

HM 450.04

Kaplan turbine



Description

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

Kaplan turbines are characterised by an axial flow through and adjustable blades. They are used at low heads and very large flow rates. Because Kaplan turbines belong to the double regulated turbines, meaning that both the guide vanes and the blades can be adjusted, they are suitable for operation at changing operating conditions. Compared to fixed-blade propeller turbines, Kaplan turbines offer a high efficiency over a wide range of operating. In practice, Kaplan turbines are used in run-of-the river power plants.

The Kaplan turbine HM 450.04 is an accessory for the HM 450C trainer. The experimental unit consists of the rotor with manually adjustable blades, the distributor with manually adjustable guide vanes, a wear-free and adjustable eddy current brake for loading the turbine and the housing with a transparent pipe element. The transparent cover enables you to observe the water flow, the rotor, the distributor and the guide vane and blade adjustment.

The angle of the water inlet into the turbine and the cross-section of flow are adapted by adjusting the guide vanes. The adjustment of the blades allows the velocity at the rotor to be adapted. The combination of both adjustment options optimises efficiency and keeps losses as low as possible.

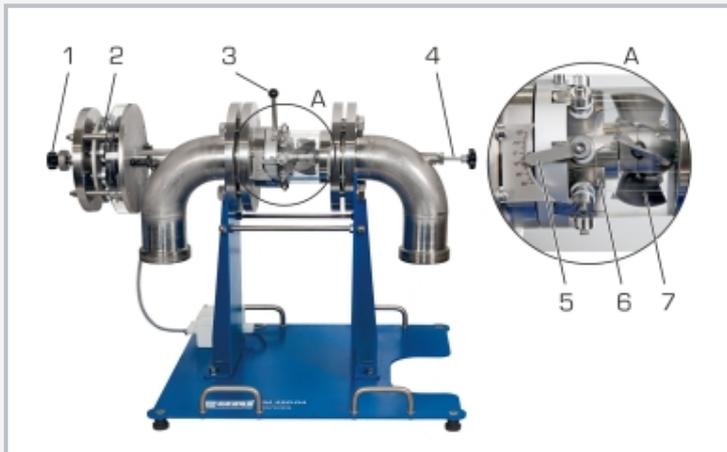
The pressure at the turbine inlet is recorded with a pressure sensor. A force sensor and a speed sensor are attached to the eddy current brake. Thus, the mechanical power output of the turbine can be determined. Speed, torque and pressure are displayed on the switch cabinet of HM 450C and processed further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

Learning objectives/experiments

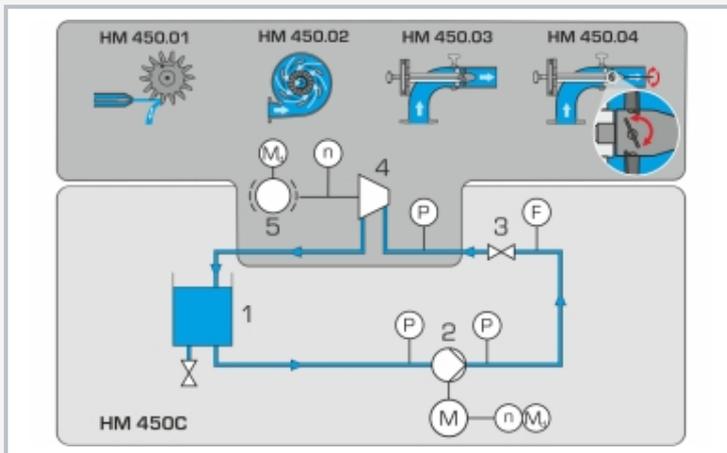
- determination of mechanical output
- determination of efficiency
- recording of characteristic curves
- investigation of the influence of the guide vane and blade position on the efficiency

HM 450.04

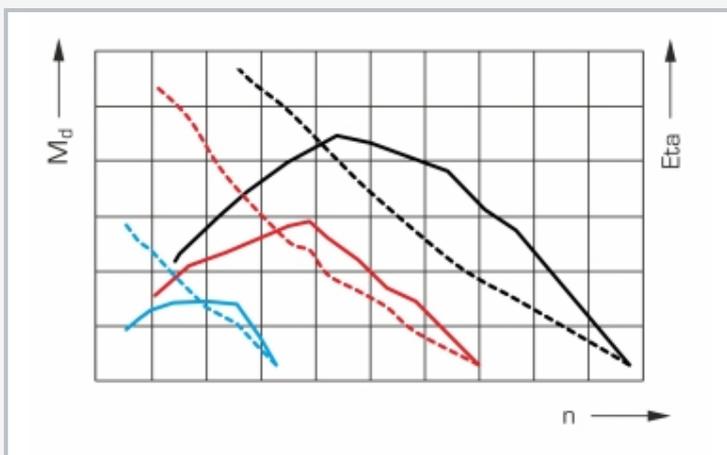
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1 handwheel for adjusting the brake, 2 eddy current brake, 3 adjustment of the guide vane position, 4 handwheel for adjusting the blades;
A detail view
5 index with scale of the guide vane position, 6 guide vanes, 7 rotor with adjustable blades



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



Efficiency and torque (dashed lines) depending on the speed at different angles of the blades and guide vanes:
black blades: -30° / guide vanes: -20° ,
red blades: -30° / guide vanes: 0° ,
blue blades: 30° / guide vanes: 0° ,
Eta efficiency, n speed, Md torque

Specification

- [1] transparent pipe element for observing the operating area
- [2] adjustable guide vanes for setting different angles of the water inlet into the turbine
- [3] rotor with adjustable blades for setting different velocities at the rotor
- [4] recording the curves of a Kaplan turbine and investigating the influence of the guide vane and blade position
- [5] loading the turbine by use of a wear-free and adjustable eddy current brake
- [6] non-contact speed measurement and force sensor at the brake for measuring the torque
- [7] pressure sensor at the turbine inlet
- [8] speed, torque and pressure displayed on the switch cabinet of HM 450C
- [9] water supply, flow rate measurement and data processing software via HM 450C

Technical data

Turbine

- output: approx. 14W at 530min^{-1} , $530\text{L}/\text{min}$
- max. speed: 1100min^{-1}
- rotor
 - ▶ 5 blades, adjustable
 - ▶ blade adjustment with scale
 - ▶ internal \varnothing : 30mm
 - ▶ external \varnothing : 67mm
- distributor
 - ▶ 8 guide vanes, adjustable
 - ▶ guide vane adjustment: $-20\dots30^\circ$

Measuring ranges

- torque: $-25\dots25\text{Nm}$
- pressure: $0\dots4\text{bar abs.}$
- speed: $0\dots4000\text{min}^{-1}$

LxWxH: $680 \times 615 \times 840\text{mm}$

Weight: approx. 42kg

Scope of delivery

- 1 experimental unit
- 1 set of instructional material

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Required accessories

HM 450C Characteristic variables of hydraulic turbomachines