

# AXIAL TURBINE INSTALLATION GUIDE



**Prepared for: Energy Program of ITDG-Peru**

**The rule of this guide is to address guidelines in reference to the manufacture of the axial turbine; the manufacturers should rely in their own ability and decide the use of this guide. ITDG does not assume responsibilities to any institution or prosecution for any losses or damages caused by any error or omission in the work, if the error or omission is caused by negligence or any other reason, Any and all responsibilities are refused.**

**Energy Program ITDG-Peru**

**Intermediate Technology Consultants (ITC), ITDG-UK**

## INTRODUCTION

This simple guide gives the most important process steps for the installation of the Axial Turbine that this guide describes. This publication tries to sum up in brief the team's trial during the installation of the first model in the town, Las Juntas in Jaen, and gives some practical advices that will improve or shorten the steps for a correct installation.

As it can be appreciated, in spite of the low power of this machine (25 KW), its dimensions and weight are great if compared to the turbines of less volume (Pelton and Banki), a careful handling during the installation, not only will allow a good installation of the machine and its reliable operation but the assurance of the physical integrity of the personnel doing the installation.

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## 1. FOUNDATION AND ANCHORING

The foundation of the Axial Turbine is the first step of the installation process; considering the forces produced during the full load operation, this foundation must, in the best way, anchor the turbine frame, as well, the suction tube.

The spiral form frame of the turbine has floor anchor supports for tie down to the concrete floor via perforations for  $\frac{3}{4}$  inch bolts, previously, inserted in the concrete foundation.

A practical form of doing the foundation of the turbine is as follows: When the structure is prepared for the pouring of the concrete, the frame of the turbine is placed with the anchoring bolts installed and properly tied down, then pour the concrete making sure of not moving the frame from its placement

## 2. LEVELING

The leveling of the turbine is done during the foundation and anchoring, prior the concrete pouring, with the help of winch, the frame is leveled then anchored to insure that does not move or is unlevelled during the concrete pouring.

If the turbine is not properly leveled, after the concrete hardening, the frame can be shimmed to the required level. Once the leveling has been attained, the frame is tied down to the floor using the bolts anchored to the floor.

The foundation of the base of the generator is done in parallel with the installation of the turbine frame and it is joined to the frame via bolts and resting on a concrete wall.

(Fig. 1 and 2)



Fig. 1 and 2 Leveling and Anchoring of the Axial Turbine Frame.

The installed turbine frame is the guide for the flange of the suction tube coupling to the flange of the cover of the runner (area of rotation) in the inferior face of the frame, between the flanges, a 3 mm, minimum thickness, rubber reinforced gasket is used. Fig. 3 shows the suction tube coupled to the turbine frame



Fir. 3 Suction Tube coupled to the Axial Turbine frame

Coupled to the suction tube, a rectangular discharge channel constructed to direct the turbine-discharged water in the house of machines towards the river (Fig.4 and 5).





Fig. 5 and 6 Discharge channel and Machine house in La Juntas, Peru

### 3. TURBINE COUPLING – PRESSURE TUBING (Valve-Coupling Dresser)

The joining of the Turbine to the pressure tubing is done via a coupling of expansion (coupling dresser) for two reasons:

- For easy placement or removal of the turbine.
- To allow for the expansions due to temperature changes.

The coupling dresser, as well, allows small misalignments that could exist between the turbine and the pressure tubing.

It is, as well, necessary a valve to control the water intake to the turbine placed just behind the coupling dresser (toward the water intake) to facilitate the removal or replacement of the turbine with the valve closed.

The valve for this turbine, as built, was a gate type valve but another type of valve can be used to control the water, it can be butterfly type valve.

To accomplish the installation of the coupling dresser and the valve, both have to be aligned to the pressure tubing and turbine with the help of a hoist to support each one of the pieces. Once the elements are aligned (forming a common axis), a 6 mm thick rubber reinforced gasket is placed between the two flanges and bolted tight.

To obtain the best alignment between the turbine and the pressure tubing, the process can be initialized with the placement of the turbine (Foundation and anchoring of it) then align the tubing to the turbine with the coupling dresser and Valve assembled, or install the turbine and tubing assembled, first doing the leveling and alignment then placing concrete to the base of the turbine and to the tubing, preferably in the change of direction (elbow).

#### **4. - RUNNER INSTALLATION AND ACCESORIES ON THE SUPPORTS**

After the turbine installation, the concrete needs to harden for 8 days, and then proceed to assemble the turbine components by installing the guides first, that forms a moveable group, (it was built with this characteristic for the purpose of an easy installation or removal). The mating of this piece to the frame is done via bolts and silicon rubber as a “sealant”.

The runner is assembled to the lowest part of the shaft, affixed with a square wedge, being the shaft supported by two bearings that carry the radial and axial forces.

For the transmission of movement and power, a set of pulleys and belts are used. The power pulley is installed on the shaft between two load-carrying bearings that are installed and affixed with a square wedge and the pulley, for easy assembling, has an adjustable cone .



The assembling sequence of the components that go in shaft is as follows:

- The runner
- Entrance cone
- Support of the burlap-clamp
- The burlap-clamp
- Support for the lower bearing
- Lower bearing (includes journal bearing)
- Power pulley
- Support for the top bearing (projecting)
- Top bearing (includes journal bearing)

Each one of the pieces is assembled in their designed areas as indicated by the drawings (plans), making sure that the shaft turns freely (without adjustments or frictions).

The adjustment of the bearings to the shaft is by means of a retaining sleeve to easy up the assembling. The perpendicularity of the shaft and the correct position of the other components must be verified prior the adjusting of the retaining sleeve, proceeding next with the adjustment of the top and lower bearing sleeves. At the same time, the journal bearings are secure to their respective supports with their corresponding bolts. For the adjustment of the sleeves nuts, it is necessary to use a special tool that is recommended by the bearing manufacturer to avoid breakage and/or other damages.

The adjustment of the burlap-clamp is done accordingly with the water leakage, making sure that the graphite tape be in contact with the water (It should exist a minimum water leakage to the outside) to have refrigeration and avoid heating of the graphite tape and consequently the shaft.

The shaft and the assembled accessories to it, form a unit that easy up the assembly or des-assembly. (Fig. 6)



Fig. 6 Joining of the shaft and components to the frame.

## 5. GENERATOR INSTALLATION

The installation or assembling of the generator is done over a base previously prepared for it, next to the frame of the turbine. To easy up the displacement of the generator (tensioning the belts) a steel plate with holes is used in accord with the generator dimensions.

## 6. BELT TENSIONING

If the power transmission is done with pulleys and belts, the adjustment is done via stretchers to give the necessary adjustment, the generator steel plate is secured to concrete structure.

## 7. TESTS PRIOR INITIAL STARTING

After the assembly of the turbine and generator and before the initial running, verifications and tests are done to determine the behavior of the set up to detect strange sounds or troubles that could be present when the shaft and its assembly is manually

Once it has been verified that there are not problems, the control valve is partially opened to turn on the assembly for a few minutes to observe the correct operation and for detection of strange sounds and to check the bearings' temperature, water leakage or something not normally expected for immediate adjustment.

The equipment is started after all necessary adjustments are done,. (Fig. 7)



Fig. 7 Axial turbine after final assembly

## 8. SUGGESTIONS

- To adjust the pulleys and the runner wedges, make sure to use captive bolts and not other type.

- The bearings should be perfectly aligned for free rotation of the shaft.
- To seal the parts, prefer the use of Silicon Rubber and for the flanged joints use 6 mm thick reinforced rubber gasket.

### **TOOLS AND MATERIALS USED FOR THE ASSEMBLY OF THE AXIAL TURBINE**

<b>Item</b>	<b>Description</b>
01	Socket set ¼” to 1” or 6 mm to 25 mm metric.
02	02 llaves inglesas (stilson) de 12”
03	02 llaves francesas de 12”
04	Set of Phillips and Blade screddrivers
05	One tonne Hoist, minimum
06	Set of Allen wrenches 1/8” to ½” and/or equal metric set
07	Limas media caña grano fino de 6” y 8”
08	Limas redonda grano fino de 6” y 8”
09	Comba de plástico o bronce para golpear
10	Thin Files N 140 and 240
11	Grease in quantity
12	Grease LGMT 3/1 for bearings
13	Hammer
14	Huaype
15	Manual Level horizontal use.
16	Manual Level vertical use
17	Non electric hand drill
18	Arco de sierra