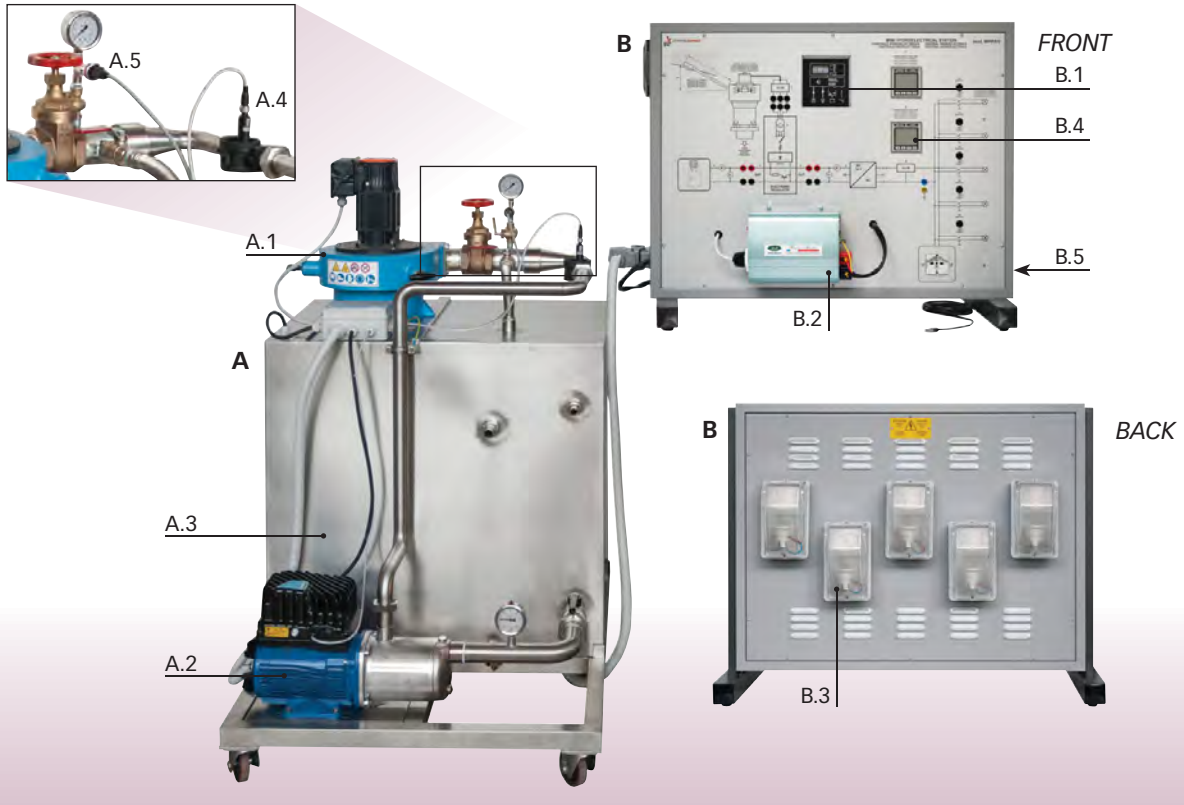


# MINI HYDROELECTRIC POWER PLANT TRAINER

## Mod. WPP-E/EV

## Mod. WPP/EV (computerized version)



## INTRODUCTION

Energy saving and environmental pollution reduction are crucial global issues. Using renewable energies as alternative sources to fossil fuels can address both issues, with great benefits especially in countries where traditional energy sources are scarce.

Considering the above, this system enables experimental investigation on the conversion of hydraulic energy into electricity by means of a Pelton turbine. The system configuration is stand-alone (isolated from the grid). The equipment is manufactured using real components available on the market.

*A video demonstration is available on Elettronica Veneta YouTube channel*



Scan code to watch



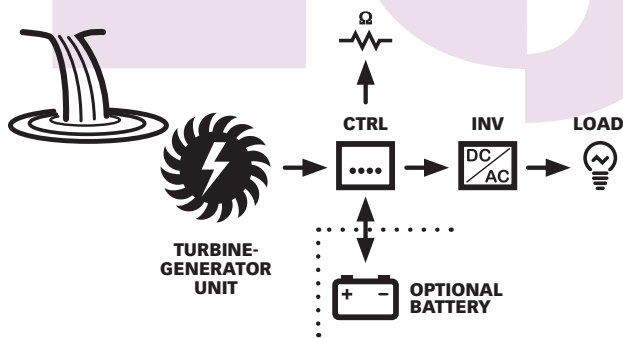
## DESCRIPTION

The system consists of:

- A) Mini hydroelectric power plant mounted on castors including:
  - A.1) Turbine-generator unit with water distributor
  - A.2) Variable speed centrifugal pump
  - A.3) Stainless steel water tank
  - A.4) Flow rate sensor (mod. WPP/EV) or flow meter (mod. WPP-E/EV)
  - A.5) Pressure sensor (mod. WPP/EV) and pressure gauge
- B) Table top control panel including:
  - B.1) Controller with air dissipation system
  - B.2) Sinewave inverter
  - B.3) Electric loads
  - B.4) Electric instrumentation for detecting the energy flows in different branches of the circuit
  - B.5) Data acquisition board with USB interface for PC connection (mod. WPP/EV only)

**Relevant features:**

- The turbine-generator unit is equipped with a 6-jet water distribution system. In correspondence of each jet, a nozzle or a cap can be installed, thus modifying the geometry with which the water hits the turbine. Nozzles of different diameter are available.
- 3 jets can be externally intercepted (mod. WPP/EV only)
- The turbine-generator unit can be disconnected from the system, for drawing the external characteristic curve. In this case an optional device is required (refer to mod. PRH-3 at the end of this data sheet)

**Operating principle:**

- If no load is connected to the system, all the produced energy is dissipated in air or used to charge the battery pack (refer to optional item mod. SOLBA at the end of this data sheet).
- In case some loads are connected to the system, the produced energy partially feeds the loads and partially charges the battery pack (optional item) or is dissipated in air.
- When the consumption is higher than the power available from the water, the power surplus is given by the battery pack (optional item).

**TRAINING PROGRAM:**

- Physical principles whereby hydraulic power is transformed into electrical power
- Power as function of water flow rate and difference in height of the hydraulic pipe
- Head losses
- Hydraulic efficiency
- Turbine volumetric efficiency
- Turbine-generator mechanical efficiency
- Generator electrical efficiency
- Electric power output
- Load control
- Energy conversion
- Study of energy flows and related measurement devices

**TECHNICAL SPECIFICATIONS:****Mini hydroelectric power plant mounted on castors:**

- Turbine-generator unit:
  - AISI 304 stainless steel Pelton turbine,  $d = 100$  mm, blade no. = 20
  - 6-jet distributor
  - 3 jets can be externally intercepted (mod. WPP/EV only)
  - permanent magnets synchronous generator
  - rated voltage: 25 Vac three phase

- frequency: 200 Hz
- electric power output: 0.5 kW (height 30 m, flow rate 3 l/s)
- generator speed: 3000 rpm
- AISI 304 stainless steel horizontal axis multistage monoblock pump:
  - power: 1.1 kW
  - maximum flow rate: 60 liters/minute
  - maximum head: 40 m
  - frequency converter for rpm adjustment
- AISI 304 stainless steel water tank, capacity: 250 liters
- AISI 304 stainless steel hydraulic circuit feeding the turbine-generator unit with:
  - ball valve and dial vacuum gauge, range:  $-1 \div 5$  bar, at pump suction
  - dial pressure gauge, range:  $0 \div 6$  bar, and gate valve at pump discharge
  - ball valve at distributor-tank by-pass

**Flow rate sensor (mod. WPP/EV only)** for measuring and transmitting the water flow rate to the control panel

- Transducer type: rotating vane
- Range:  $5 \div 140$  liters/minute

**Variable area flow meter (mod. WPP-E/EV only)**

- Range:  $400 \div 4000$  liters/hour

**Pressure sensor (mod. WPP/EV only)** for measuring and transmitting the water pressure to the control panel

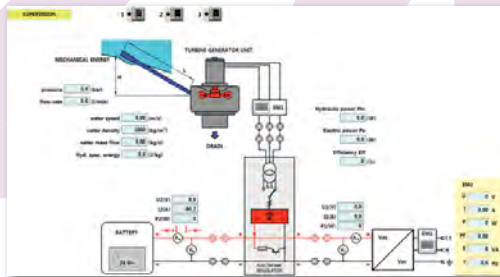
- Transducer type: piezoresistive
- Range:  $0 \div 10$  bar

**Table top control panel:**

- Steel structure with:
  - front side: comprehensive colored diagram of the system
  - back side: AC loading system consisting of 5 30 W switchable lamps
- Controller
  - Rectifier
  - Air dissipation system
  - Digital voltmeter for the DC parameters
  - Digital ammeter for the DC parameters
- Inverter
  - continuous output power: 600 W
  - peak output power: 1200 W
  - input voltage: 24 Vdc
  - output voltage: 230 Vac - 50 Hz
  - output waveform: modified sine wave
  - stop for low battery charge
  - protection against overload, short circuit, overtemperature
- Instrumentation
  - multifunction instruments, microprocessor-based, for AC parameters
- Socket for connection to an external optional AC load (refer to mod. ACL220V at the end of this data sheet)
- $\varnothing 4$  mm safety holes for connection to the optional portable rheostat (refer to mod. PRH-3 at the end of this data sheet)
- $\varnothing 4$  mm safety holes for connection to an external optional DC load (refer to mod. DCL24V at the end of this data sheet)

**PC data acquisition (mod. WPP/EV only)**

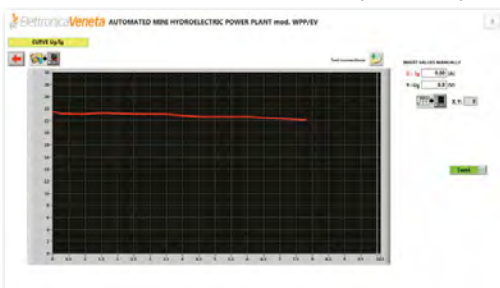
- The unit includes a data acquisition board with USB interface for connection to PC and voltage and current converters.
- A specific software (developed with LabView) is supplied to monitor the different parameters of the system.
- Parameters displayed:
  - All DC (V-I-P) and AC (V-I-P-S-Freq-Power Factor) parameters
  - Water pressure and flow rate



- The software enables to:
  - Calculate the hydraulic energy conversion efficiency
  - Visualize the energy flows to and from turbine-generator unit, battery pack (if present) and inverter

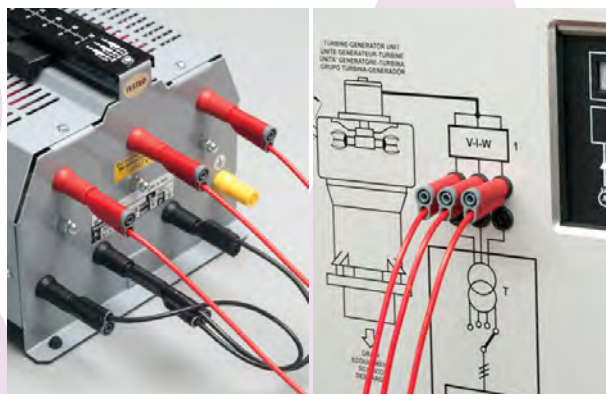


- Draw the characteristic curve efficiency / flow rate to find out the point of maximum performance of the turbine-generator unit
- Save the exercises data for future analysis or project work



**Power supply:** 230 Vac 50 Hz single-phase - 1400 VA  
(Other voltage and frequency on request)

**Dimensions:**  
 Control panel: 92 x 46 x 72 cm  
 Mini hydroelectric station: 100 x 80 x 130 cm  
**Weight:** 170 kg



Connection of rheostat mod. PRH-3 (optional item) to the control panel to draw the generator external characteristic curve.



Detail of Pelton turbine and distributors

**REQUIRED**

**PERSONAL COMPUTER**  
- NOT INCLUDED -



**SUPPLIED WITH**

**THEORETICAL-EXPERIMENTAL HANDBOOK**



**OPTIONAL (REF. ACCESS. AND INSTRUMENTS)**

**PORTABLE RHEOSTAT MOD. PRH-3**

To draw the external characteristic curve of the generator



**BATTERY PACK Mod. SOLBA**  
To store the generated electricity

**SPOTLIGHT Mod. ACL220V**

To be used as 220 Vac electric load



**LAMP Mod. DCL24V**  
To be used as 24 Vdc electric load