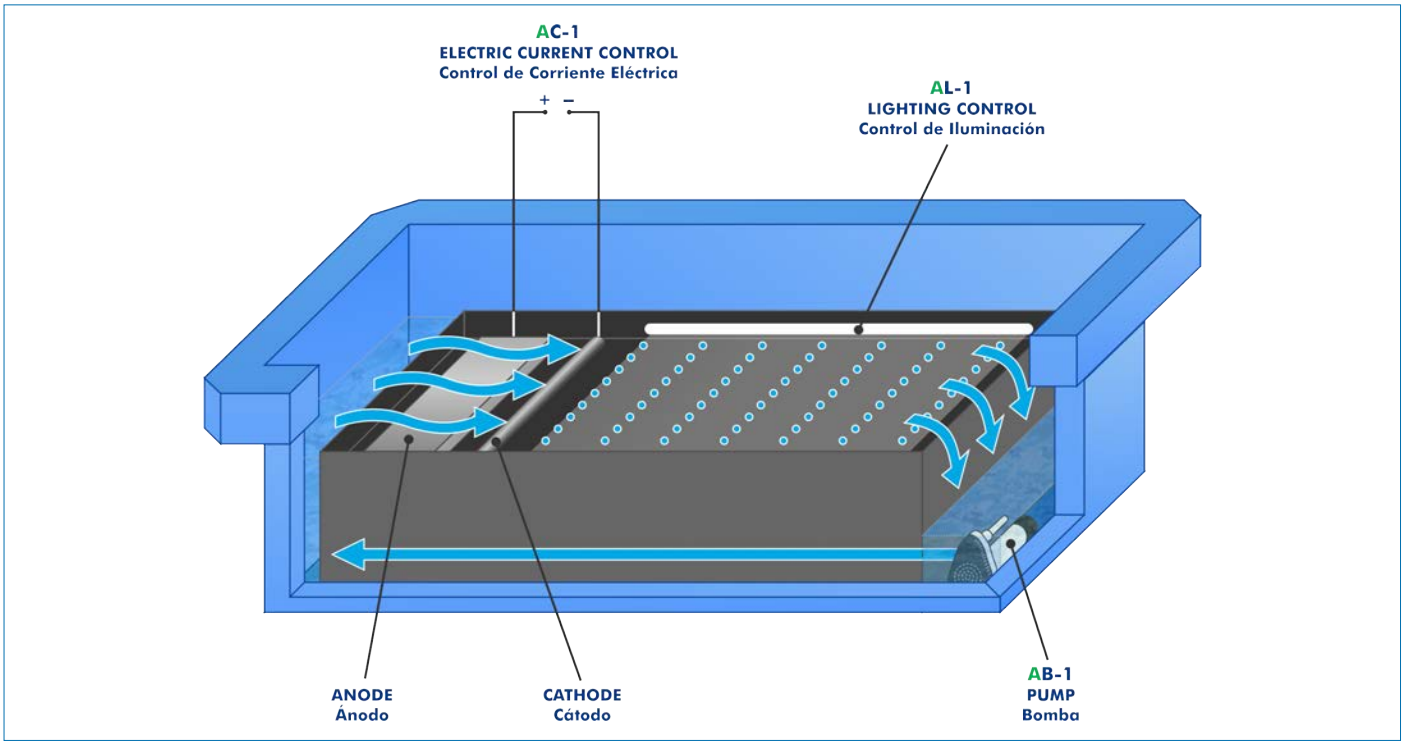
Engineering and Technical Teaching Equipment

Hydrogen Bubble Flow Visualization Unit

UVF

www.edibon.com
PRODUCTS
8.- FLUID MECHANICS

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate (total safety)

Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)

"Worlddidac Quality Charter" and Platinum Member of Worlddidac

INTRODUCTION

Many design problems in the fluids flow area require an exact knowledge of the speed and pressure distribution, for example the flow over curved surfaces along the wings of an airplane, through the strokes in a pump, in a compressor or over the crest of a floodgate. Knowing the flow in two or three dimensions of a fluid offers a wider vision of many real situations of the flow.

Between the different flow visualization techniques, the hydrogen bubble flow visualization technique allows the study of the flow visualization in two dimensions, being it essential to understand fluid mechanics problems. But the most important application is that, from a purely visual technique, quantitative data of the flow can be obtained, apart from their advantages against other techniques:

- Hydrogen bubbles do not contaminate the flow of water, allowing a clean recycling system.
- Bubbles generation by pulses improves accuracy for quantitative flow analyses.

The Hydrogen Bubble Flow Visualization Unit, "UVF", is a particularly useful unit to understand the complex flow patterns associated to water passing around solid bodies. Besides, the hydrogen bubble technique is very useful for laboratories and conferences, showing the path of water.

GENERAL DESCRIPTION

The Hydrogen Bubble Flow Visualization Unit, "UVF", is a self-contained unit designed to study different flow patterns through the hydrogen bubble flow visualization technique.

Bubbles are generated by electrolysis by the application of an electric current between one cathode (thin thread of platinum) and one anode (plate of steel), immersed in a flow of water. Hydrogen and oxygen are separated from water by electrolysis, being the hydrogen bubbles generated in the cathode. Since these bubbles are small, they are easily swept by the flow of water.

The electrolysis is performed in a shallow working section (adjustable) with black base to optimize the visualization of the flow patterns.

This working section is located inside a water storage tank, where there is a submersible adjustable speed pump, which will impel water along the working section. By regulating the flow, the user can change the water flow along the working section from laminar to turbulent. A flow rectifier makes the flow uniform and with little turbulences.

The electric current can be applied continuously. The intensity can be regulated, thus the size of the generated hydrogen bubbles can be varied or the corresponding quantitative measurements can be carried out. The bubbles can be "switched on" or "switched off" by pulses. Pulses and intervals are independently variable and are indicated in the screen.

To observe the flow separation and the vortex formation clearly, the unit includes different interchangeable models. They are bodies that exert resistance and modifications of the cross section that are introduced in the working section to study the surrounding flows and the passing flows.

For an optimum visualization of the flow patterns there is an adjustable lighting system, located at the side of the working section, which makes hydrogen bubbles shine.

SPECIFICATIONS

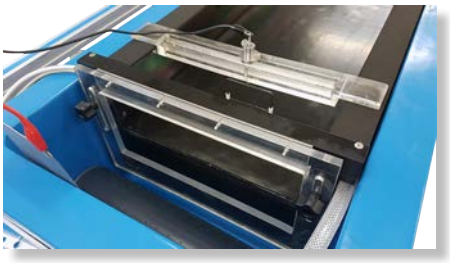
Anodized aluminum frame and panels made of painted steel.
The unit includes wheels to facilitate its mobility.
Main metallic elements made of stainless steel.
Diagram in the front panel with distribution of the elements similar to the real one.
Tank made of fiberglass with capacity of 25 l.
Submersible adjustable speed pump:
- Maximum flow: 1320 l/h.
- Maximum height: 14 m.

Flow rectifier and inlet gate to obtain a uniform flow without turbulence.
Working section of dimensions: 600 x 290 mm, included:
- Outlet gate to regulate the depth of the working section.
- Plate made of stainless steel with a thickness of 1 mm that forms the anode.
- Three threads made of platinum with a diameter of 0.2 mm and different lengths (30, 50, 75 mm) that form three exchangeable cathodes.
- Three fork-shaped supports for the cathodes.
- Bubble generator:
  - Maximum intensity: 450 mA. Pause: 0 – 2000 ms. Pulse: 0 – 2000 ms.
- Set of submersible white light LEDs with adjustable intensity.

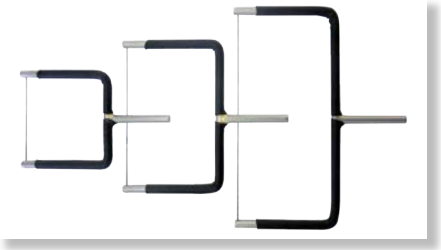
Briefcase with set of models:
- Four cylinders made of PVC with different size (6, 12, 19, 25 mm. of diameter).
- Rectangular block made of PVC (70 x 40 x 25).
- Two straight guides of 330 mm long.
- Aerodynamic section made of methacrylate.
- Flat plate made of methacrylate with rounded ends.
- Flat plate made of methacrylate with one triangular end and one rectangular end.
- Two curved plates made of methacrylate.

Console, including:
- Metallic box. Main switch.
- DC switch and control. DC digital display.
- Pulse time and pause between current pulses switch and control.
- Pulse time and pause between current pulses digital display.

Cables and Accessories, for normal operation.
Manuals: This unit is supplied with the following manuals: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.



UVF detail



Detail of the exchangeable cathodes with support

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Visualization of the flow around different obstacles.
2.- Understanding laminar and turbulent flow.
3.- Boundary layer separation and vortex formation.
4.- Analogies with the aerodynamic flow.

Additional practical possibilities:

5.- Two-dimensional visualization of the hydrogen bubble flow.
6.- Quantitative analysis of the flow parameters with little bursts of bubbles.
7.- Visualization and demonstration of the boundary layer.
8.- Demonstration of Karman vortices.
9.- Visualization of flow around models created by the user.
10.-Presentations with flow patterns recordings using a video camera or webcam (not supplied).

REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.

DIMENSIONS AND WEIGHTS

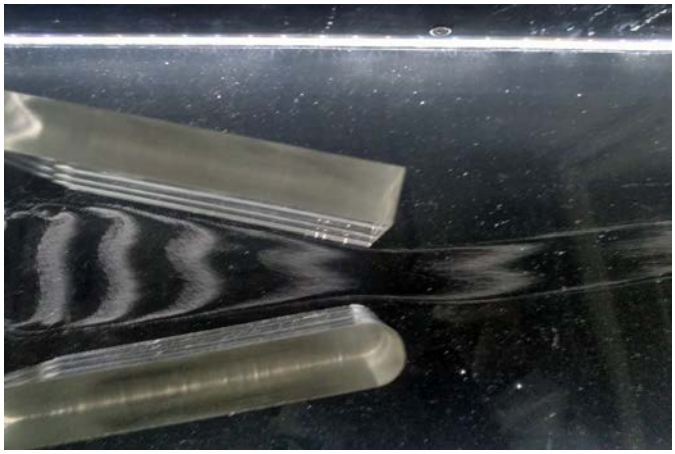
UVF:

-Dimensions: 1500 x 700 x 900 mm approx.
(59.05 x 27.55 x 35.43 inches approx.)

-Weight: 25 kg approx.
(55 pounds approx.).

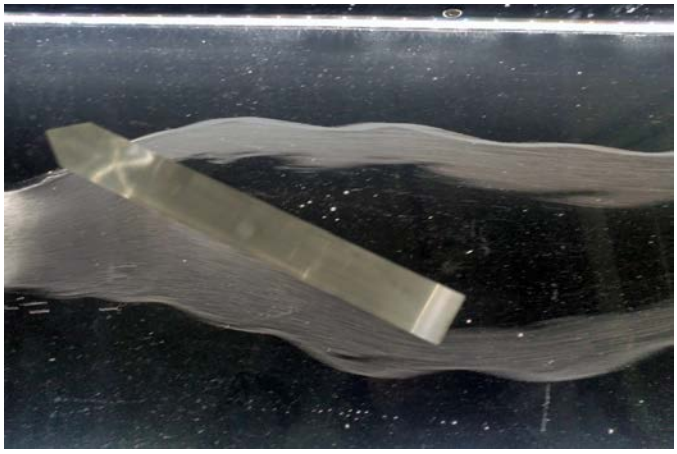
RECOMMENDED ELEMENTS (Not included)

- Camera or video camera to take pictures or record different flow patterns.
- Glauber's salt (Na_2SO_4 x $10H_2O$).
- Graduated scale/ruler to measure the distances of bubbles pulses.
- Chronometer.



Velocity increase when the passage section of the flow.

Flow through different configurations of rectangular blocks.



Flow through a flat plate with one triangular end and one rectangular end made of methacrylate.

Formation of boundary layer on the walls of a pipe.

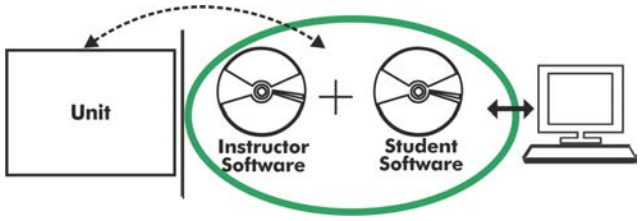
Formation of vortices when flow passes around a cylinder.

Laminar flow velocity profiles.

Pulses and modification of the flow direction.

Separation of boundary layer in an aerodynamic section.

UVF/ICAI. Interactive Computer Aided Instruction Software:



With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF).** Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

Instructor Software

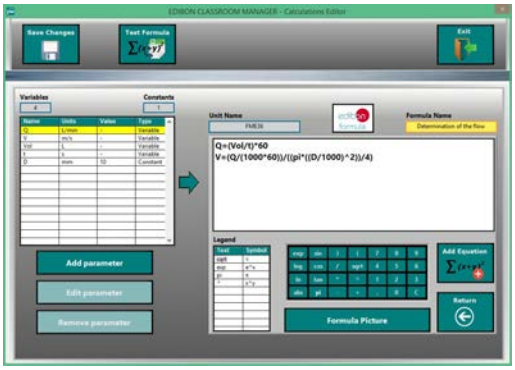
- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

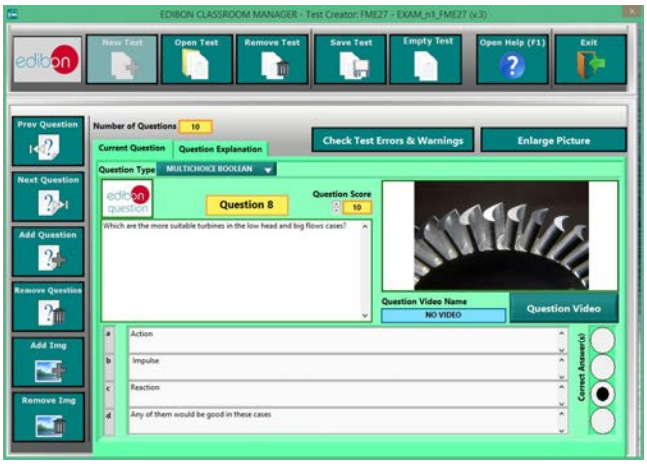
Innovative features:

- **User Data Base Management.**
- **Administration and assignment of Workgroup, Task and Training sessions.**
- **Creation and Integration of Practical Exercises and Multimedia Resources.**
- **Custom Design of Evaluation Methods.**
- **Creation and assignment of Formulas & Equations.**
- **Equation System Solver Engine.**
- **Updatable Contents.**
- **Report generation, User Progression Monitoring and Statistics.**

ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen



ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

Optional

Student Software

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

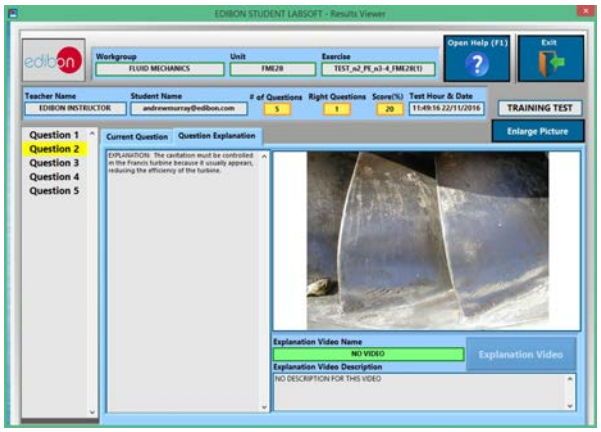
Innovative features:

- **Student Log-In & Self-Registration.**
- **Existing Tasks checking & Monitoring.**
- **Default contents & scheduled tasks available to be used from the first session.**
- **Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- **Evaluation Methods to prove your knowledge and progression.**
- **Test self-correction.**
- **Calculations computing and plotting.**
- **Equation System Solver Engine.**
- **User Monitoring Learning & Printable Reports.**
- **Multimedia-Supported auxiliary resources.**

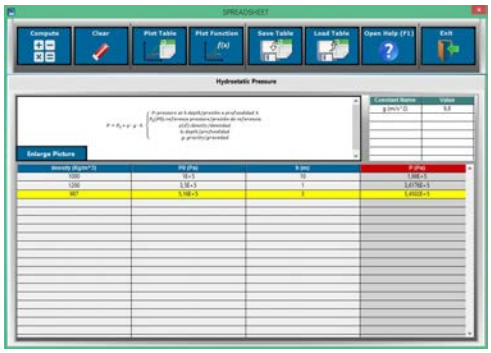
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen

For more information see **ICAI** catalogue. Click on the following link:
www.edibon.com/en/files/expansion/ICAI/catalog



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

✱ Specifications subject to change without previous notice, due to the convenience of improvement of the product.

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REPRESENTATIVE: