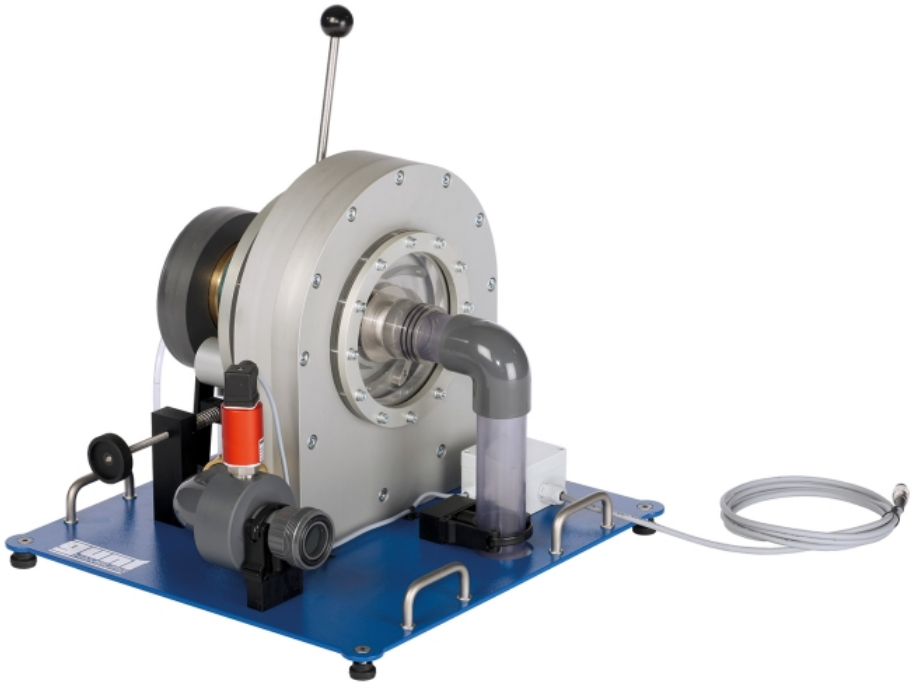
HM 450.02
Francis turbine



Description

- **Francis turbine with visible operating area**
- **closed water circuit and data processing software for use with the HM 450C trainer**

The Francis turbine is part of the reaction turbines which convert the pressure energy of water into kinetic energy in the distributor and in the rotor. Francis turbines are used at medium heads and large flow rates. The turbine power is changed by adjusting the guide vanes. In practice, Francis turbines are used in run-of-the river power plants and in storage power plants.

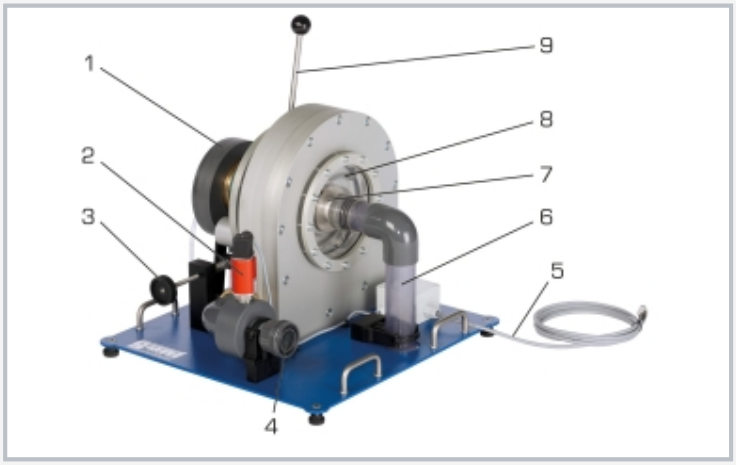
The Francis turbine HM 450.02 is an accessory for the HM 450C trainer. The experimental unit consists of the rotor, the distributor with adjustable guide vanes, an adjustable band brake for loading the turbine and the spiral housing with a transparent front panel. The transparent cover enables you to observe the water flow, the rotor and the guide vanes during operation. The angle of attack and the cross-section of flow are adapted to the speed and power of the turbine by adjusting the guide vanes.

The pressure at the turbine inlet is recorded with a pressure sensor. A force sensor and a speed sensor are attached to the band brake. Thus, the mechanical power output of the turbine can be determined. Speed, torque and pressure are displayed on the switch cabinet of HM 450C and processed further in the software. Water supply and flow rate measurement are provided by HM 450C.

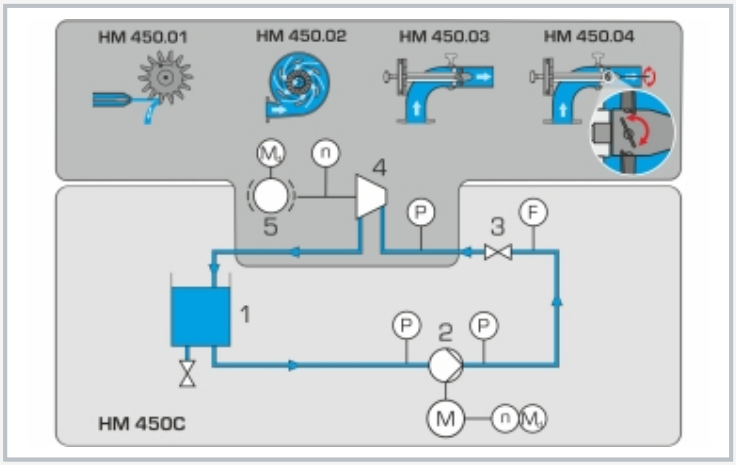
Learning objectives/experiments

- determination of mechanical output
- determination of efficiency
- recording of characteristic curves
- investigation of the influence of the guide vane position on the power output
- velocity triangles

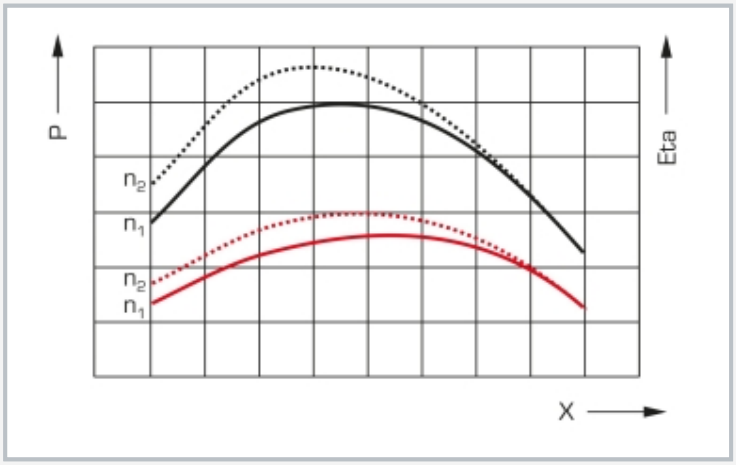
HM 450.02
Francis turbine



1 band brake, 2 pressure sensor, 3 handwheel for adjusting the brake, 4 water inlet, 5 connecting cable to HM 450C, 6 water outlet, 7 rotor, 8 guide vanes, 9 lever for adjusting the guide vanes



1 tank, 2 pump, 3 flow control valve, 4 turbine, 5 brake, M motor;
F flow rate, P pressure, n speed, M_d torque



Efficiency and mechanical power depending on the guide vane position at different speeds: black: power output, red: efficiency; n speed, Eta efficiency, P mechanical power, X guide vane position

Specification

[1] recording the curves of a Francis turbine and investigating the influence of the guide vane position
[2] transparent front panel for observing the operating area
[3] adjustable guide vanes for setting different angles of attack
[4] loading the turbine by use of the adjustable band brake
[5] recording the torque via band brake and force sensor
[6] pressure sensor at the turbine inlet
[7] speed, torque and pressure displayed on the switch cabinet of HM 450C
[8] water supply, flow rate measurement and data processing software via HM 450C

Technical data

Turbine
- output: approx. 350W at 1500min^{-1}, 270L/min, H=15m
- max. speed: 3000min^{-1}
- rotor
  - 11 blades
  - medium diameter: 60mm
- distributor
  - 7 guide vanes
  - angle of attack: 0...20°

Measuring ranges
- torque: 0...9,81Nm
- pressure: 0...4bar abs.
- speed: 0...4000min^{-1}

LxWxH: 510x490x410mm
Weight: approx. 38kg

Scope of delivery

1 experimental unit
1 set of instructional material

HM 450.02
Francis turbine

Required accessories

HM 450C	Characteristic variables of hydraulic turbomachines