



## FREE AND FORCED VORTICES



**DL DKL152**

This system is designed to study the formation of free and forced vortices; a forced vortex is the rotation of a fluid moving as a solid on an axis. By definition, in this kind of vortex each particle has the same angular velocity.

With this equipment students can create a forced vortex with water supply through nozzles that, thanks to a certain inclination, will start the movement of the helix. This helix makes the fluid rotate creating a parable curve; once that the vortex is generated, it will be possible to represent the parable through measuring rods allowing the determination of the height for each point at a fixed radial distance.

The free vortex is one of the basic types of irrotational flow: this movement is different from the forced vortex because each particle moves in a circular path at variable speed. This variation is inversely proportional to the distance to the rotation center; in this case, the other pair of nozzles will be responsible of getting the fluid to the reservoir and their inclination allows the free vortex creation.

The system includes different outlet nozzles allowing the analysis of the influence of the outlet diameter in relation to the vortex, as well as pitot tubes of different lengths, that will grant the possibility to make pressure readings at different depths. Moreover, a gauge included in the system can provide readings of vortex diameter according to the respective depth so that students will be able to graphically represent the result.

In order to provide an accurate observation of the vortex in each experiment, the flow control is carried out by the discharge valve of the hydraulic bench in the inlet and the ball valve at the outlet.



# FLUID MECHANICS



## PERFORMABLE EXPERIMENTS

- Study of a forced vortex.
- Study of a free vortex.

## TECHNICAL DATA

### Tank:

- Material: methacrylate.
- Cylindrical tank:  $\varnothing 250 \times 180$  mm
- Inner diameter tank:  $\varnothing 244$  mm

### Inlet flow nozzle:

- Free vortex nozzle:
  - Inner  $\varnothing = 12.5$ mm
  - Inclination angle:  $15^\circ$
- Forced vortex nozzle:
  - Inner  $\varnothing = 6$ mm
  - Inclination angle:  $60^\circ$

### Accessories:

- Vertical rods for height measurement.
  - Rods:  $\varnothing 6$ mm
  - Rod length:  $L=320$ mm
  - Radial rod position: 110, 90, 70, 50 and 30mm
- Pitot tubes:
  - Length radius: 15, 25 and 30mm
  - Inner  $\varnothing = 1$ mm
- Caliber
  - Range= 20 – 120mm
- Outlet nozzle:
  - Diameters:  $\varnothing 8$ mm,  $\varnothing 16$ mm and  $\varnothing 24$ mm

### Requirements:

Hydraulic bench DL DKL014, not included in this item.