

FR - 007

# Francis Turbine Educational Unit

## Overview

The Francis turbine trainer is designed to illustrate the characteristics of a powerful Francis turbine. The educational unit allows changing the power output by adjusting the guide vanes.



## Specifications

- The Francis turbine trainer is used to study the function and operating behavior of a Francis turbine.
- The educational unit is distinguished by its dimensions that guarantees realistic measured values.
- The unit is considered a closed water circuit that includes a tank with optional cooling, a centrifugal pump and a flow control valve.
- The centrifugal pump is with variable speed by a frequency converter which provides for an energy efficient operation, the flow control valve of the unit is used to adjust the inlet pressure.
- The transparent operating area of the turbine enables an excellent observation of water flow, rotor and guide vanes during operation.
- The trainer allows adjusting the guide vanes and the angle of attack, this results in a change in the cross-section and thus the output of the turbine.
- The unit includes an asynchronous machine that is used as a generator for loading the turbine.
- The unit includes an inductive, non-contact position sensor at the generator shaft which is used to measure the speed of the turbine.
- The generator is equipped with a pendulum

bearing and a force sensor to determine the torque.

- The trainer is equipped by sensors to measure the pressures at the inlet and outlet of the turbine, the temperature and the flow rate are recorded by sensors.
- The unit is provided with an interactive software used for data acquisition and visualization which makes the experiments clear and enables fast execution of experiments with reliable results.
- The unit is provided with a USB socket for

connection with PC through which the measured values are transmitted to the software.

- There are digital displays for each of the pressures at the inlet and outlet of the turbine, the temperature and the flow rate, these measured values can be processed further in the software.
- The output data of the examined turbine are determined and can be represented by characteristic curves.

## Experiments

- Investigation of the conversion of hydraulic into mechanical energy.
- Determination of the operating characteristics of a Francis turbine at different speeds.
- Height of the turbine.
- Determination of the Francis turbine's power, Torque and efficiency curves at constant flow with guide vanes open.
- Determination of the Francis turbine's power, Torque and efficiency curves at constant flow with guide vanes closed.
- Determination of the power, Head and efficiency curves at constant rotation speed and guide vanes opened.
- Determination of the power, Head and efficiency curves at constant rotation speed and guide vanes closed.
- Recording of characteristic curves.
- Investigation of the influence of the guide vane position.
- Velocity triangles.

## Accessories

- User manual for the training system
- BEDO Software

## Technical Data

- **Francis turbine**
    - » Speed range: 0-1200 rpm
    - » Rotor
    - » Number of blades of the turbine: 15.
    - » Diameter: 85 mm
    - » Stator
    - » Number of adjustable guide vanes of the distributor: 10.
    - » angle of attack adjustable: 0...23°
  - **Centrifugal pump, multistage**
    - » variable speed
    - » power consumption: 3.5 kW
    - » max. flow rate: 600L/min
    - » pump head: 56m
  - **Asynchronous machine as generator**
    - » output: 2,2kW at 1440min-1
- Tank: 550L  
 Temperature sensor range: 0...100°C  
 Pressure sensor range: 0-6 bar  
 Flow sensor range: 0...700L/min  
 Torque: 0...20Nm  
 Speed sensor range: 0...20000 rpm

## Options

- Laboratory PC