

HM 150.12

Vertical flow from a tank



Learning objectives/experiments

- Torricelli's law
- determine the level as a function of time
- determine evacuation times
- study of the outlet jet (diameter, velocity)
- determination of flow rate at different discharge heads
- determine loss coefficients
 - ▶ discharge coefficient
 - ▶ velocity coefficient
 - ▶ contraction coefficient

Description

- **determination of the diameter and velocity of the outlet jet**
- **study of openings with different inlet and outlet contours**
- **determining the discharge coefficient**

Pressure losses in the flow from tanks are essentially the result of two processes: the jet deflection upon entry into the opening and the wall friction in the opening. As a result of the pressure losses the real discharge is smaller than the theoretical flow rate.

HM 150.12 determines these losses at different flow rates. Different diameters as well as inlet and outlet contours of the openings can be studied. Additionally, the discharge coefficient can be determined as a characteristic for different contours.

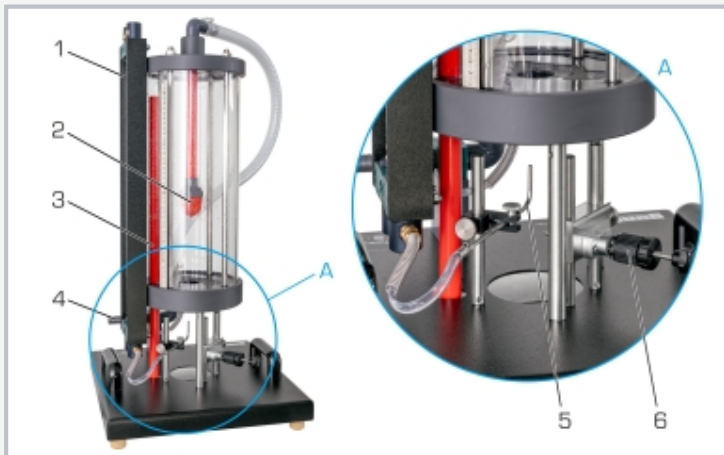
The experimental unit includes a transparent tank, a measuring device as well as a Pitot tube and twin tube manometers. An interchangeable insert is installed in the tank's water outlet to facilitate the investigation of various openings. Five inserts with different diameters, inlet contours and outlet contours are provided along with the unit.

The issued water jet is measured using a measuring device. A Pitot tube detects the total pressure of the flow. The pressure difference (read on the manometer) is used to determine the velocity.

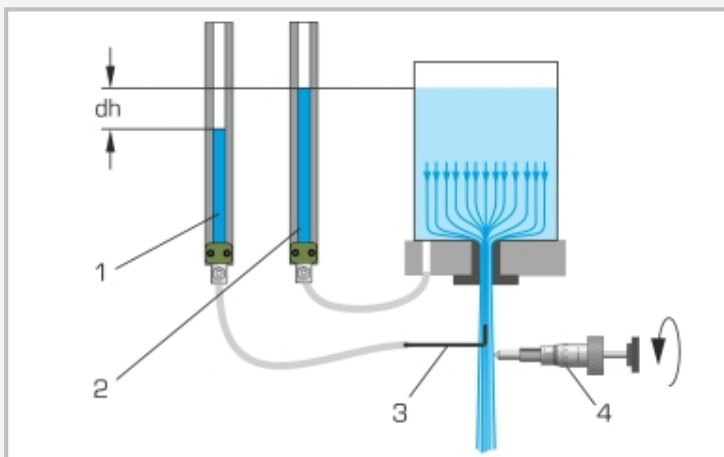
The tank is fitted with an overflow and a measuring point for static pressure. Via a gate valve in the inlet, the level can be precisely adjusted and read on the manometer. The experimental unit is positioned easily and securely on the work surface of the HM 150 base module. The water is supplied and the flow rate measured by HM 150. Alternatively, the experimental unit can be operated by the laboratory supply.

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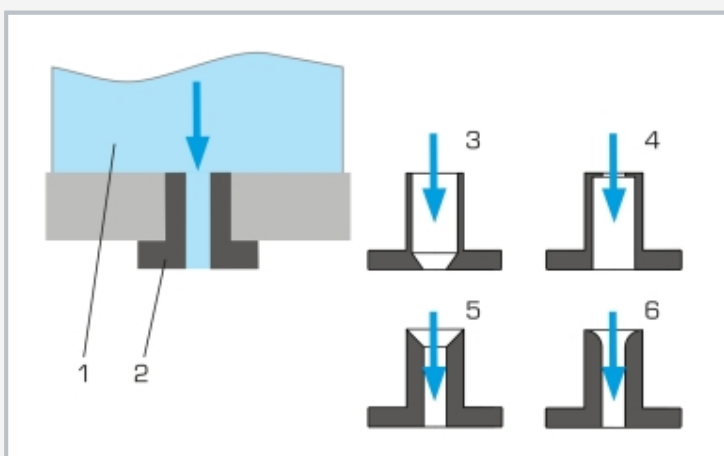
Vertical flow from a tank



1 inlet strainer, 2 water connection, 3 overflow, 4 twin tube manometers, 5 Pitot tube, 6 measuring device for jet diameter



Measuring the pressures and the jet diameter
1 total pressure in the free jet, 2 static pressure in the tank, 3 Pitot tube, 4 measuring device for jet diameter; dh loss due to conversion of pressure into velocity



Interchangeable inserts to study different inlet and outlet contours
1 tank, 2 insert with cylindrical hole, 3 insert with conical outlet, 4 insert with orifice plate at the inlet, 5 insert with conical inlet, 6 insert with rounded inlet

Specification

- [1] study of pressure losses in vertical flows from tanks
- [2] determining the discharge coefficient for different contours and diameters
- [3] tank with overflow
- [4] inlet with gate valve
- [5] 5 interchangeable inserts with different contours
- [6] measuring device for determining the jet diameter
- [7] Pitot tube for determining the total pressure
- [8] pressure display on twin tube manometers
- [9] flow rate determined by HM 150 base module
- [10] water supply using HM 150 base module or via laboratory supply

Technical data

Tank

- capacity: approx. 11L
- overflow height: max. 400mm
- max. flow rate: 14L/min

Inserts

Inner diameters: d_1 =inlet, d_2 =outlet

- 1x cylindrical hole, $d=12$ mm
- 1x outlet from the insert: cone $d_1=24$ mm, $d_2=12$ mm
- 1x inlet to the insert: orifice plate $d_1=24$ mm, $d_2=12$ mm
- 1x inlet to the insert: cone $d_1=30$ mm, $d_2=12$ mm
- 1x inlet to the insert: rounded, $d=12$ mm

Measuring ranges

- pressure: 500mmWC
- jet radius: 0...10mm

LxWxH: 400x400x900mm

Weight: approx. 18kg

Required for operation

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

Scope of delivery

- 1 experimental unit
- 5 inserts
- 1 set of hoses
- 1 set of instructional material

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Optional accessories

HM 150 Base module for experiments in fluid mechanics