

# HM 152

## Potential flow



### Description

- **two-dimensional, inviscid potential flow**
- **visualisation of streamlines**
- **flow around different models: drag bodies and changes in cross-section**
- **modelling the flow around bodies by overlaying the parallel flow and sources and / or sinks**
- **sources and sinks, individually or in combination**

The laminar, two-dimensional flow in HM 152 is a good approximation of the flow of ideal fluids: the potential flow. All physical systems described with the Laplace equation can be demonstrated with potential flow. This includes current and thermal flows as well as magnetic flux.

The core element of the HM 152 trainer is a classic Hele-Shaw cell with additional water connections for sources and sinks. The laminar, two-dimensional flow is achieved by water flowing at low velocity in a narrow gap between two parallel glass plates. The parallel flow generated in this way is non-vortical and can be regarded as potential flow.

Sources and sinks are generated via eight water connections in the bottom glass plate. The streamlines are displayed on the glass plate by injecting a contrast medium (ink).

In experiments the flow around bodies is demonstrated by inserting models into the parallel flow. Interchangeable models such as a cylinder, guide vane profile or nozzle contour are included.

To model the flow without models, it is possible to overlay parallel flow, sources, sinks and dipoles as required. This allows the demonstration of the formation of Rankine half-bodies.

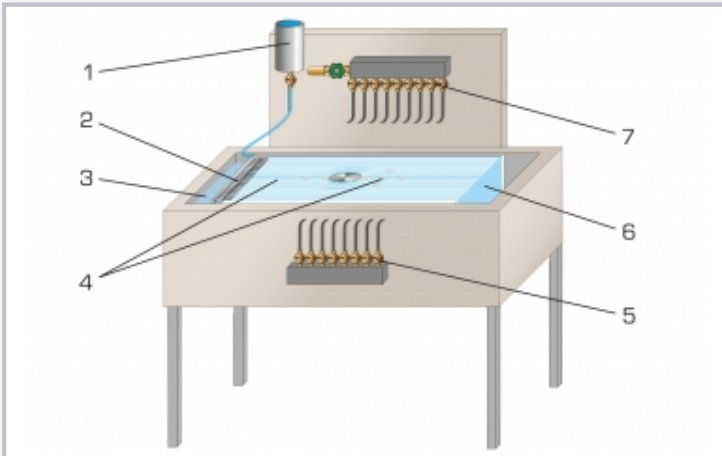
The water flow rate and the quantity of contrast medium injected can be adjusted by using valves. The water connections are also activated by valves and can be combined as required.

### Learning objectives/experiments

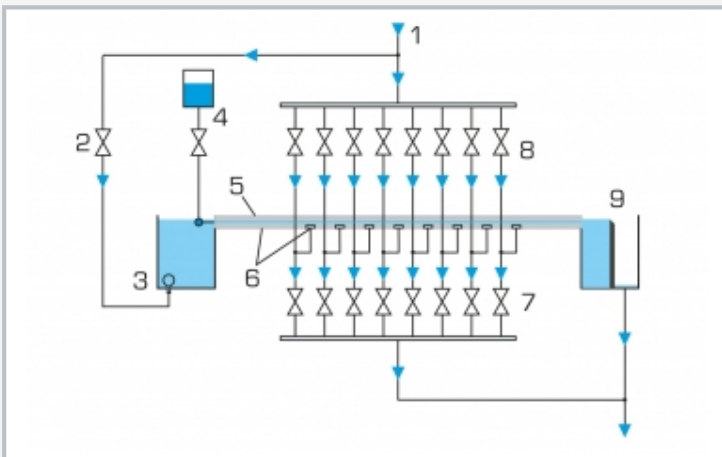
- visualisation of streamlines in
  - ▶ flow around drag bodies: cylinder, guide vane profile, square, rectangle
  - ▶ flow through models: nozzle contour, sudden contraction or enlargement
  - ▶ flow separation, flow with 90° deflection
- modelling the flow around bodies by overlaying parallel flow and sources and/or sinks
  - ▶ formation of Rankine half-bodies
  - ▶ demonstration of a dipole
- analogy between potential flow and other physical systems which are described by the Laplace equation

# HM 152

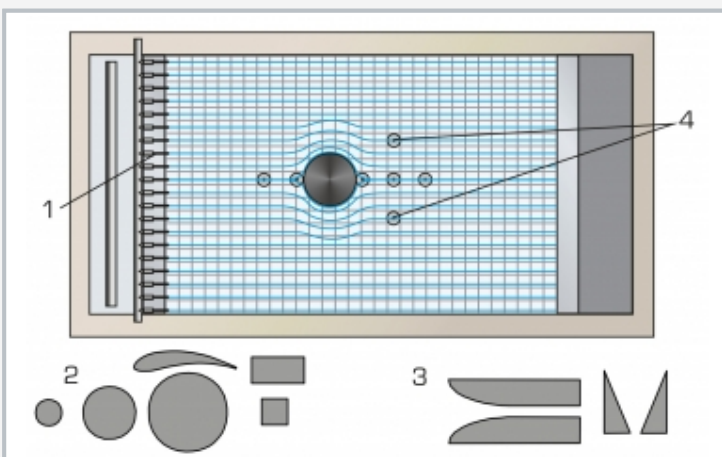
## Potential flow



1 contrast medium, 2 nozzles for injecting the contrast medium, 3 water inlet, 4 Hele-Shaw cell with sources/sinks, 5 valves for sinks, 6 water outlet, 7 valves for sources



1 water inlet, 2 valve, adjusting the flow velocity, 3 tank, 4 contrast medium, 5 upper glass plate, 6 bottom glass plate with water connections (sources/sinks), 7 valves for sinks, 8 valves for sources, 9 water outlet



Flow around a cylinder: 1 injection of the contrast medium, 2 drag body, 3 models for changes in cross-section, 4 sources/sinks arranged in a cross shape

### Specification

- [1] demonstration of potential flow in a Hele-Shaw cell for visualising streamlines
- [2] flow around supplied models: cylinder, square, rectangle, guide vane profile, various models for changes in cross-section
- [3] modelling the flow around contours without models by overlaying parallel flow with sources or sinks
- [4] water as flowing medium and ink as contrast medium
- [5] Hele-Shaw cell made of two glass plates arranged in parallel with narrow gap
- [6] upper glass plate, hinged for swapping models
- [7] bottom glass plate with cross-shaped water connections for generating sources/sinks, can be combined as required
- [8] grid in the bottom glass panel for optimal observation of the streamlines
- [9] flow velocity, water inlet and water outlet in sources/sinks as well as dosage of the contrast medium can be adjusted by using valves

### Technical data

- 2 glass plates, LxW: 910x585mm
- distance between the plates: 5mm
- bottom glass plate with eight water connections for sources/sinks

### Models

- 6 drag bodies
- 2 changes in cross-section
- material: rubber
- thickness: 5mm

### Injection of the contrast medium (ink)

- 19 nozzles

Tank for contrast medium: 200mL

LxWxH: 1350x700x1380mm

Weight: approx. 119kg

### Required for operation

water connection 300L/h, drain

### Scope of delivery

- 1 trainer
- 1 set of models (drag bodies, changes in cross-section)
- 1L Ink
- 1 set of instructional material