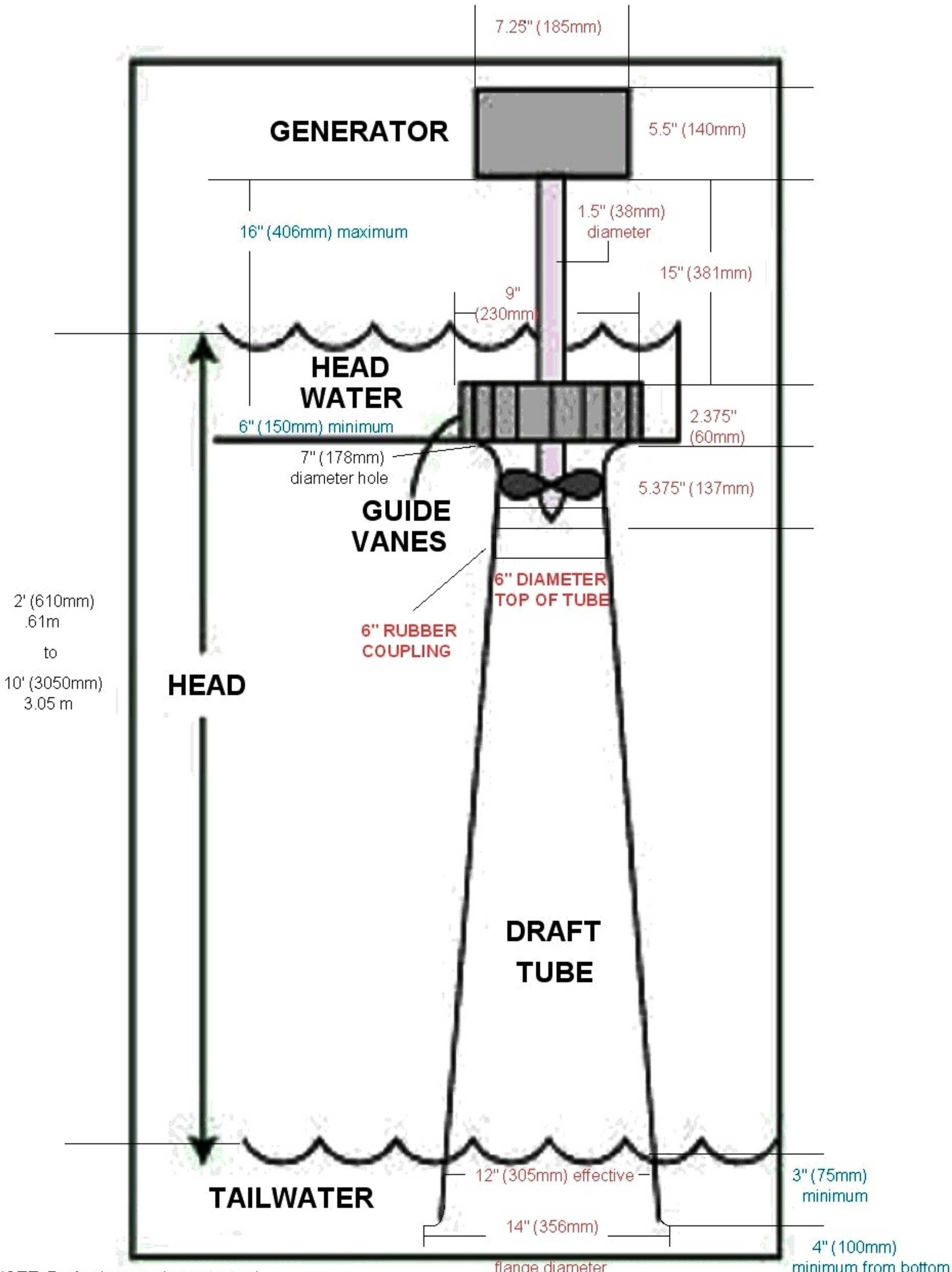
Series

Series Wiring

For series wiring the machine, look at the shot of the shot that shows this. You will see that for this scheme, you will connect wires to all four of the screw terminals in each of the three sections. These screws are separated by the three flat head screws that are used to mount the terminal blocks. The first and last screws are also connected to the lead wires so these must also be connected when changing the wiring. The first screw will have only the white wires connected to them, along with the lead wire end. The next screw will have both the black and blue wires connected. The next screw will have the red and yellow wires connected. The last screw will have the green wire and the lead wire connected. This is done at all three of the sections to complete the wiring.

LH1000 INSTALLATION





NOTE: Draft tube must be supported on base from above or below

LH1000 INSTALLATION

Personal Hydropower

Product Information

Model # ______________________ Serial # _____________________
Date Purchased ____
Purchased From ____
Name: ____
Address: ____
City: ____
State/Prov: __________________ Zip/Postal Code: _______________
Telephone: ____
Email: ____
Comments: ____
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