

Installation Instruction

Caution

Iron wire is **prohibited** to be used as conductive wire for this series of turbine generator units. **Only** aluminum wire or copper wire can be suitable. If the cable range is longer than 300 meters, the conductive wire should be appropriately enlarged according to the rated power of the unit, otherwise the generated power will be seriously affect.

Classification and Name

A micro hydro turbine generator unit consists of a generator and a turbine. The series of micro hydro turbine generator units are classified according to the power range of the generator or the structure of turbine.

For example:

Series of 600W kaplan turbine

Series of 1KW turgo turbine

Series of 1KW generator (not including turbine)

Classification according to turbine structure:

kaplan turbine (axial flow hydro generator unit), turgo turbine (inclined-jet hydro turbine generator unit), and Banki turbine (Cross-flow) hydro turbine generator unit, etc.

Classification according to the power range of generator:

600W, 1KW and 2KW-100KW, etc.

Measurement Methods for Water Head and Water Flow

Measurement for water head (head of water)

The head of water (water head) is the vertical distance from the upstream water level to the downstream water level, or the distance the water has to fall, as shown in Figure 1.

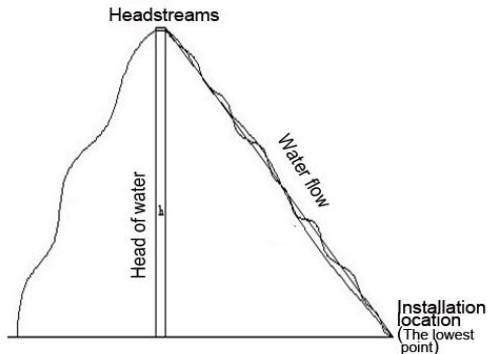


Figure 1

Measurement for Water Flow

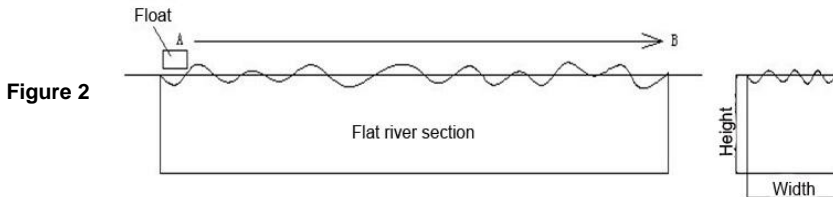
The water flow is the weight of water which flows through the cross-sectional area of the river per second.

The measurement formula is as below:

A flow rate = 1 cubic meter = 1 ton = 1000liters (water)

Measuring methods

1. The best way is to use professional measuring instruments such as water meter, triangle flow measurement weir, etc.).
2. Make the measurement on a flat section of the river. Details can be seen in Figure 2.



Mark a point in the upstream with “A”, and a “B” in a point of downstream, prepare a float(such as leaves) and a clock, then use the clock to count how many seconds the float will take to flow from A to B.

Supposing that, the length, width and height in the cross-section of point A are 10m, 60cm and 40cm separately. And the float takes 8 seconds to flow from A to B.

A's sectional area is: $10\text{m} \times 0.6\text{m} \times 0.4\text{m} = 2.4\text{m}^3 = 2400\text{liters/second}$. (Tip: $1\text{ m}^3 = 1000\text{liters}$)

The Water flow will be: $2.4\text{m}^3 \div 8 = 0.3\text{m}^3/\text{second} = 300\text{liters/second}$.

3. For small stream from mountain area, a bucket or basin can be used to measure the water flow.

After using the bucket or basin to catch water, weigh out the water, then its weight is divided by the seconds spend on catching the water, which is the water flow at last.

Example:

60kgs water can be caught during 3 seconds.

The water flow will be:

$60 \div 3 = 20\text{kgs/second} = 0.02\text{m}^3/\text{second} = 20\text{liters/second}$. (Tip: $1\text{kg} = 1\text{liters}$)

These three methods are just references. Different methods and repeated measurements should be considered according to different situations such as dry season and rainy periods. It is better to measure flow which is long lasting no matter in which season. After knowing the actual water head and flow, the power range of hydro turbine generator that is suitable for installation will be known.

Calculation formula for power of hydro turbine generator unit:

Water head \times water flow $\times 9.81 \times 0.65$ (turbine efficiency) = actual installed power.

Explanation

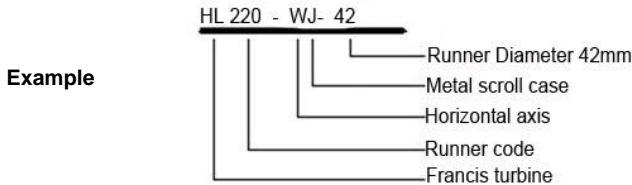
The model number of turbine illustrates its type and structure characteristics. The model number consists of three-parts, and each part is separated by “—”. The first part represents a turbine, using the first capital letter of Chinese phonetic alphabet “Shui” (See table 2). The code for runner is indicated with Arabic numerals, which is also unified code for rotary speed. The second part indicates the arrangement and structural characteristics of main axis, which are all in Chinese phonetic alphabet. L means vertical installation, while W means horizontal installation (See Figure 3). The third part represents the runner diameter. Its unit is Centimeter. For impulse type and inclined-jet type hydro turbine generator unit, the third part is as below: runner diameter / nozzle number * diameter of jet flow.

Table 1

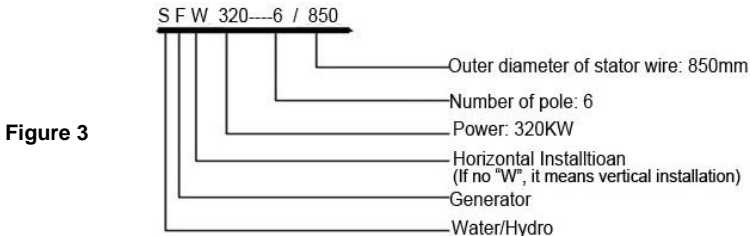
Turbine Type	kaplan turbine type with fixed blades	Francis type	Turgo turbine	Impulse type
Code	ZD	HL	CT	CJ

Table 2

Structural Characteristics	Concrete Scroll Case	Open Flume	Pressure open Flume	Metal Scroll Case
Code	H	M	MY	J



This means a Francis turbine with runner code 220, runner diameter 42cm, horizontal axis and metal scroll case.



Generator Type

According to the position of axis, the turbine generator units can be classified into vertical type and horizontal type. For large and medium-size units, a vertical axis is generally applicable, while the horizontal type is usually used for middle and small size units. Model example for small and medium-size hydro turbine generator is as below:

Kaplan Turbine

There are two types of axial flow turbine generator: fixed blade propeller turbine and Kaplan turbine.

Fixed Blade Turbine Generator

Blades of fixed blade propeller turbine are non-adjustable, but its structure is simple. When the water flow and power output changes, its efficiency also changes greatly and the average operation efficiency is low. Therefore, fixed blade propeller turbine is suitable for hydro power station whose required power output is not big and whose water flow does not change very much. It requires 3-30 m water head to operate..

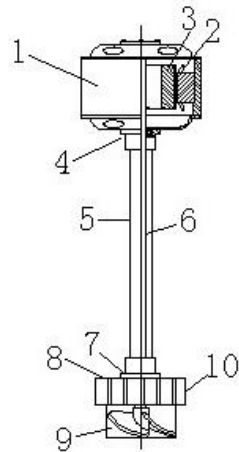
Kaplan Turbine Generator

Kaplan turbine has a blade rotating structure, called guide vanes or wicket gates, inside the turbine runner, which can rotate comparatively to the runner. According to different load and water flow, the blades cooperate with guide vanes to form a double adjustment, and obtain higher hydro efficiency and stable operation and expand the scope of operation efficiency. Therefore, it is suitable for water flow which changes greatly, especially for power station with great power output difference. It requires 3-30 m to operate and is widely used in electric power station with low water flow but great capacity.

Micro Permanent Magnet Hydro Turbine Generator Unit

The series of kaplan turbine are suitable for low water head (1-5 meters) but large flow.

- | | |
|---------------------------|---------------------------|
| 1. Generator | 6. Inner axis |
| 2. Stator (coil) | 7. Bottom bearing housing |
| 3. Permanent magnet rotor | 8. Turbine |
| 4. Top bearing housing | 9. Blades |
| 5. Outer axis | 10. Water diversion cover |



Working Principle

The channel brings the water from the dam to the turbine, and then the turbine blades are funded by the water. After the water has given up its energy to the turbine, it drops down into the draft tube (made by iron or concrete). The draft tube becomes vacuum, which will suck the upstream water and make it into jet flow. The high speed jet flow will strike at the blades, which converts the energy of flowing water into mechanical energy. The mechanical energy moves the generator to produce electricity.

Technical parameters

- Model: ZD760-LM-10-25 permanent magnet hydro turbine generator-LM unit
- Phase: single-phase/three phase
- Voltage: 220V AC, 380 V AC.
- Nominated power: 0.3KW, 0.5KW, 0.6KW, 1.0KW, 1.5KW, 2.0KW, 3.0KW, 5.0KW, 8.0KW.
- Water head: 1meters to 5 meters.
- Water flow: 0.02 - 1.0 m³/s (20Liters/s-1000Liters/s)
- Available working environment temperature: -10 °C-+60 °C
- **Working type:** continuous.

Installation and Testing

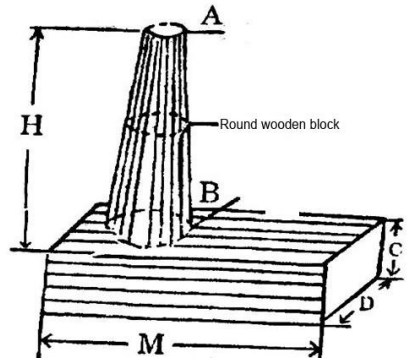
Preparation before Installation

Select an ideal installation location, measure out the water head and water flow.

1. Base on the installation requirements and installation location, make a budget that how much quantity of sand, stone, brick and other materials will be needed for making concrete, and transfer them to the installation location.
2. According to the turbine model and the structure of draft tube ends (small on the top but big at the bottom), use round wooded block and small square wood pieces to form the molds of draft tube and water outlet like Figure 4 and the data.

Figure 4

Tip: The Model of turbine can be seen in the nameplate on the unit. For example: ZD760-LM-10, 10 is the model of turbine.



Unit: Centimeters

Turbine Model	A	B	C	D
Model 10	10	20	15	25
Model 12	12	24	20	25
Model 15	15	33	25	40
Model 18	18	36	30	40
Model 20	20	40	30	40
Model 25	25	50	40	70

A and B represent the diameter of round wooden block and small square wood pieces together.

H is determined by water head, while M is determined by the inclination of the mountain

Preparation before construction

Following the data in Figure 4, dig a square hollow place (60-100 cm) under the position where the unit will be installed. The hollow place must also be under the downstream water level. Then, pour concrete of 3-10 cm thickness at its bottom.

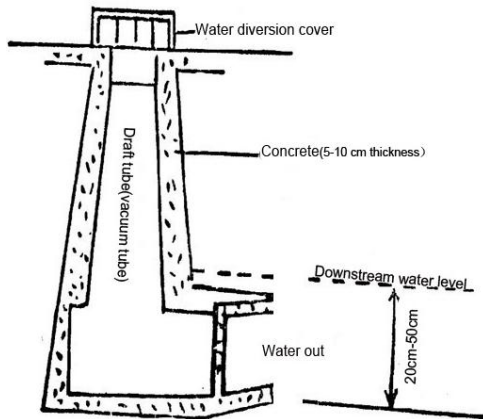
Wrap the moulds of draft tube and water outlet well with newspaper or cement bag paper to prevent deformation, and then place them in the middle of the hollow place.

Construction

Firstly, lay bricks around the draft tube mold and make sure that the thickness of draft tube must be 5-10 cm (the thickness between the bricks and the draft tube mold). Then, carefully poured concrete made of water, mud, sand and stone into the space between the mold and the bricks. Note: The pouring must be continuous at one time, in case of uneven distribution or air leak.

When pouring concrete to the top part, discharge the water diversion cover from the unit and install it on the upper end of the draft tube, and then pour concrete to connect and solidified them well. The cover and the draft tube must be vertically installed. Otherwise, the generating capacity of the turbine generator unit will be affected. Details can be seen in Figure 5.

Figure 5



Building Method and Data for Spiral Housing

The spiral housing is built for water diversion. Its size is determined by the size and the model of turbine.

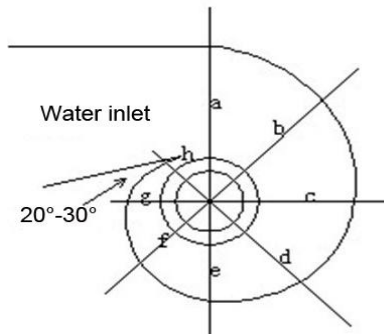
Before construction, confirm the water inlet, draw a big “米” on a paper mold(like Figure 6). Then, draw out a general shape by following the data below on the paper mold.

And then, cut out the paper mold and place it on the flat top of the draft tube (which has been poured), lay bricks of 30-60cm height around the edge of the paper mold, and use concrete to smoothly paper the bricks into round shape.

Data

Turbine Model	a	b	c	d	e	f	g	h
Model 10	15.5	13.6	11.6	9.7	7.8	5.8	3.9	1.94
Model 12	17.5	15.4	13.2	11	8.8	6.6	4.4	2.2
Model 25	41	36	31	26	21	16	11	6
Model 15	22	19.6	16.8	14	11.2	8.4	5.6	2.8
Model 20	27	23.8	20.4	17	13.6	10.2	6.8	3.4

Figure 6



(Water inlet is determined by the actual water flow of the river. It's better to be larger.)

Installation

Generally, the concrete needs 6-7 days to become solidified. After the concrete is totally solid, the molds of draft tube and water outlet can be removed. When removing, use hammer or hard wooden piece to knock off the round wooden block and wooden pieces. They can be taken out from either the upper end or the bottom end of the draft tube. The water diversion cover should be also removed and fixed again with the turbine. After these, check whether there's air leak in the draft tube. If not, the turbine generator unit can be installed. See Figure 7.

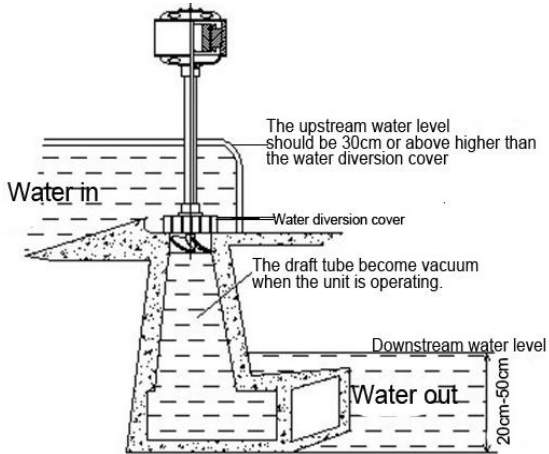


Figure 7

Test

After the installation, allow water flow into the unit to make test. After a few minutes, if there are air bubbles come out from the draft tube, the water should be shut down to stop the unit, and take remedial measures.