FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

This equipment is designed to study the behavior of fluids in open channels, and allows to perform a wide range of experiments and training.

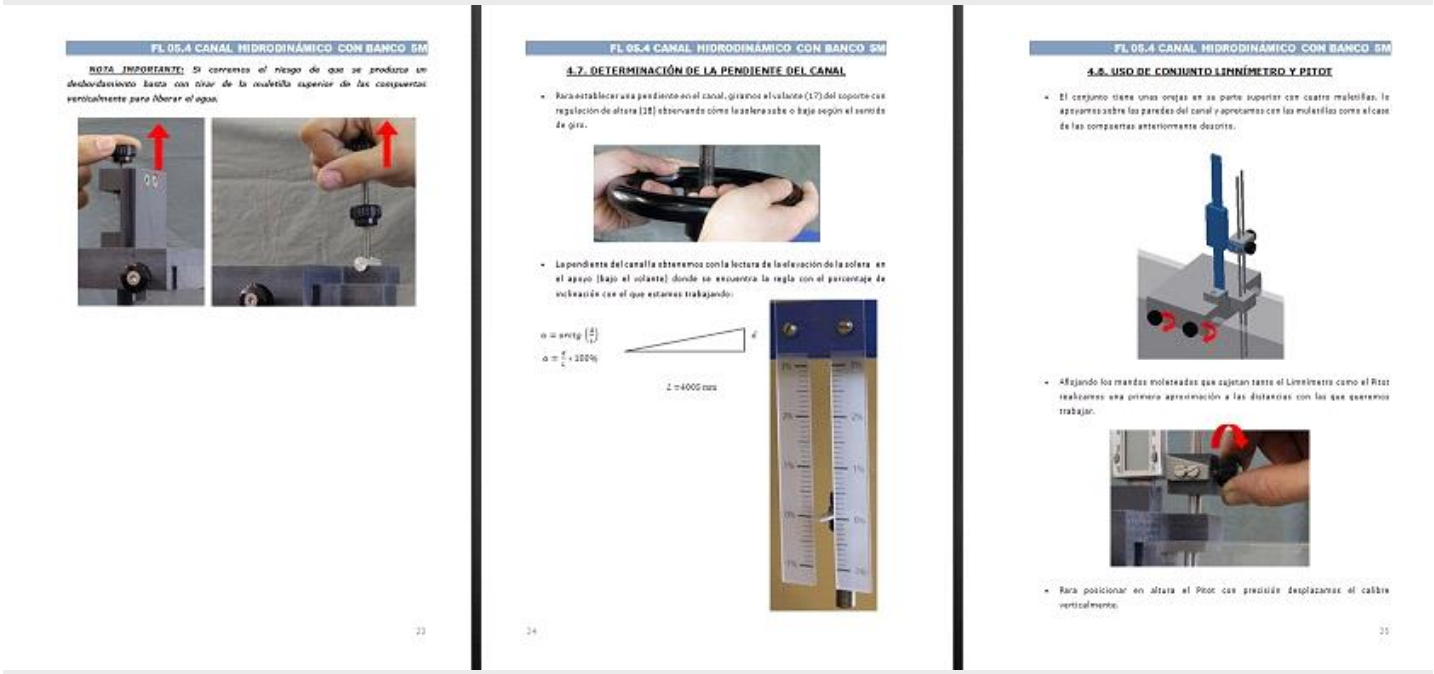
HIGHLIGHTS

- Choice between negative and positive channel slope.
- A range of devices for reading different parametres, manometric gauges, limnimeter, Pitot tube, etc.
- Wide range of accessories to study multiple phenomena.
- It includes a valve to regulate the appropriate flow rate at any moment.
- The flowmeter provides readings of the workflow rate at any time.

IMPORTANT NOTE

- We can provide a range of flow channels in various sizes. Consult without compromise.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com



FL 05.4 CANAL HIDRODINÁMICO CON BANCO SM

NOTA IMPORTANTE: *Si corremos el riesgo de que se produzca un desbordamiento hasta con girar de la ruedecilla superior de las compuertas verticalmente para liberar el agua.*

FL 05.4 CANAL HIDRODINÁMICO CON BANCO SM

4.7. DETERMINACIÓN DE LA PENDIENTE DEL CANAL

- Para establecer una pendiente en el canal, giramos el volante (17) del soporte con regulación de altura (18) observando cómo la solera sube o baja según el sentido de giro.

- La pendiente del canal la obtenemos con la lectura de la elevación de la solera en el apoyo (bajo el volante) donde se encuentra la regla con el porcentaje de inclinación con el que estamos trabajando:

$\alpha = \arctg\left(\frac{d}{L}\right)$

$\alpha = \frac{d}{L} \cdot 100\%$

$L = 4000\ mm$

FL 05.4 CANAL HIDRODINÁMICO CON BANCO SM

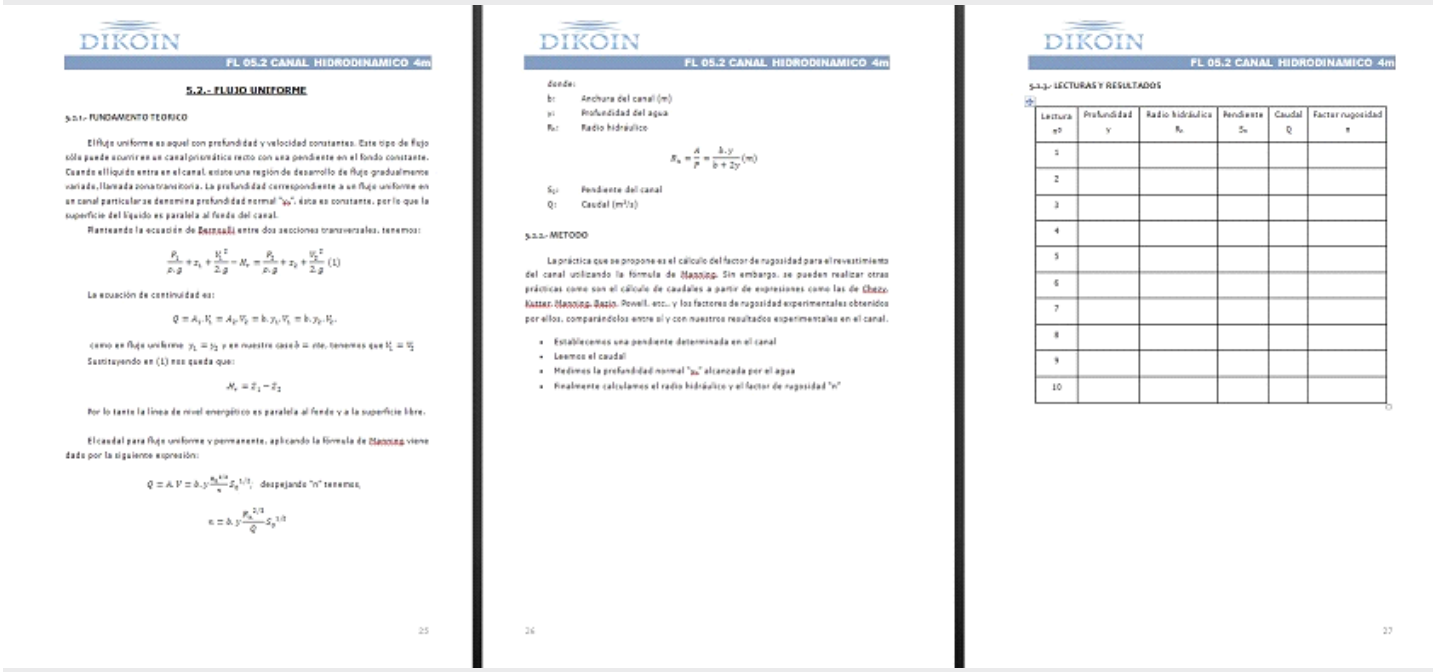
4.8. USO DE CONJUNTO LIMNÍMETRO Y PITOT

- El conjunto tiene unas orejas en su parte superior con cuatro muletillas. Lo apoyamos sobre las paredes del canal y aproximamos con las muletillas como el caso de las compuertas anteriormente descrito.

- Aflojando los mandos moleteados que sujetan tanto el Limnímetro como el Pitot realizamos una primera aproximación a las distancias con las que queremos trabajar.

- Para posicionar en altura el Pitot con precisión desplazamos el calibre verticalmente.

The manual shows clearly and with a lot of images, the hole process to operate the equipment.



DIKOIN

FL 05.2 CANAL HIDRODINAMICO 4m

5.2.- FLUJO UNIFORME

5.2.1.- FUNDAMENTO TEORICO

El flujo uniforme es aquel con profundidad y velocidad constantes. Este tipo de flujo sólo puede ocurrir en un canal prismático recto con una pendiente en el fondo constante. Cuando el líquido entra en el canal, existe una región de desarrollo de flujo gradualmente variado, llamada zona transitoria. La profundidad correspondiente a un flujo uniforme en un canal particular se denomina profundidad normal "y_n", ésta es constante, por lo que la superficie del líquido es paralela al fondo del canal.

Planteando la ecuación de Bernoulli entre dos secciones transversales, tenemos:

$$\frac{P_1}{\rho \cdot g} + z_1 + \frac{V_1^2}{2g} - h_r = \frac{P_2}{\rho \cdot g} + z_2 + \frac{V_2^2}{2g} \quad (1)$$

La ecuación de continuidad es:

$$Q = A_1 V_1 = A_2 V_2 = b \cdot y_1 \cdot V_1 = b \cdot y_2 \cdot V_2$$

como es flujo uniforme $y_1 = y_2$ y en nuestro caso $b = cte$, tenemos que $V_1 = V_2$

Sustituyendo en (1) nos queda que:

$$h_r = z_1 - z_2$$

Por lo tanto la línea de nivel energético es paralela al fondo y a la superficie libre.

El caudal para flujo uniforme y permanente, aplicando la fórmula de Manning viene dado por la siguiente expresión:

$$Q = A \cdot V = b \cdot y \frac{R_h^{2/3}}{n} S_0^{1/2} \quad \text{despejando "n" tenemos,}$$

$$n = b \cdot y \frac{R_h^{2/3}}{Q} S_0^{1/2}$$

DIKOIN

FL 05.2 CANAL HIDRODINAMICO 4m

donde:

b: Anchura del canal (m)
y: Profundidad del agua
R_h: Radio hidráulico

$$R_h = \frac{A}{P} = \frac{b \cdot y}{b + 2y} (m)$$

S_0: Pendiente del canal
Q: Caudal (m^3/s)

5.2.2.- METODO

La práctica que se propone es el cálculo del factor de rugosidad para el revestimiento del canal utilizando la fórmula de Manning. Sin embargo, se pueden realizar otras prácticas como son el cálculo de caudales a partir de expresiones como las de Chezy, Kutter, Hazen-p, Bazin, Powell, etc., y los factores de rugosidad experimentales obtenidos por ellos, comparándolos entre sí y con nuestros resultados experimentales en el canal.

- Establecemos una pendiente determinada en el canal
- Leemos el caudal
- Medimos la profundidad normal "y_n" alcanzada por el agua
- Finalmente calculamos el radio hidráulico y el factor de rugosidad "n"

DIKOIN

FL 05.2 CANAL HIDRODINAMICO 4m

5.2.3.- LECTURAS Y RESULTADOS

Lectura nº	Profundidad y	Radio hidráulico R_h	Pendiente S_0	Caudal Q	Factor rugosidad n
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

The instruction manual explains and shows all the theoretical foundations, as well as all the mathematic expressions used during the experimentation.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.01 - 4 TUBE MULTIMANOMETER
Multimanometer of 4 tubes for flow channel.

Characteristics:
- Height 300mm
- Connections with double obturation
- Coupling channel with adjustable tilt angle

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.02 - INCLINED MANOMETER
Inclined manometer to flow channel.

Characteristics:
- Maximum height 300mm
- Regulation of the angular tilt of tube manometer.
- Connections with double filling.
- Coupling channel with adjustable tilt angle

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.05 - PITOT + LIMNIMETER (For Flow channel)
Accessory composed by a Pitot tube and a clinometer, connected to a gauge, allowing a great accuracy in the readings.

Characteristics:

- High accuracy caliber.
- Easy coupling to the channel walls.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.10 - THIN PLATE WEIR (For Flow channel)
Thin plate rectangular weir without contraction.

Characteristics:

- Rubber profiles on the side of the spillway, to seal.
- Easy placement on the floow of the channel.
- Top of the spillway sharp.
- Height of the spillway 150mm.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.11 - VERTICAL GATE (For Flow channel)
Vertical gate for hydrodynamic channel.

Characteristics:

- Gate lift system allows a quick opnening to prevent overflows or a controlled opening for an easy adjustment to desired height.
- Easy placement on the walls of the channel.
- Rubber profiles on the sides of the gate, for seal.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.12 - RADIAL GATE (For Flow channel)
Radial gate for flow channel.

Characteristics:

- Gate lift system allows a quick opnening to prevent overflows or a controlled opening for an easy adjustment to desired height.
- Easy placement on the walls of the channel.
- Rubber profiles on the sides of the gate, for seal.
- Manufacture in stainless steel.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.15 - BROAD CRESTED WEIR (For Flow channel)
Broad crested weir for flow channel.

Characteristics:

- Easy placement on the bottom of the channel.
- Rubber profiles on the sides, for seal.
- Dimensions (Lenght x Height): 250 x 150 mm.
- Radios on one extreme of 25 mm, and the other with sharp crest.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.16 - CRUMP WEIR (For Flow channel)
Crump weir for flow channel.

Characteristics:

- Easy placement on the bottom of the channel.
- Rubber profiles on the sides, for seal.
- Dimensions (Lenght x Height): 273 x 50 mm.
- Angles in extremes of 15º and 30º.

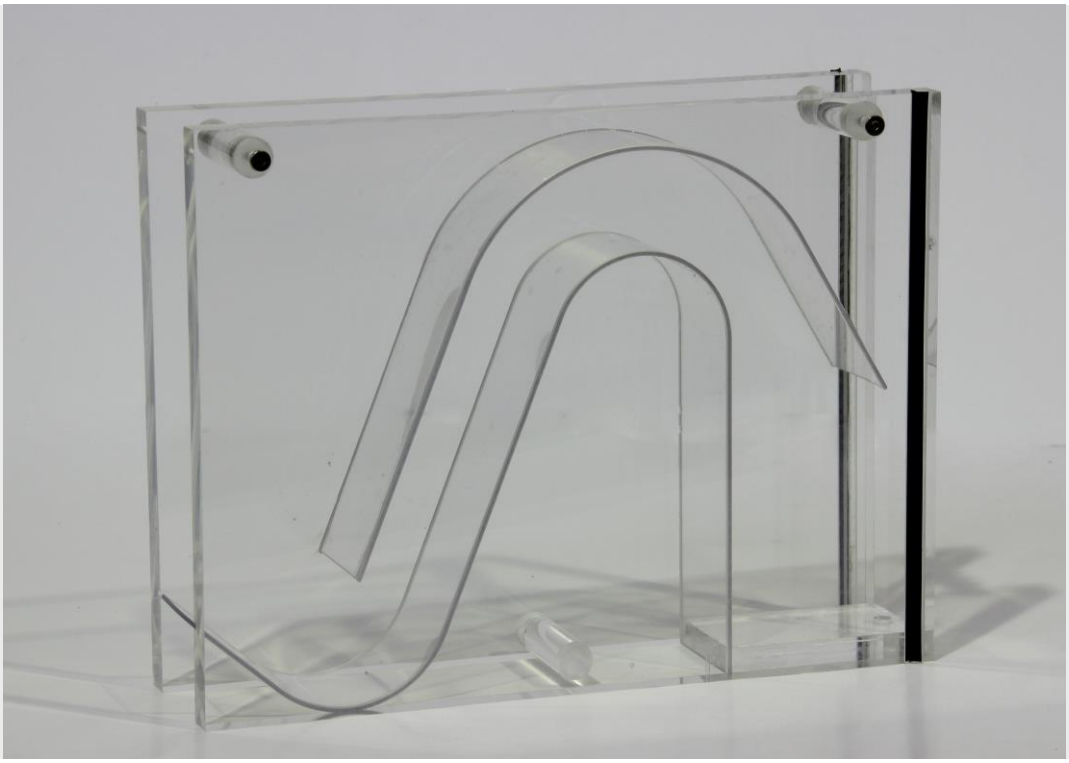
FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.17 - OGEE CRESTED WEIR (For Flow channel)
The HD.Z.17 equipment allows a study of the behaviour of the ogee crested weir and to analyze the flow discharge that it originates.

Characteristics:

- Easy placement on the bottom of the channel.
- Rubber profiles on the sides, for seal.
- Weir height 150mm.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

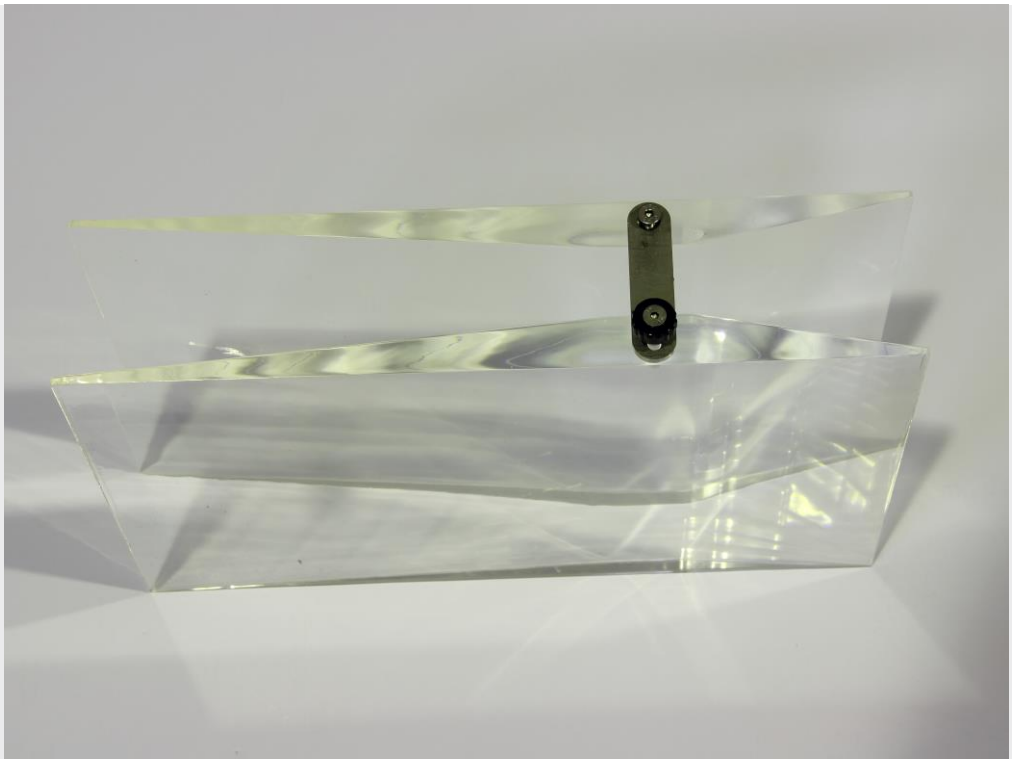


Optional Accessory: HD.Z.20 - SIPHON WEIR (For Flow channel)
The Siphon weir accessory for the flow channel, is placed easily in the bottom of the channel. Built with transparent methacrylate, it forms a closed channel that allows a bigger flow of water than an open channel, due to the suction effect.

Characteristics:

- Rubber profiles on the sides of the weir, for seal.
- Easy placement on the bottom of the channel.
- Complete manufacture in transparent methacrylate.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH



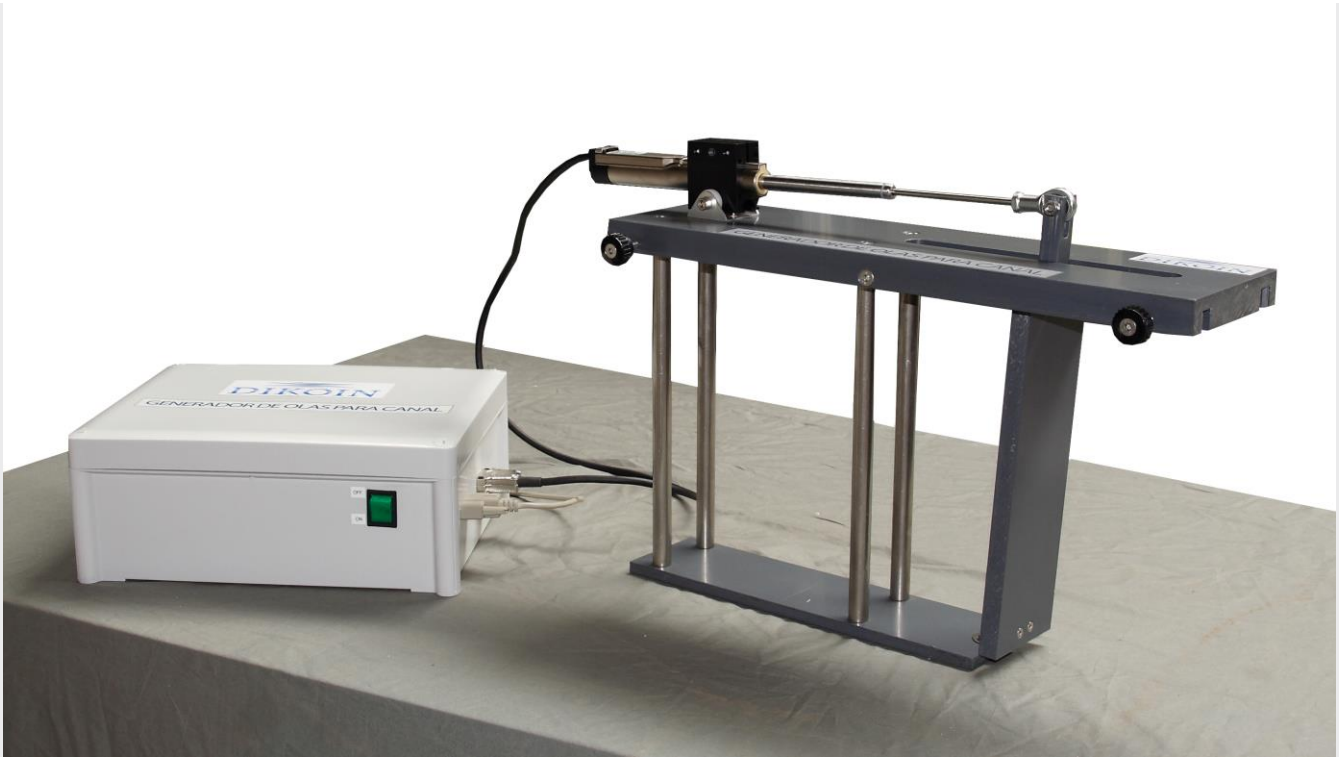
Optional Accessory: HD.Z.21 - VENTURI (For Flow channel)
The Venturi accessory for flow channel, is colocated easily in the bottom of the channel. Built with transparent methacrylate, it forms a narrowing in its horizontal section. With the Pitot tube, experiments can be performed according to the Bernoulli equation.

Characteristics:

- Easy placement on the channel.
- Complete manufacture in transparent methacrylate.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH



Optional Accessory: HD.Z.50 - WAVE GENERATOR
The wave generator HD.Z.50 is designed for its use in 80mm hydrodynamic channels in all lenghts, in order to be able to study the behaviour of waves in a controlled enviroment.

The equipment has an electric engine that generates a smooth movement of swinging on a plate that moves the water, with variable speed.

It is a compact equipment, of easy placement and fixation in the channel.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.51 - VARIABLE TILT PLAIN BEACH
The HD.Z.51 accessory, is intended to be used in flow channels, along with the HD.Z.50.

It allows to vary the inclination of the beach in an easy way, which helps to observe how the wave is formed in the shore in different work conditions.

The surface of the beach is waterproof and is made of stainless steel.

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.06 - SPEED METER IN WATER
The HD.Z.06 water speed meter provides a digital display and a probe, which inmersed in water, will not show the speed of flow in its path.

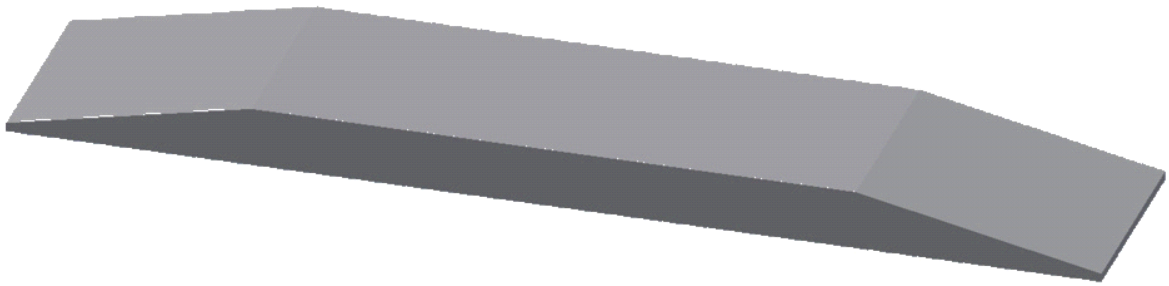
Perfect element for the study of flow channels.

Totally portable and easy to use.

Optional Accessory: HD.Z.30 - 7 PILLARS FOR FLOW CHANNEL
Set of 7 interchangeable pillars of different geometric shapes, for placement and study in hydrodynamic channels.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH



Optional Accessory: HD.Z.40 - SILL
This accessory for the flow channel, is a sill with an entry and an exit at an angle, in which the behavior of the water and its disturbances can be clearly verified.

Optional Accessory: HD.Z.07 - LEVEL GAUGE
Accessory composed of a limnimeter, attached to a gauge, which allows great accuracy in the readings.

Characteristics:
- High accuracy gauge.
- Easy coupling to the walls of the channel.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

Optional Accessory: HD.Z.19 - PLATE WEIRS (TRIANGULAR, RECTANGULAR AND CIPOLETTI)
Set of 3 plate weirs: Triangular, rectangulkar and Cipolletti.

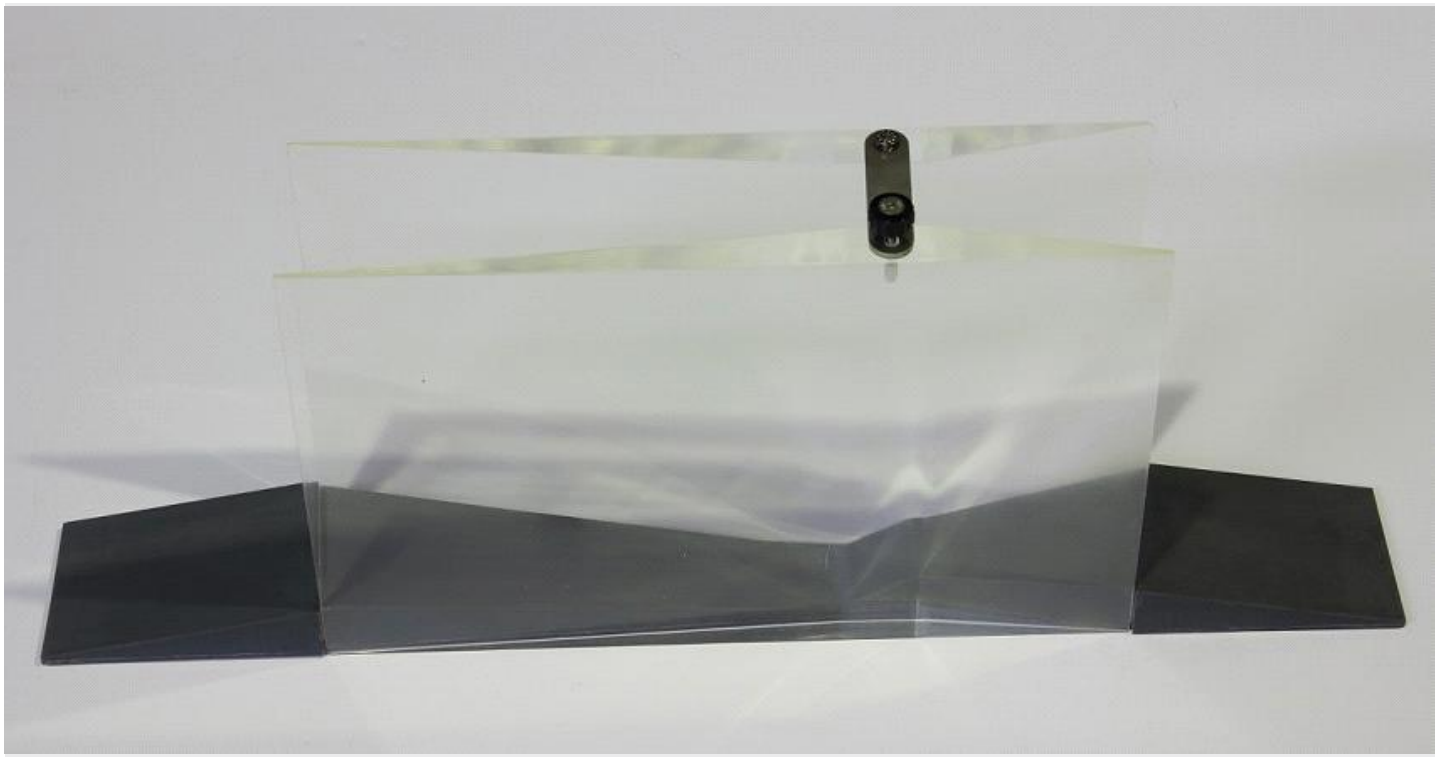
Characteristics:

- Rubber bands for tightness.
- Easy placement on the channel floor.
- Sharp top of the weirs.
- Height of the weirs 190mm.

Optional Accessory: HD.Z.22 - CULVERT FITTING, SQUARE AND ROUNDED EDGE

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH



Optional Accessory: HD.Z.24 - PARSHALL`S DEVICE

Optional Accessory: HD.Z.03 - MULTIMANOMETER 10 TUBES
Multimanometer of 10 tubes for flow channel.

Characteristics:
- Height 300mm
- Double seal connections
- Coupling to the channel with tilt angle adjustment.
- Includes level for fully horizontal placement.

DIKOIN Ingeniería S.L.U.
+034 946 55 15 35 / www.dikoin.com / info@dikoin.com

FL 05.5 - 2,5M FLUME FOR HYDRAULIC BENCH

LEARNING OBJECTIVES

- Study of flow through open channels , measuring variables such as:
  - Height of water.
  - Speed at different points of a cross section .
- Study of uniform flow , gradually varied flow and behavior of surface profiles .
- Study and use of landfill sites for the thin-walled flow measurement.
  - Rectangular weir without lateral contraction .
- Using dumps and study of thick wall for flow measurement .
  - Rectangular weir .
  - Triangular weir .
- Study and use of Venturi channel .
- Analysis and study of flow under doors .
  - Vertical gate .
  - Radial gate .
- Study of the hydraulic jump .
- Analysis of flow over spillways of dams .

* Some of the experiments require optional accessories.

TECHNICAL DATA

Composed by:

- Channel, support structure.
- Flow regulation.
- Flow stabilization system composed by a honeycomb at the entrance, to minimize turbulence.

Materials:

- All the materials used are resistant to corrosion, especially in areas in contact with water.
- Channel: Treated stainless steel.
- Channel walls: 10mm thick laminated, tempered and bevelled glass.
- Tanks: Treated stainless steel.
- Legs: Treated and painted steel.

Section of work:

- Section of work (high/wide): 300 / 87 mm.
- Length: 2.500 mm.

Slope:

- Adjustable -1%+3% of its length.

Flowmeter:

- Scale 1.000-10.000 l/h.

REQUIREMENTS

- Basic Hydraulic Bench 250 l, FL 01.6 equipment.
- To carry out some of the experiments, accessories of the HD.Z.xx range are required.

NOTE: The shown image is indicative.