

# HM 289

## Experiments with a Pelton turbine



The illustration shows HM 289 on top of the water tank in HM 290.

### Description

- illustrative model of a Pelton turbine
- adjustable, wear-free eddy current brake as turbine load
- GUNT software for data acquisition, visualisation and operation
- part of the GUNT Labline fluid energy machines

Pelton turbines are types of impulse turbine. They are driven by free jet nozzles. In the nozzles, the water is strongly accelerated. Ambient pressure exists at the nozzle outlet.

The experimental unit is placed upon the base unit HM 290. The two units together provide the basic experiments to get to know the operating behaviour and the most important characteristic variables of Pelton turbines.

The water jet is accelerated in a nozzle and hits the Pelton wheel tangentially. In the blades on the circumference of the Pelton wheel the water jet is deflected by approximately 180°. The impulse of the water jet is transmitted to the Pelton wheel.

HM 289 consists of a Pelton wheel and a needle nozzle, mounted in a transparent housing. The needle nozzle can be adjusted during operation. The loading device is outside of the housing. The eddy current brake generates a defined load. The eddy current brake is specially developed by GUNT. It is wear-free and can be finely adjusted.

The torque delivered by the turbine is determined via an electronic force sensor. The speed is measured with an optical speed sensor. The measuring values are transferred to the base unit HM 290.

The water supply and the flow rate measurement are realised with the base unit HM 290. A pressure control included in HM 290 enables the recording of characteristics at a constant head.

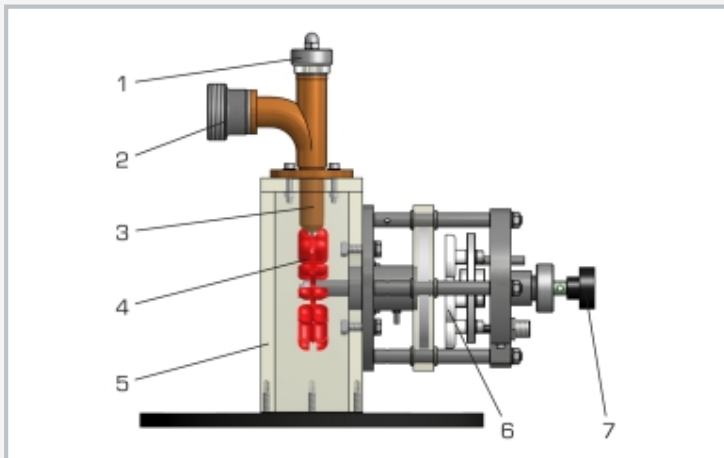
All the advantages of software-supported experiments and evaluation are offered by the GUNT software in HM 290.

### Learning objectives/experiments

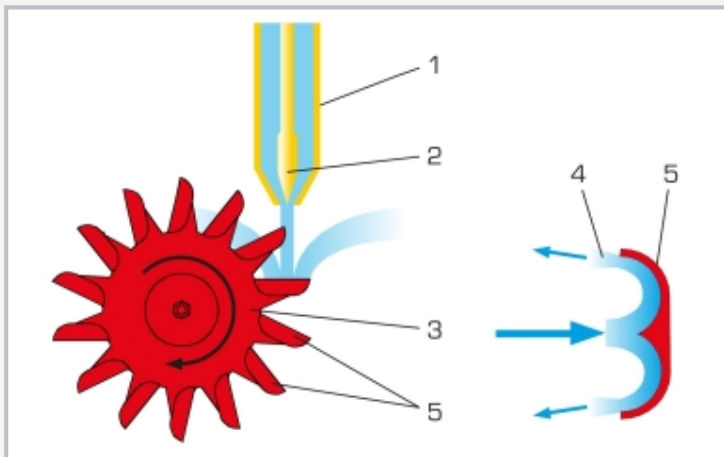
- principle of operation of a Pelton turbine
- characteristic at constant head
  - ▶ relationship between torque and speed
  - ▶ efficiency dependent on speed
  - ▶ flow rate dependent on speed
  - ▶ hydraulic power and mechanical power dependent on speed
- evaluation of measuring values and characteristics based on the theory
- partial load behaviour with needle control in comparison to throttle control

# HM 289

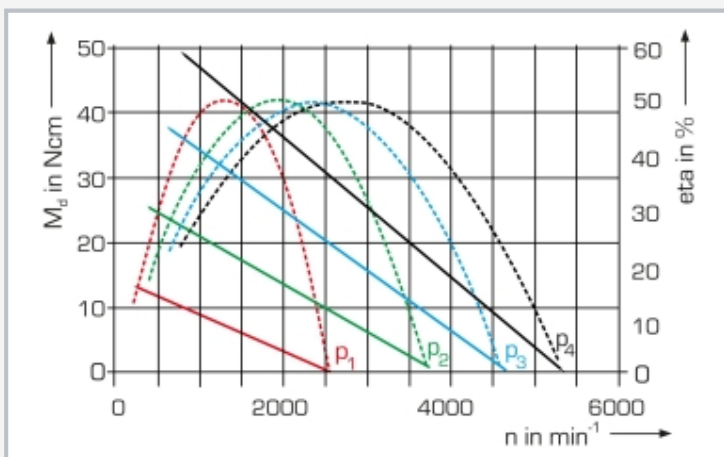
## Experiments with a Pelton turbine



1 adjustment of the needle nozzle, 2 water supply, 3 needle nozzle, 4 Pelton wheel, 5 transparent housing, 6 eddy current brake, 7 adjustment of the eddy current brake



Principle of operation of a Pelton turbine  
1 needle nozzle, 2 adjustable nozzle needle, 3 Pelton wheel, 4 deflected water jet, 5 impinged blade



Characteristic curves of the Pelton turbine at different pressures ( $p_1 \dots p_4$ ); torque (continuous lines) and efficiency (dashed lines) dependent on speed;  $M_a$  torque,  $n$  speed,  $\eta$  efficiency

### Specification

- [1] turbine to place upon the base unit HM 290
- [2] functioning and operating behaviour of a Pelton turbine
- [3] transparent housing for observing the Pelton wheel and needle nozzle
- [4] different nozzle cross-sections via adjustable nozzle needle
- [5] constant pressure of the turbine represents in practice the head and is adjusted via HM 290
- [6] turbine load using the wear-free and adjustable eddy current brake
- [7] force sensor to determine the torque on turbine shaft
- [8] optical speed sensor for measuring the turbine speed
- [9] water supply, flow rate measurement and unit-specific software data acquisition and operation via HM 290

### Technical data

#### Pelton turbine

- power output: approx. 70W at 2700min<sup>-1</sup>
- wheel diameter: 70mm

#### Measuring ranges

- torque: 0...0,5Nm
- speed: 0...9000min<sup>-1</sup>

LxWxH: 350x250x300mm

Weight: approx. 5kg

### Scope of delivery

- 1 experimental unit
- 1 set of instructional material

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## Experiments with a Pelton turbine

Required accessories

HM 290            Base unit for turbines