Revised January 2009
EcoInnovation Pelton Turbine Installation Manual

Please read this manual carefully before beginning installation

Typical turbine install pictures

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Introduction

Your Pelton turbine will only perform optimally if correctly set up at your site. Please fully read this manual prior to installing this turbine.

Tests to date on installed turbines have indicated that our Pelton turbines can achieve efficiency as high as 60%. Our Turgo turbine has been replaced by using 2 or more of our Pelton turbines on lower head sites. It is not uncommon to have 5-6 turbines installed on some sites delivering 1- 5kW.

Low head install – 2 or more turbines

EcoInnovation would like you to measure the flow rate of water through the turbine, the supply pressure and output power so that we can determine conversion efficiency at your site. This helps us refine our calculations for future clients. As every site is different efficiency will vary from site to site.

Installation

It should take no more that one day for two people to install a Pelton turbine (depending upon site terrain and assuming client has installed pipeline correctly).

Many home owners attempting to install a renewable energy system themselves for the first time can and often do make some fairly serious connection errors.

EcoInnovation runs courses to assist with the connection of this equipment. **If you hook up this equipment incorrectly and in doing so damage other equipment in your system EcoInnovation will not be liable.**
If you are not happy with this condition then please either engage EcoInnovation to install the equipment or return the goods for a partial refund.

Common mistakes include

- Connecting a hydro turbine to a solar regulator not designed for a hydro turbine
- Connecting the hydro turbine polarity in reverse (this normally destroys the rectifier)
- Connecting the hydro turbine to the inverter lead and then removing the battery and regulator fuses, this results in a high voltage input to the inverter and will damage it
- Working on the battery bank with the hydro in operation – **never do this**
- Using a poor quality second hand battery bank with dirty/corroded terminals that results in the battery not being connected in the system. This is fatal to inverters as the battery is your primary voltage regulation and must remain connected to the turbine at all times when the turbine is running
- Forgetting to tighten the battery terminal bolts resulting in the battery bank being disconnected from the systems, result as above
- Working on the system and removing wires while the hydro turbine is in operation **(never do this)**
- Not checking that the regulator is working correctly prior to leaving the site
- Installing a regulator that is too small or one that does not work and not knowing how to determine if the regulator is working

Over the years we have had 3 occasions where clients have killed inverters by either having bad battery terminals or the battery fuses incorrectly positioned resulting in the hydro turbine becoming connected to the inverter, this results in the hydro turbine going high voltage (normally about 3-4 times nominal running voltage) into the inverter which normally destroys it.

What controls the voltage in my battery inverter system

Primarily your battery bank and its state of charge controls battery voltage. You should always connect a hydro turbine directly to your battery bank. The battery bank will clamp the output voltage of the hydro turbine to be the same as the battery bank. As the battery bank charges, the voltage of the battery bank will gradually lift until it reaches fully charged. Your regulator will now start to divert surplus energy not required to a resistive element.

Solar PV regulators work by switching the PV panels on and off to control the amount of incoming energy. If this was done with a hydro turbine the voltage from the turbine would increase rapidly as the load was removed from the generator combined with rapid acceleration of the unloaded generator. This high voltage output would destroy most solar PV regulators, so do not do it.

Generally speaking you are allowed, under electrical regulations, to work on systems up to 50 volts ac and 120 volts dc in New Zealand without qualifications.

Outside NZ you need to check your rules to see what you can legally do yourself

You should always exercise care when working with batteries. Burns, acid splashes and electric shocks can occur. If you do not have sufficient skill and/or experience to install this equipment then engage an RE professional to do it for you.

If you disconnect a hydro turbine from the battery the voltage will no longer be clamped by the batteries and can increase up to 3-4 times higher than normal. This is potentially very dangerous. Never disconnect a hydro turbine from the battery bank while it is going.

Voltage regulator failure

Systems that generate high continuous output power (micro hydro) often have small battery banks, these systems depend heavily on the diversion load to control state of charge. EcoInnovation recommends that a 2nd voltage regulator be installed in such cases. Eventually the voltage regulator will fail and in such cases the battery voltage will rapidly climb and this can result in inverter failure (internal capacitors can explode causing a fire hazard) and batteries can be wrecked. Two voltage regulators with one set high and the other set normally would prevent this failure. On wind and PV systems that typically have a large battery bank and less generating ability then one regulator is acceptable provided that the user regularly checks that it is working correctly. A 2nd regulator is good piece of mind and ensures you can sleep well when away on holiday.

A note on battery bank sizing

Generally we refer to the 10:10:10 rule of thumb. This is if you want a 10 year life from a deep cycle lead acid battery bank then you should limit the discharge cycle to be 10% of the fully charged capacity: the maximum sustained charge rate to 10% of the amp hour capacity: the maximum sustained discharge rate to 10% of the amp hour capacity.

For example a hydro turbine generating 500W into with a 48 vdc battery bank consisting of 2 banks at 200 amp hours each can have a maximum sustained draw of 10% x 200 x 2 x 48 + 500 =
2420W for a time not exceeding 1 hour. The charge rate is 500/48 = 10 amps approx, maximum allowable = 40 amps.

Average daily draw from the battery bank allowing for 10% battery loss and 10% inverter loss is 400W = 9.6 kWhrs/day total consumption. This is normally fine for

an energy efficient home using a 3kW inverter. If you wish to draw more than 2.4kW for a sustained period you should install a larger battery bank and inverter. In practice battery life is typically around 5-7 years, accidents happen and batteries are occasionally flattened, this can have a significant impact on their total life.

Although there are many instruments to help determine battery state of charge the most reliable method is a hydrometer. Check your batteries state of charge weekly and keep a log book. Either increase generation or decrease consumption if your state of charge is falling. You need to generate 20% more than you use.

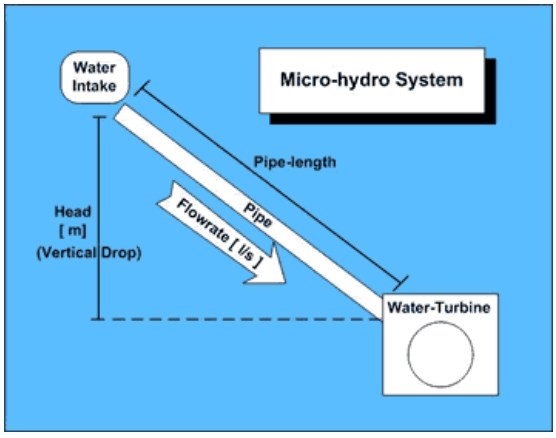
Two parallel battery banks are better than one, if you do get a loose connection or forget to turn off the hydro turbine when working on your system you may get away with it. Generally it is regarded a good practice not to have more that 3 parallel banks.

Grid tied applications

EcoInnovation has a grid tied batteryless option available for clients that are already connected to the grid and have a good water resource close by.

Your supply pipe line

EcoInnovation will have sized the appropriate pipe for you and advised. Make sure you obtain the greatest fall possible in the shortest possible distance. Try to lay the pipe to ensure that you cannot trap air bubbles, avoid high spots in the line. If this is unavoidable you may need to place a bleed valve at the high point in the line to purge air. Air locks in the line will significantly affect the power output of the turbine. The longer your line the more of a problem this tends to be. Lines over 1 km long can be problematic if there are many high spots in the line.



When laying the pipe try to do the following:

- Install a good strong intake structure
- Secure the pipe against flash floods
- Obtain a good fall in the first 5-10 meters of pipe
- Keep the pipe on a gradual always descending line where possible
- Keep the number of high points to a minimum and vent these high points for air locks
- Avoid siphon systems if possible

When starting the pipe

- Fit jet to the pipe and turn on valve
- Allow pipe to run and purge of air bubbles (on long small pipes this can take a few hours)
- Check intake still has surplus overflow water, fit smaller jet if all water is being used as you will be drawing air into the pipe
- Check you are not drawing air into the pipe at the intake
- Walk the pipe and lift sections to locate any air locks and fit riser vents as required

Each jet of the turbine needs to be connected to your supply line. Make sure the pipe is secured firmly prior to the turbine, this reduces the stress that the pipe would otherwise impart into the hydro casing, distorting it. EcoInnovation will have indicated the diameter of these pipes at the assessment stage.

Ensure that the supply pipe does not stress the connection between the jet/valve and the turbine casing. **Support the pipe as necessary and strap securely.** You can do this by installing a wooden post either side of the pipe with a horizontal member above and below the pipe to secure it once you have the correct pipe position.

The jet size should be cut to the size indicated in the calculations supplied during the assessment stage. As a check it is recommended that the jet be removed from the turbine housing and the flow rate of water through the jet measured by noting the time to fill a container of known volume. Ensure you flush the line of all air first.

Siting your turbine

Your turbine should be positioned about 50-100mm above ground height to allow exhaust water to escape. Keep it as low as possible while ensuring that is it still above flood water level. Ensure that the exhaust water can return to the river without scouring the bank. Line bank with concrete or plastic sheet as required.

Intake

Your intake for a Pelton turbine should be positioned at the base of a small set of rapids to allow room for a sloping intake screen. Some typical examples follow.

Angled screen

Flat screen in road culvert

Stainless steel perforated tube

Perforated galvanized cable tray intake

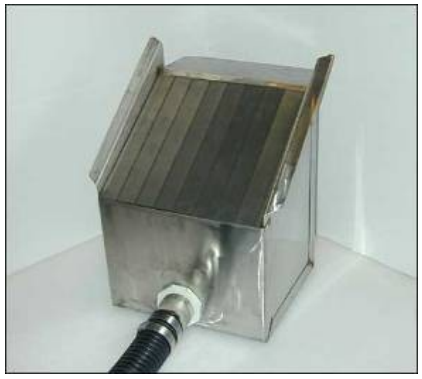
Angled guides and screen

perforated box in concrete

Intakes often need to be made to suit each site. The 6 pictures above illustrate different ways to do the same job.

Intake screen

Intake screens such as these can be purchased, however, they are easy enough to make to suit your site. Water flows over the top of the screen falling into the chamber below that feeds the supply line. Leaves and twigs are washed away preventing the intake from blocking. You can use a stainless steel mesh and plywood box, make sure you support the screen from behind with stainless steel rods otherwise during floods the mesh will be pushed in.
Ensure you securely attach this screen to the riverbed by driving galvanized stakes into the ground or attaching to large boulders with brackets and cement.



Some ideas for intakes

Distance to batteries

The distance your turbine is away from your batteries has a significant bearing upon the wire size that is required. To keep wire sizes down EcoInnovation recommends that in most cases 48 V systems should be installed.
Multiplying the current by the cable length in meters and dividing this answer by 100 determines approximate cable size for long runs. For example 10 amps over a 50m cable length you would require 10*50/100 = 5 mm^2. **This is a rule of thumb method;** there are many tools on the web that will determine the %

power lost in the cable for you. Try and keep losses under 5%. On occasions we run cables with losses up to 20%, but only in situations where the cable cost is very significant in the total equipment cost. EcoInnovation can assist you with advice on cable sizing for your project.

For long run hydro cables an option is aluminum cable running at 100-120 vdc into a FlexMax MPPT OutBack regulator that will deliver 12/24/48 vdc to your battery bank. This option needs over-voltage protection for the FlexMax but can be a very good solution.

EcoInnovation holds considerable stocks of cable at very good prices for our NZ customers.

EcoInnovation can supply a higher voltage version with step down transformers for sites where the distance involved is considerable. Losses in the cable and transformer will consume about 10-15% of the total power generated. However the cable cost is much lower.

Rectifier

The rectifier is mounted on the back of the turbine, this way the rectifier is water-cooled. You can rectify your turbine at the other end of the cable if you so desire, in such cases the rectifier will have been supplied loose. The rectifier must be bolted to a suitable heat sink. The polarity for the wires is stamped into the rectifier housing + for positive – for negative.

Battery charge control and over voltage protection

Charge control is provided using any good quality charge controller such as a Xantrex C40 or Morningstar TS45, such a controller will ensure that the batteries are charged correctly and divert surplus power to a resistive element such as a water heater element (special element required).

Never hook a hydro turbine to a regulator designed for Solar PV panels only. Some regulators can work as either a Solar PV charge controller or as a diversion load controller. You must fit a diversion control regulator of a suitable size to handle the maximum Wattage your turbine can generate.

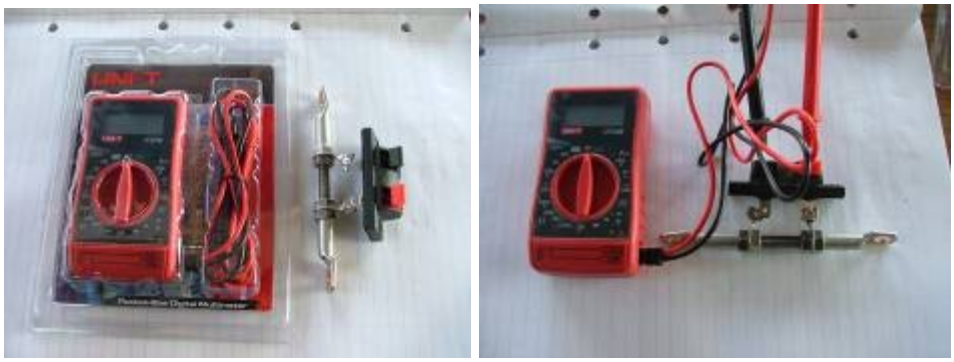
We strongly recommend you order our standard cabinet and meter with pre-wired regulator and diversion load to go with your hydro turbine.

Standard cabinet and regulator

Uni-T Meter to measure current

The meter supplied has been calibrated to read amps when set on the 200 mV dc scale. A shunt is supplied that has been calibrated for this meter. Any other make of meter will not read correctly. The shunt can be placed on either the positive or negative wire. If you connect it at the turbine end you will be able to see how much current you are generating and be able to quickly optimize the output using the washers supplied. Remember current x volts = the power you are generating. Measure the voltage at the turbine end and at the battery end. Note that you can only have a voltage drop in a cable, you cannot have a current drop - this remains the same. The power lost will therefore be in proportion to the DC voltage drop in the wire from the turbine end to the battery end.
The voltage drop in the cable should not be more that 5-10% of the battery voltage, if it is then you need to upgrade the cable size. We strongly recommend

you buy a good DC clamp meter, **this meter is only to get you started and not covered by any warranty**.



Uni-T multi-meter and shunt

Jet size optimization

Limited water supply

If you only have a small amount of water at the intake cut the jet size to use a little less than the water available. This will ensure you do not draw air down the line, which will cause the turbine to have a reduced output.

The table below is only an indication. You can calibrate jet size to flow rate by noting the jet size, pressure on gauge and time to fill a 100-litre drum.
Make the jet larger until you use the available water.

Plenty of water

If you have plenty of water and want to generate the most amount of power that your pipe line can deliver (before pipe friction chokes the output power) you should set the jet size so that the pressure on the gauge drops to 2/3 of the static pressure.

Cut jet and test flow rate with jet removed from turbine

Jet sizing

The jet-sizing table presented here allows you to quickly determine the approximate jet size required for your head and available flow rate. EcoInnovation supply a plastic tapering jet that can be cut on site with a sharp knife. The jets are inexpensive so a trial and error approach can quickly determine the correct jet size. During periods of higher than normal flow the jet size can be increased to result in a 1/3 pressure drop to yield the maximum power transfer of your pipeline.

Jet sizing table – flows in L/s

Head	Jets Sizing (mm)																			
m	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5	5.2	5.4	5.6	5.8	6	7	8	9	10
5	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.18	0.19	0.21	0.23	0.24	0.26	0.28	0.38	0.50	0.63	0.78
10	0.10	0.11	0.13	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.28	0.30	0.32	0.35	0.37	0.40	0.54	0.70	0.89	1.10
15	0.12	0.14	0.16	0.17	0.19	0.22	0.24	0.26	0.29	0.31	0.34	0.36	0.39	0.42	0.45	0.49	0.66	0.86	1.09	1.35
20	0.14	0.16	0.18	0.20	0.22	0.25	0.27	0.30	0.33	0.36	0.39	0.42	0.45	0.49	0.52	0.56	0.76	1.00	1.26	1.56
25	0.16	0.18	0.20	0.23	0.25	0.28	0.31	0.34	0.37	0.40	0.43	0.47	0.51	0.55	0.59	0.63	0.85	1.11	1.41	1.74
30	0.17	0.20	0.22	0.25	0.28	0.30	0.34	0.37	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.69	0.93	1.22	1.54	1.91
35	0.19	0.21	0.24	0.27	0.30	0.33	0.36	0.40	0.44	0.47	0.51	0.56	0.60	0.65	0.69	0.74	1.01	1.32	1.67	2.06
40	0.20	0.23	0.25	0.29	0.32	0.35	0.39	0.43	0.47	0.51	0.55	0.60	0.64	0.69	0.74	0.79	1.08	1.41	1.78	2.20
45	0.21	0.24	0.27	0.30	0.34	0.37	0.41	0.45	0.49	0.54	0.58	0.63	0.68	0.73	0.79	0.84	1.14	1.49	1.89	2.33
50	0.22	0.25	0.28	0.32	0.36	0.39	0.43	0.48	0.52	0.57	0.62	0.67	0.72	0.77	0.83	0.89	1.21	1.57	1.99	2.46
55	0.23	0.26	0.30	0.33	0.37	0.41	0.46	0.50	0.55	0.59	0.65	0.70	0.75	0.81	0.87	0.93	1.26	1.65	2.09	2.58
60	0.24	0.28	0.31	0.35	0.39	0.43	0.48	0.52	0.57	0.62	0.67	0.73	0.79	0.85	0.91	0.97	1.32	1.72	2.18	2.70
65	0.25	0.29	0.32	0.36	0.41	0.45	0.49	0.54	0.59	0.65	0.70	0.76	0.82	0.88	0.94	1.01	1.37	1.80	2.27	2.81
70	0.26	0.30	0.34	0.38	0.42	0.47	0.51	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.98	1.05	1.43	1.86	2.36	2.91
75	0.27	0.31	0.35	0.39	0.44	0.48	0.53	0.58	0.64	0.69	0.75	0.81	0.88	0.94	1.01	1.08	1.48	1.93	2.44	3.01
80	0.28	0.32	0.36	0.40	0.45	0.50	0.55	0.60	0.66	0.72	0.78	0.84	0.91	0.98	1.05	1.12	1.52	1.99	2.52	3.11
85	0.29	0.33	0.37	0.42	0.46	0.51	0.57	0.62	0.68	0.74	0.80	0.87	0.94	1.01	1.08	1.15	1.57	2.05	2.60	3.21
90	0.30	0.34	0.38	0.43	0.48	0.53	0.58	0.64	0.70	0.76	0.83	0.89	0.96	1.04	1.11	1.19	1.62	2.11	2.67	3.30
95	0.31	0.35	0.39	0.44	0.49	0.54	0.60	0.66	0.72	0.78	0.85	0.92	0.99	1.06	1.14	1.22	1.66	2.17	2.75	3.39
100	0.31	0.36	0.40	0.45	0.50	0.56	0.61	0.67	0.74	0.80	0.87	0.94	1.01	1.09	1.17	1.25	1.70	2.23	2.82	3.48

Head											
m	12	14	16	18	20	22	24	26	28	30	32
5	1.12	1.52	1.99	2.52	3.11	3.77	4.48	5.26	6.10	7.00	7.97
10	1.58	2.16	2.82	3.56	4.40	5.33	6.34	7.44	8.63	9.90	11.27
15	1.94	2.64	3.45	4.37	5.39	6.52	7.76	9.11	10.56	12.13	13.80
20	2.24	3.05	3.98	5.04	6.22	7.53	8.96	10.52	12.20	14.00	15.93
25	2.51	3.41	4.45	5.64	6.96	8.42	10.02	11.76	13.64	15.66	17.81
30	2.74	3.74	4.88	6.17	7.62	9.22	10.98	12.88	14.94	17.15	19.51
35	2.96	4.03	5.27	6.67	8.23	9.96	11.86	13.91	16.14	18.53	21.08
40	3.17	4.31	5.63	7.13	8.80	10.65	12.68	14.88	17.25	19.80	22.53
45	3.36	4.57	5.98	7.56	9.34	11.30	13.44	15.78	18.30	21.01	23.90
50	3.54	4.82	6.30	7.97	9.84	11.91	14.17	16.63	19.29	22.14	25.19
55	3.72	5.06	6.61	8.36	10.32	12.49	14.86	17.44	20.23	23.22	26.42
60	3.88	5.28	6.90	8.73	10.78	13.04	15.52	18.22	21.13	24.26	27.60
65	4.04	5.50	7.18	9.09	11.22	13.58	16.16	18.96	21.99	25.25	28.72
70	4.19	5.71	7.45	9.43	11.64	14.09	16.77	19.68	22.82	26.20	29.81
75	4.34	5.91	7.71	9.76	12.05	14.58	17.36	20.37	23.62	27.12	30.86
80	4.48	6.10	7.97	10.08	12.45	15.06	17.93	21.04	24.40	28.01	31.87
85	4.62	6.29	8.21	10.39	12.83	15.53	18.48	21.68	25.15	28.87	32.85
90	4.75	6.47	8.45	10.69	13.20	15.98	19.01	22.31	25.88	29.71	33.80
95	4.88	6.65	8.68	10.99	13.56	16.41	19.53	22.92	26.59	30.52	34.73
100	5.01	6.82	8.91	11.27	13.92	16.84	20.04	23.52	27.28	31.31	35.63

Turbine setup and optimization

Once plumbed in the jet should be turned on and the output of the turbine optimized. **Optimization is done by noting the output current on the meter and then gradually packing out the magnetic rotor until the point of maximum power is achieved. Once this point has been found the rotor should be packed with the washers provided and tightened securely.**

If you are using our FlexMax 60/80 option then this controller will automatically adjust the speed of the turbine and optimize it for you, no packing required.

Making small changes will alter the current; try to get the largest reading possible. Adjust the following:

- Ensure that the water jet is hitting the centre of the Pelton rotor. The Pelton rotor can be packed with washers to align if necessary.

- Apply downward, upwards and sideways pressure to the jet to alter the angle slightly, see what effect this has on output. The jet position can be moved slightly within the casing. Once optimized, secure and support the pipe. The jet retaining cap should only be hand tight, ensure the thread is well greased so it will come apart in the future.

- Pack out the magnetic rotor with washers to see if increasing the rotor speed increases output current. **This is very important and will make a significant difference to power generation.**

- A useful tip is that when the turbine is running at the correct rpm the exhaust water will hit the clear front at 90 degrees to the jet. If the exhaust water bounces back towards the jet the turbine is running too slow and you should pack it more. If the exhaust water travels through and hits the opposite side of the casing to the jet then the turbine is running too fast, reduce the packing.

Running slow – water exhausting towards jet

Running at correct speed

Running too fast, exhaust water hits other side of casing

Once you have optimized the output for one jet then the other jets can be opened (if installed). Optimization will have to be carried out again. Note the number of washers required when running on 1 or 2 jets and change packers when closing valves as your river flow changes with the seasons.

You may be able to further increase the power output from your turbine using larger jet sizes. This has the effect of increasing the flow rate. There comes a point when the increase in flow rate causes a dramatic drop off in pressure due to increased pipe friction losses. This occurs when the pressure in the pipe (just prior to the jet) drops to 2/3 of the static pressure (pressure when valve closed). When this point is reached increasing the jet size further will reduce the power output. The jet sizes supplied will have been calculated based on the head, pipe size and flow indicated. Some fine-tuning on site will be required.

When operating at 2/3 of static pressure you will notice that more Smart Drive rotor packing does not make a significant difference when close to the maximum power point. This is because you are on the top of the performance curve, so slight changes in RPM of the rotor will not make a dramatic difference in output power.

You will also notice that when you are operating at close to the static pressure of the line, that packing of the Smart Drive rotor will make a very significant difference as the speed is increased to coincide with optimum Pelton rotor rpm.

Protection from the elements – UV and rain

The generator rotor is made from plastic, which will weaken if left out in the elements. The turbine must be protected from direct **sunlight, rain and water spray.** Some clients have modified large plastic drums to fit over the turbine. This also helps to reduce noise, our turbines run remarkable quiet and this in not normally a problem unless you have neighbours very close to your turbine site.

If you observe water spraying onto the bottom of the Smart Drive than attach a piece of plywood between the turbine legs to deflect this spray. A picture of a good tidy install is shown below. The install below could be improved by extending the timber decking so that it protects the generator from exhaust water splash.

Different streams into one turbine

We are often asked if 2 small streams can be piped into a common 2 jet turbine. Generally the answer is no unless the head and pipe friction losses for each pipe are very similar. Generally we would advise 2 turbines, one for each site, the electrical output of each are then joined together into a common supply cable. The picture above illustrates such a set up.

Shaft and bearings

It is very important that the stainless steel shaft is loctited (glued using a metal compound) onto the bearings. This prevents the bearings from spinning on the shaft. If your turbine arrived assembled we will have done this for you. Also if you are a customer outside NZ and you have purchased a complete turbine sent in a packed condition then it will be glued in for you.

If you purchased a turbine in kit form you will have to do this. Likewise if you purchased the shaft/bearing block as a spare part you will need to do this. Failure to loctite the shaft in the bearings will result in shaft wear that will lead to misalignment of the generator stator and rotor, which will cause damage. This is not covered under warranty, if you forget to loctite the shaft.

You will need to check the bearings every year, and replace if required (note our warranty terms require annual replacement), they are inexpensive and easy to replace. We recommend you hold a spare bearing block and shaft on the shelf to make this procedure very easy and quick to do. A spare set of bearing is

supplied with each new turbine. Our Pelton turbines have been running on the same bearings for up to 3 years on our test site. To increase bearing life you can squirt 10ml of oil into the cavity between the bearing every few months, note a small hole is provided for this in the bearing block. This oil will work into the bearings and assist in keeping them well lubricated, helpful if your turbine is working above 500W and essential if running about 750W.

EcoInnovation also has available an extra heavy duty bearing block for those interested in an upgrade. If you have any questions regarding the operation/ performance of your unit then contact EcoInnovation by email via our web site below.

For turbines running at high pressures and output powers, EcoInnovation can also install a seal in addition to the slinger for extra protection from water ingress.

Max RPM

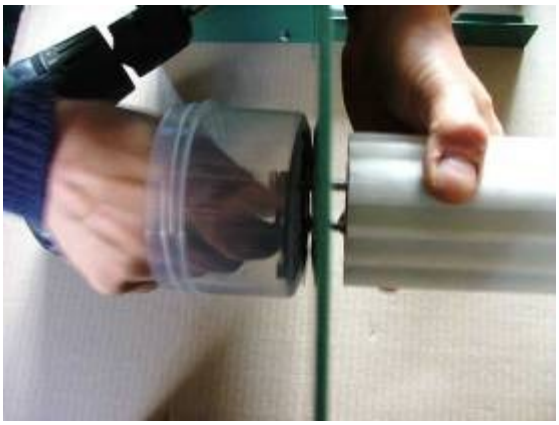
Turbines running above 1000 rpm should have balanced Smart Drive rotors and Pelton rotors installed to prevent vibration of the turbine. EcoInnovation do this on all turbines we supply. DIY'ers supplying their own generators please take note that you will need to balance the Smart Drive rotor.

Turbines running above 1500 rpm should have a cover over the turbine in the event of Smart Dive rotor failure. This is a safety precaution.

Assembly instructions for packaged turbines and kitset turbines

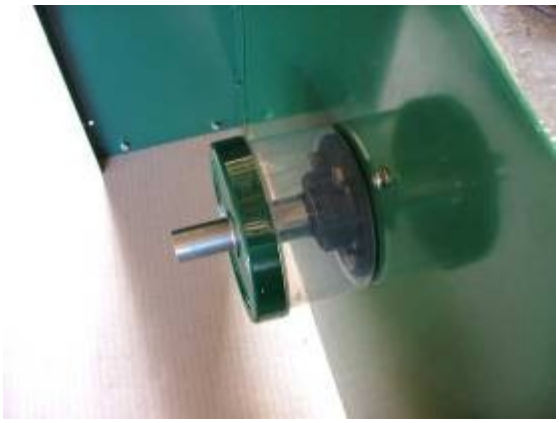

- Packed Pelton as it arrived for overseas customers.


- Unpack and unwrap parts, inform EcoInnovation of any transit damage immediately.

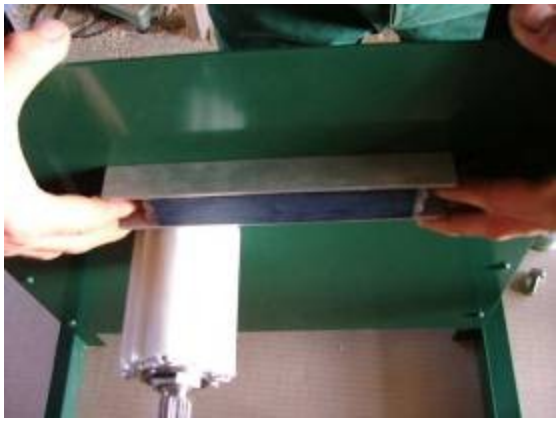



- Assemble legs first, two fixing per leg.
- Install slinger cover (rubber seal, plastic housing, washer, fixings) into bearing holder as shown (hole in slinger should point down).


- Note the small hole in the plastic housing should be downwards.
- Insert shaft (remember to loctite it into both bearings – clean all parts first).

- Tighten nut finger tight only.
- Screw plastic lid into place.

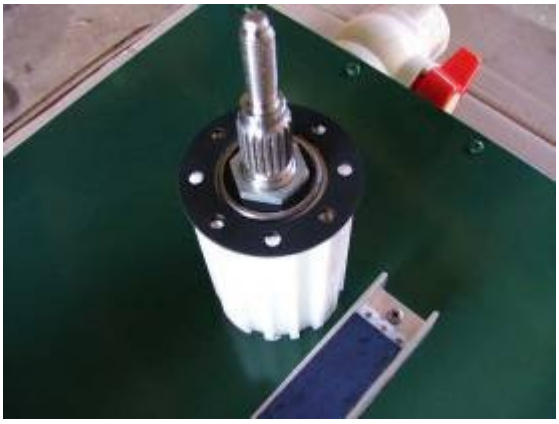



- Bolt rectifier into position, holes provided. You can position the rectifier at the battery end if required. Note the rectifier used might look different to the one in the picture.
- Place washer onto shoulder of shaft, this is to space Pelton runner. You may need to adjust this later to ensure the runner lines up with the center of the jet.

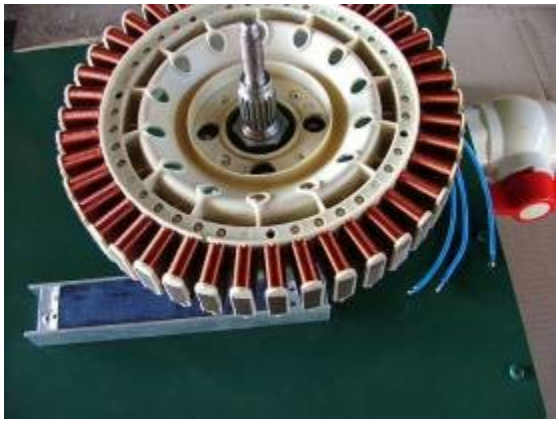

- Position runner and remaining washers.

- Position steel cap. (note this detail may vary from the picture)


- Position washer and fixing and tighten securely.
- Install jet and valve.

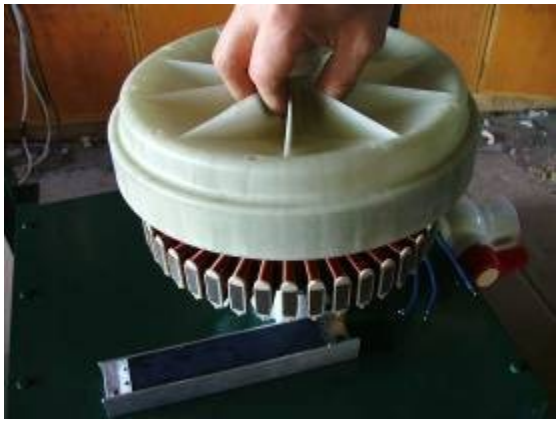
- Install casing front brace (also retains plastic glazing).
- Position washer ready to fix Smart Drive stator in place.



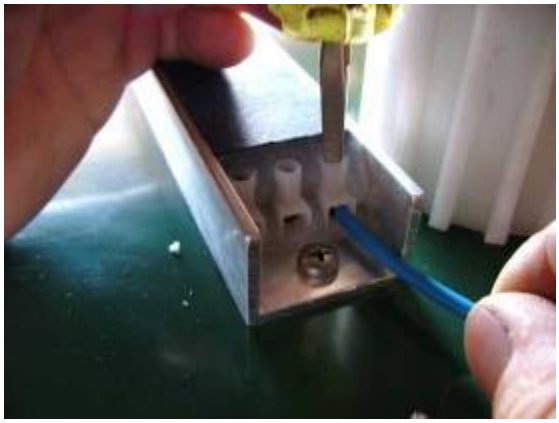
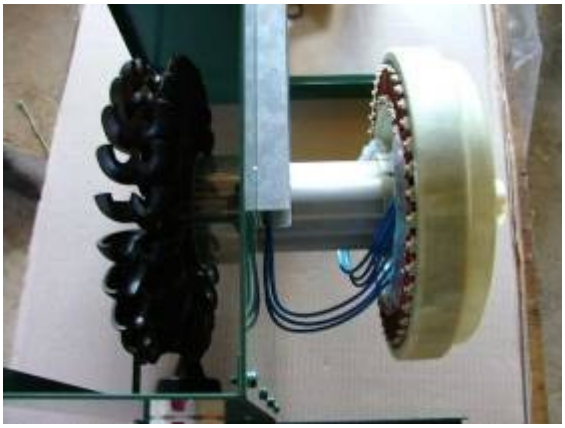

- Position Stator.
- Position second washer.


- Insert fixings and tighten.
- Insert packing washer (only if required, determined during on site set up).
- The spare 2nd nut should be inserted first, then washers sit on the nut squarely if needed for rotor packing.


- Insert plastic extractor nut into Smart Drive rotor.



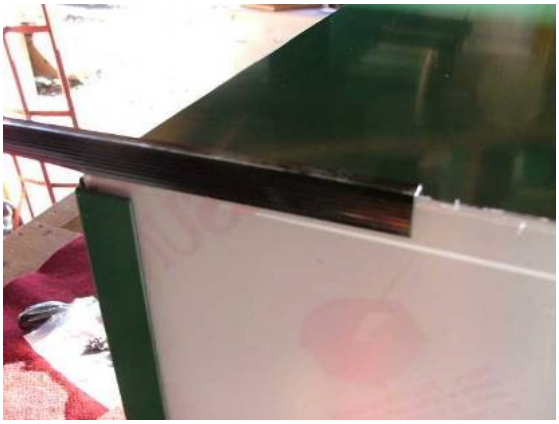

- Position rotor onto shaft, it should sit down onto the splined shaft.
- Tighten plastic nut.

- Connect the wires to rectifier. Order not important. Some units are supplied with six wires for star or delta connection.


- Position lid and fix into place with the 4 fixings supplied.


- Top sealing strip should be fixed into position and sealed with silicon
- Insert glazing
- Glazing is retained with plastic strip as shown below

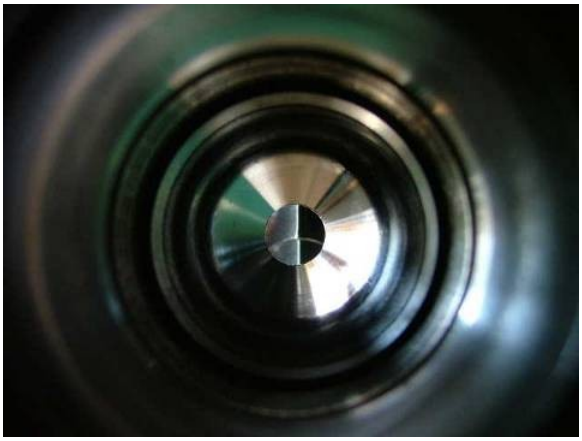



Silicon inside edges of turbine casing to prevent leaking. The aluminum angle supplied is to seal (from the outside) between the lid and the backing to stop water ingress. Apply a bead of sealer and pot rivet into place. It prevents water running down the back of the turbine that can cause corrosion damage to the rectifier. When running ensure water does not leak from this joint onto the rectifier. Let all the silicon dry, then you are ready to generate at your site.

Using the meter

To use the shunt and meter, connect the shunt in the positive cable and insert the wires from the meter. Turn the meter to 200m Vdc. Meter will read current flow in amps. If there is a negative sign turn the shunt around. Meter battery will flatten after a few hours and result is an incorrect reading, turn off when not needed. We strongly advise you buy a good quality DC clamp meter as this will be very useful in a Renewable Energy system. This meter included is just to get you started.

Aligning the jet



View looking through jet onto Pelton runner knife-edge. The water jet needs to hit the middle of the Pelton runner knife-edge. If it is off to one side then pack the rotor across using the washers supplied. You can see in this picture that the Pelton rotor needs packing the left. If the jet is too low and some of the water is missing the runner then lift the jet up slightly or push up/down on the pipe until you generate maximum amps and then secure pipe in position.

OUR MONEY-BACK GUARANTEE AND LIABILITY / WARRANTY TERMS

(complete water turbines only – excludes kit sets and trade customers. Refer to warranty upgrades and support options as detailed on our web site)

Innovative
Cost effective
Reliable

EcoInnovation is confident in the performance, reliability and cost effectiveness of our range of water turbines that we offer you the purchaser:

- Full refund if not satisfied after running at your site for a 30-day period (this must occur within 3 months of dispatch from EcoInnovation for clients

outside NZ). Client to pay return freight cost, turbine must be returned in as new condition for a full refund. Excludes trade customers.

- Performance guaranteed if our installation advice is followed (applies to turbines that have output power greater than 200 W). For turbines less than 200 Watts a 25% margin should be allowed for.

- 1-year return to base warranty (upgradeable to 2,3,4,5,6,7,8,9,10 years), subject to completion of registration form; this includes installation pictures and performance running data within 1 month of install. This warranty is valid provided it has been installed by an EcoInnovation installer or by an installer with relevant experience in micro hydro systems. Note that in NZ SEANZ members have to offer a 2-year installation warranty. Check with your installer if this is a site warranty or return to base warranty, remote sites are often excluded from onsite warrantys due to high travel costs.

- 2-year warranty provided it is installed by a SEANZ member and registration form is fully completed (subject to maintenance procedure and above conditions). If there is a problem we will fix it by sending out a replacement part to you within 14 days (anywhere in the world, you will need to email a picture of the failed part). 2 jets must be fitted for turbines with an output greater than 400 Watts.

- If you can find a similar quality product at a more competitive price we will beat it by 20%, prior to purchase.

- Extended warranty available up to 10 years, refer to web site to purchase extended warranty.

- The cost of **any single replacement part** (outside the 1-2 year warranty period) for the original purchaser of our turbine will never be more than $200 NZ plus freight (5-year limit from purchase date).

- warranty only valid for 12 months from date of purchase unless warranty registration form is fully completed and returned to EcoInnovation within 40 days of installing turbine.

- Our maximum liability is limited to the full amount paid for the turbine. If you are an oversees customer that has purchased this equipment mail order over the internet then this is the maximum extent of our liability.

- Customers that harm or kill themselves or others during the installation and operation of this equipment take all such risk themselves. Have it

installed by a professional RE installer if you do not have the skill, qualifications and experience to install this equipment safely.

The quality of our products speak for themselves:

- Stainless steel 25mm shaft
- Stainless steel and hot dipped galvanized fixings
- Durable adjustable jets and Pelton rotors made from hard wearing plastic
- Spare set of bearings and 5 spare jets with your purchase
- Aluminum bearing holder and casing
- Green powder coating on casing
- State of the art permanent magnet brushless generator
- Designed by a qualified mechanical design engineer with 15 years experience in the design of micro-hydro systems
- Conversion efficiencies up to 60%
- 24 hour product support via email. All NZ customers are entitled to 1 free hour product support, after that additional support can be purchased from our web site

Our products are innovative and cost effective. The reason for this is that we use mass-produced permanent magnet motors for generators. These generators are very efficient, they have to be as they are made from plastic and cannot tolerate heat. The Smart Drive motor can deliver over 1.5 kW of continuous power in some cases, but we rarely run them above 1000 Watts in most applications.

EcoInnovation has a good working relationship with Fisher and Paykel (a large white-ware manufacturer in New Zealand) this has allowed us to use a mass produced motor as a generator. You benefit from the savings that mass production allows. These motors are state of the art technology, the Fisher & Paykel washing machine is currently one of the most energy efficient top loaders in the USA market. Why? Because the motor is very efficient. It is similarly efficient as a generator. Some parts are common with Whirlpool and Maytag washing machines which are available globally.

EcoInnovation has developed a technique of reconnecting these motors so that they can be used in 12/24/48/120/300-500 Volt applications. In fact, we can modify them to just about any voltage required.

EcoInnovation hold good stocks of generators. So if you ever have a problem parts will be air freighted (in most cases) within days.

If you are not completely satisfied with the performance of our products we will refund all your money in the time frame stated above. You will only have to return the product to us at your expense in a timely fashion in as new condition.

EcoInnovation reserves the right to improve the product and alter the above specifications without notice. Please visit our web site regularly to make sure you have the most up to date version of the manual. To save on paper and airfreight weight/cost this manual is only supplied electronically to customers. We welcome your feedback on how be can improve this manual.

EcoInnovation warranty Registration Form Hydro Turbine

Your data

Your name

Your address

Your purchase invoice number

Did you purchase extended warranty and/or extra support?

Purchase invoice date

Name of installer

Address and telephone number of installer

Has installer offered an on-site 2-year service warranty?

Is the Installer a SEANZ member?

Date installed

Location of installation

Pipe inside diameter mm

Pipe length m

Static pressure on gauge kPa

Dynamic pressure on gauge when turbine is running kPa

Jet size mm

System nominal voltage

Cable length m

Cable wire size mm^2/conductor

Generator name (for example 100-14S-1P delta)
100/80/60/60dc - ____S-____P delta/star

Performance data

Voltage on dc rectifier pins at hydro

Voltage at battery terminals

Current generated amps

Attach pictures of install

Flow rate of water through turbine (if measured)

Note – All warranties longer than 12 months are void if this form is not completed and returned within 40 days of installing the turbine.