

HM 150.19

Operating principle of a Pelton turbine



Learning objectives/experiments

- design and function of a Pelton turbine
- determination of torque, power and efficiency
- graphical representation of characteristic curves for torque, power and efficiency

Description

- model of an impulse turbine
- transparent operating area
- adjustable nozzle cross-section
- loading by band brake

Water turbines are turbomachines utilising water power. The Pelton turbine is a type of impulse turbine; such turbines convert the pressure energy of water into kinetic energy entirely in the distributor. During the conversion, the water jet is accelerated in a nozzle and directed onto the blades of the Pelton wheel tangentially. The water jet is redirected by approximately 180° in the blades. The impulse of the water jet is transmitted to the Pelton wheel.

HM 150.19 is a model of a Pelton turbine demonstrating the function of an impulse turbine.

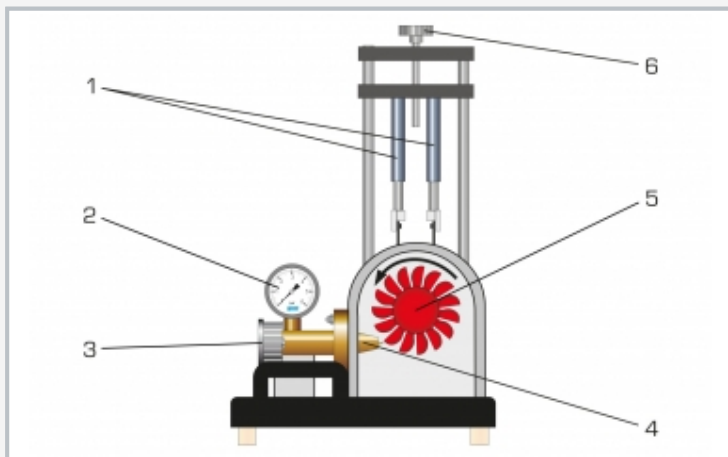
The experimental unit consists of the Pelton wheel, a needle nozzle used as distributor, a band brake for loading the turbine and a housing with a transparent front panel. The transparent cover enables to observe the water flow, the Pelton wheel and the nozzle during operation. The nozzle cross-section and thus the flow rate are modified by adjusting the nozzle needle.

The turbine torque is determined by force measurement on a band brake and is read on spring balances. For measuring the rotational speed, a non-contact speed sensor, e.g. HM 082, is required. A manometer shows the water pressure at the turbine inlet.

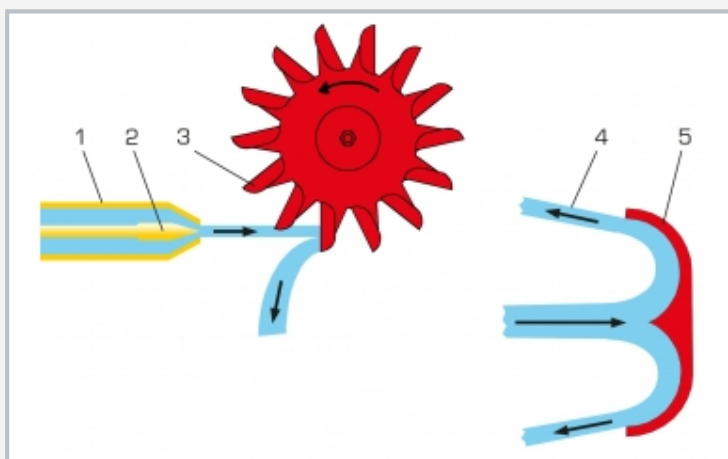
The experimental unit is positioned easily and securely on the work surface of the HM 150 base module. The water is supplied and the flow rate measured by HM 150. Alternatively, the experimental unit can be operated by the laboratory supply.

HM 150.19

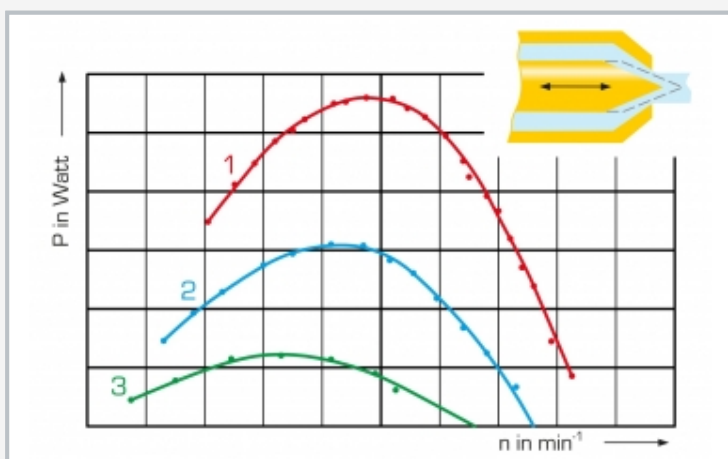
Operating principle of a Pelton turbine



1 spring balance, 2 manometer, 3 adjustment of the nozzle cross-section, 4 needle nozzle, 5 Pelton wheel, 6 adjustment of the band brake



Operating principle of the Pelton turbine:
1 needle nozzle, 2 adjustable nozzle needle, 3 blade on the Pelton wheel, 4 redirected water jet, 5 profile of the blade



Turbine output curves at different positions of the nozzle needle:
1: $Q=31,6\text{L}/\text{min}$, 2: $Q=18,8\text{L}/\text{min}$, 3: $Q=11,5\text{L}/\text{min}$;
n speed, P turbine output

Specification

- [1] function of a Pelton turbine
- [2] transparent front panel for observing the operating area
- [3] loading the turbine by use of the band brake
- [4] adjustable nozzle needle for setting different nozzle cross-sections
- [5] marking on brake drum for non-contact speed measurement
- [6] instruments: spring balances for determining the torque, manometer shows pressure at turbine inlet
- [7] flow rate determination by base module HM 150
- [8] water supply using base module HM 150 or via laboratory supply

Technical data

Pelton turbine

- output: 5W at 500min^{-1} , approx. $30\text{L}/\text{min}$, $H=2\text{m}$
- Pelton wheel
 - 14 blades
 - blade width: $33,5\text{mm}$
 - external diameter: 132mm

Needle nozzle

- jet diameter: 10mm

Measuring ranges

- force: $2 \times 0 \dots 10\text{N}$
- pressure: $0 \dots 1\text{bar}$

LxWxH: $400 \times 400 \times 620\text{mm}$

Weight: approx. 15kg

Required for operation

HM 150 (closed water circuit) or water connection, drain

Scope of delivery

- 1 experimental unit
- 1 set of instructional material

HM 150.19

Operating principle of a Pelton turbine

Optional accessories

070.15000	HM 150	Base Module for Experiments in Fluid Mechanics
070.08200	HM 082	Speed sensor