

Orifice Plate



Nozzle No. 1

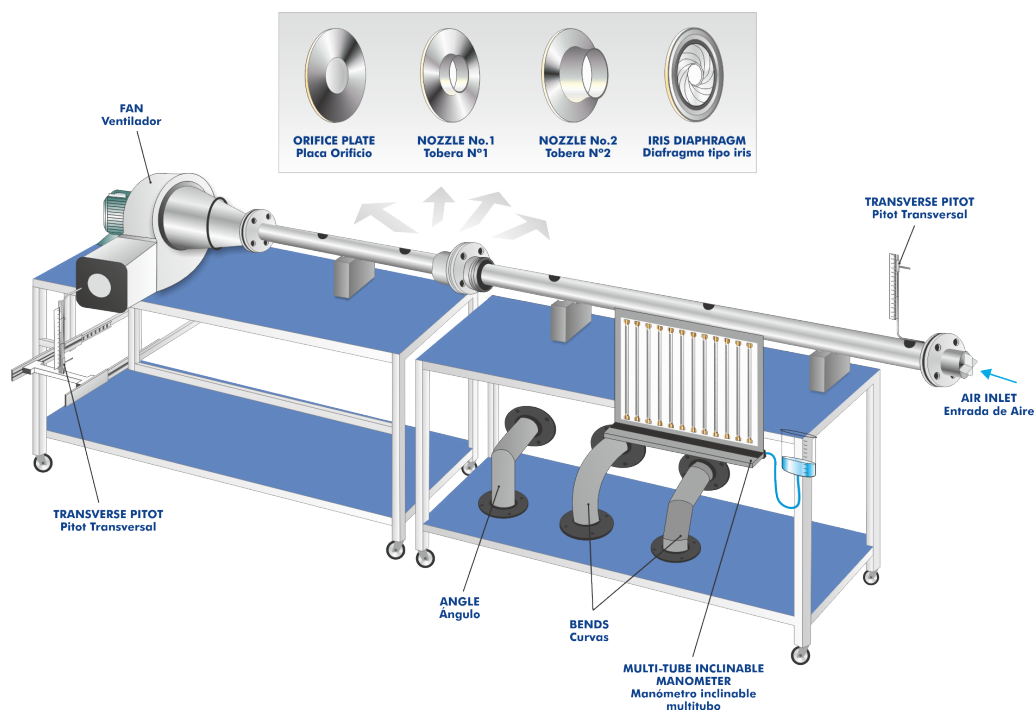


Nozzle No. 2



Iris Diaphragm

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



INTRODUCTION

One of the most common principles of fluids flow metering is the differential pressure flowmeter. In this devices type, flow is calculated by measuring the pressure drop over an obstruction inserted in the flow. This creates a pressure drop across the device. The differential pressure flowmeter is based on Bernoulli equation, where the pressure drop is a function of the flow rate.

Most common types of differential pressure flowmeters are: orifice plate, nozzles and iris diaphragm.

The Air Flow Studies Unit, "HECA", allows to study the basic principles of fluid mechanics that are applied to analyze the air flow in order to determine the pressure distribution and the velocity profile of a flow.

GENERAL DESCRIPTION

The Air Flow Studies Unit, "HECA", is a floor standing unit that allows to measure different characteristics of air distribution systems and to demonstrate certain basic principles of fluid mechanics in ducts and jets.

The unit is mounted on a metal frame with wheels and consists of two modules connected one to each other.

One module includes an electrical centrifugal fan, with speed control.

The other module includes a long and smooth test pipe that is connected to the suction side of the centrifugal fan. A deflector in the inlet prevents air separation from the wall of the pipe and reduce the formation of vortices, and the pipe diameter minimizes the presence of turbulence. Several pressure tapings are included along the length of the pipe to determine the pipe friction factor, pressure losses and velocity profiles.

The unit has two Pitot tubes:

- One located at the discharge of the fan, attached and properly protected. It can be situated at different distances from the discharge orifice to study free jet velocity profiles.
- The other one can be located in any of the different points of the test tube to perform an air flow analysis of the velocity profile inside the pipe section. This Pitot tube can also be located at different distances in the pipe to demonstrate the boundary layer growth.

The air flow rate can be measured with various measuring devices, such as iris diaphragm, a Pitot tube, an orifice plate and two nozzles with different diameters.

The unit includes two bends and an angle to fit to the pipe for comparison of pressure losses.

The measuring devices and the Pitot tubes are connected via tubes to a multi-tube inclinable manometer where the pressure differences can be measured. This manometer can be inclined to increase its resolution and can be locked into different positions.

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.

Centrifugal fan, with speed control:

Max. volumetric flow rate: 1800 m³/h.

Max. motor power: 750 W.

It includes a plate with one orifice at the discharge side of the fan to carry out air jet dispersion practical exercises, orifice diameter: 30 mm.

Long smooth test pipe, inner diameter 81.4 mm; length: 2500 mm approx. It includes:

Deflector in the inlet to prevent air-separation from the wall of the pipe and reduce the formation of vortices.

Ten pressure tapings to measure the pressure gradient along the pipe.

Five stations to use the transverse Pitot tube and to determine the boundary layer growth and the development of velocity profile.

Two Pitot tubes:

Pitot tube located at the discharge of the fan, attached and properly protected. It can be situated at different distances from the discharge orifice to study free jet velocity profiles:

Horizontal: -150...150 mm.

Vertical: -150...150 mm.

Pitot tube can be located in any of the different points of the test tube to perform an air flow analysis of the velocity profile inside the pipe section. This Pitot tube can also be located at different distances in the pipe to demonstrate the boundary layer growth:

Vertical: -24...38 mm.

Iris diaphragm, diameter: 40 – 97 mm. It includes two pressure tapings.

Orifice plate, diameter: 50 mm.

Two nozzles with different diameters, diameters: 50 and 70 mm.

Two bends and an angle may be fitted to the test pipe to compare pressure losses in fittings.

Multi-tube inclinable manometer, which can be inclined to increase its resolution. It includes: 20 water tubes with a length of 500 mm and inner diameter of 6 mm, and a tank made of PMMA to fill it with water.

Control panel:

Main switch.

ON/OFF Fan switch.

Fan speed controller.

Fan speed 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.

Additional recommended elements (Not included):

- HECA-1. Venturi Tube.
- HECA-2. Accesory to measure boundary layers on a flat plate.
- HECA-3. Accesory to study the Drag Forces.



HECA detail

Additional recommended elements (Not included)

HECA-1. Venturi Tube

When air flows through a pipe and either narrows or widens, both the pressure and the flow rate vary. This is demonstrated by the continuity equation and Bernoulli's principle.

The Venturi tube, "HECA-1", along with the HECA unit, allows the study of the continuity equation that governs the dynamics of fluids, as well as Bernoulli's principle, by varying the passage section of the fluid flow.

This accessory has six pressure tapping, located in the different sections of the Venturi tube, with which you can measure the static pressure at the points.

Specifications:

- Diameter of the sections: 59 – 81.4 mm.
- Convergence angle: 21°.
- Divergence angle: 8°.
- Six pressure tapings.



HECA-2. Accessory to measure boundary layers on a flat plate

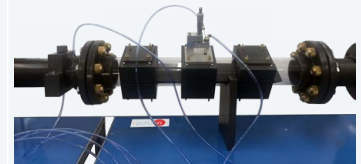
When a body is positioned in the direction of a fluid flow, the layers of the fluid in contact with that body can remain attached to it. This causes internal friction in the fluid that causes the speed of flow to vary throughout the body.

The Accessory to measure boundary layers on a flat plate, "HECA-2", along with the HECA unit, allows the study of the flow velocity profiles at different points on the surface of a flat plate as well as the boundary layer that is created above it.

For the calculation of the speed, this accessory has a Pitot tube that records the total and static pressures of the fluid. In addition, it is also height adjustable and can be positioned in different positions along the flat plate.

Specifications:

- Pitot tube:
 - Internal diameter of the tubes: 0.5 mm.
 - Height adjustment: 0 – 17 mm.
 - Three measuring positions respect to the beginning of the plate: 50 mm, 225 mm and 400 mm.
- Flat plate:
 - Dimensions: 450 x 81.4 x 10 mm.
 - 15° chamfer at the end facing the air flow.



HECA-3. Accessory to study the Drag Forces

The drag force opposes the movement of a body along the fluid, being parallel to the thrust or trajectory of the body but with the opposite direction.

The Accessory to study the Drag Forces, "HECA-3", together with the HECA unit, allows to study the drag forces on different aerodynamic profiles thanks to some load cells.

This accessory also has a console to display the force measured by the load cells.

Specifications:

- Load cell measuring range: 0 – 20 N.
- Two aerodynamic profiles:
 - Sphere: diameter 25 mm.
 - Circular flat face: diameter 25 mm.



EXERCISES AND PRACTICAL POSSIBILITIES

- 1.- Utilization of manometers to measure pressure drops.
- 2.- Measurement of air flow rate with an iris diaphragm.
- 3.- Measurement of air flow rate with a Pitot tube.
- 4.- Measurement of air flow rate with an orifice plate.
- 5.- Measurement of air flow rate with a nozzle.
- 6.- Determination of pressure losses in straight pipes.
- 7.- Determination of pressure losses in pipe bends and angles.
- 8.- Determination of the velocity profile in a pipe which air is flowing.
- 9.- Determination of the velocity profile in a free jet with the Pitot tube.
- 10.- Demonstration of the boundary layer growth.
- 11.- Understanding the use of Reynolds' numbers.
- 12.- Measuring the air flow via a Venturi nozzle. (requires the additional recommended element HECA-1)
- 13.- Determination of the exact section of the Venturi tube. Study of Bernoulli's Theorem. (requires the additional recommended element HECA-1)
- 14.- Study of the velocity profile above a flat plate. (requires the additional recommended element HECA-2))
- 15.- Study of the boundary layer on a flat plate. (requires the additional recommended element HECA-2)
- 16.- Study of the drag forces in different shapes. (requires the additional recommended element HECA-3)

REQUIRED SERVICES

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

DIMENSIONS AND WEIGHTS

HECA:

- Dimensions: 3000 x 600 x 1400 mm approx.
(118.10 x 23.62 x 55.11 inches approx.)
- Weight: 90 Kg approx.
(198 pounds approx.).

HECA-1:

- Dimensions: 575 x 200 x 200 mm approx.
(22.63 x 7.87 x 7.87 inches approx.)
- Weight: 5 Kg approx.
(11 pounds approx.).

HECA-2:

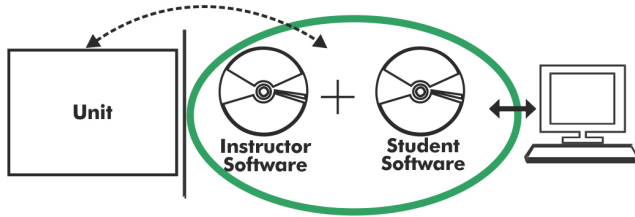
- Dimensions: 705 x 200 x 200 mm approx.
(27.75 x 7.87 x 7.87 inches approx.)
- Weight: 10 Kg approx.
(22 pounds approx.).

HECA-3:

- Dimensions: 405 x 200 x 200 mm approx.
(15.94 x 7.87 x 7.87 inches approx.)
- Weight: 5 Kg approx.
(11 pounds approx.).

ADDITIONAL RECOMMENDED ELEMENTS (Not included)

- HECA-1. Venturi Tube.
- HECA-2. Accessory to measure boundary layers on a flat plate.
- HECA-3. Accessory to study the Drag Forces.

HECA/ICAI. Interactive Computer Aided Instruction Software:

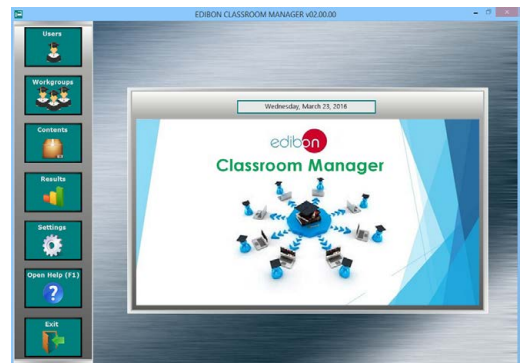
With no physical connection between unit and computer, this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF). Both are interconnected so that the teacher knows at any moment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

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

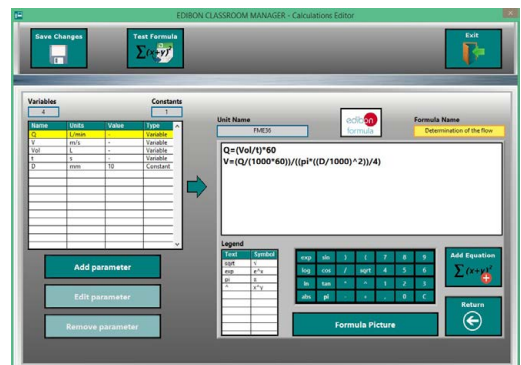
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual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

Innovative features:

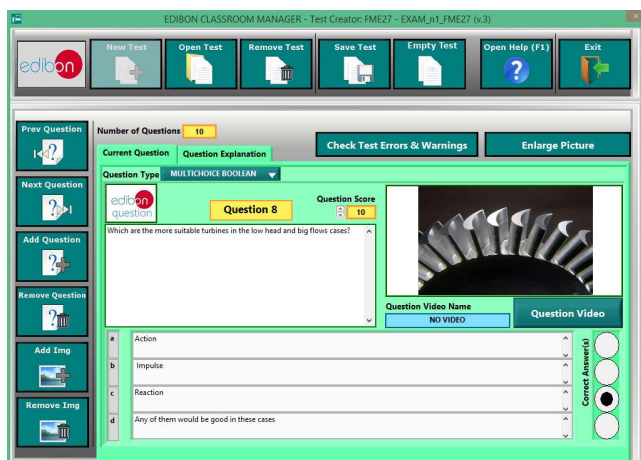
- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.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

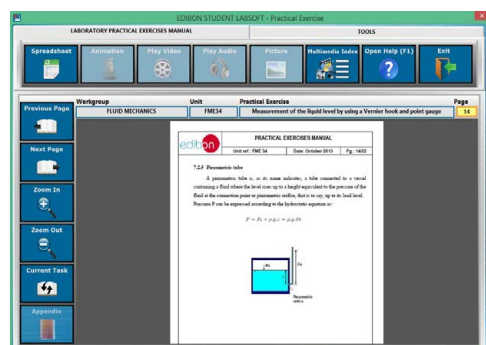
Innovative features:

- 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.

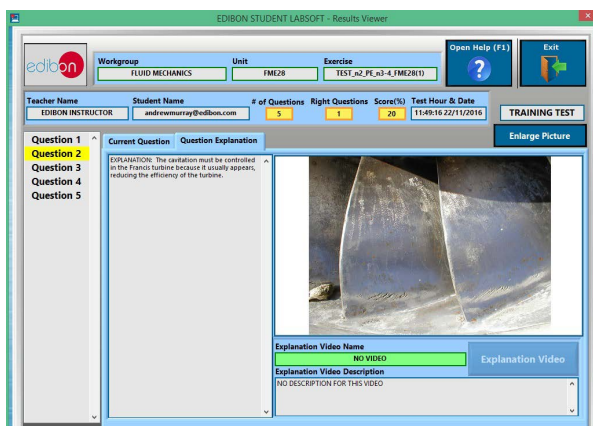
For more information see ICAI catalogue. Click on the following link:
www.edibon.com/en/interactive-computer-aided-instruction-software



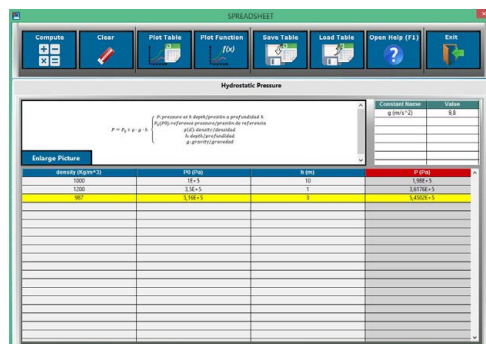
ESL-SOF. EDIBON Student LabSoft (Student Software)
Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen



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:

