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Engineering and Technical Teaching Equipment

Aerodynamic Testing Bench

ATBB

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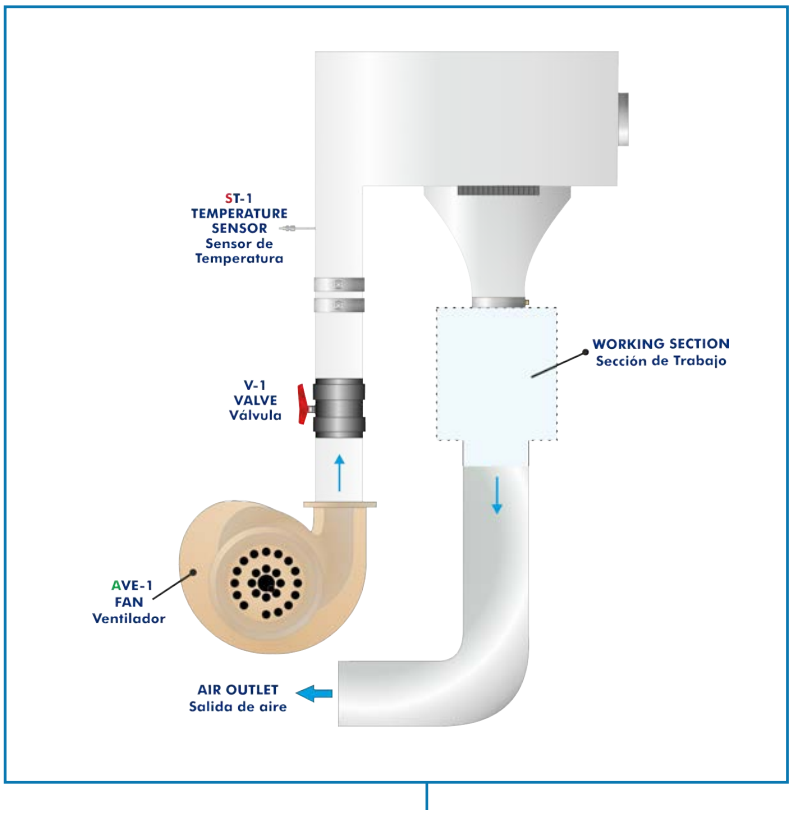
↳PRODUCTS
↳8.- FLUID MECHANICS

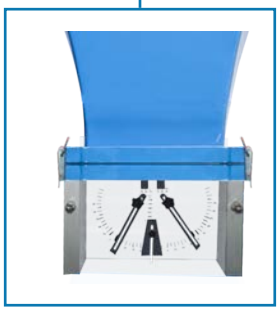
ATBB. **Aerodynamic Testing Bench**



Recommended elements

ATB/BL.
Model to Study the Boundary Layer

ATB/DF.
Model to Study the Drag Forces



ATB/CE.
Model to Study the Coanda Effect

ATB/VS.
Model to Visualize Streamlines

ATB/BP.
Model to Study Bernoulli's Principle

ATB/PDB.
Pressure Distribution in a Pipe Bend

ATB/FJ.
Model to Study a Free Jet

ATB/SS.
Pressure Distribution in a Streamlined Shape

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

Aerodynamics is a branch of fluid mechanics that studies the movement of gases when the flow falls upon a body and the behavior of these bodies at rest or in motion. The experiments in aerodynamics allows numerous advances in the design of buildings and means of transport.

The Aerodynamic Testing Bench, "ATBB", has been designed to perform aerodynamic tests both in the field of bodies exposed to flow around and in the field of steady incompressible flow.

GENERAL DESCRIPTION

The unit has two main components: a radial fan with speed control and a working section where the different accessories for the tests are fixed.

The radial blower impels the air through an air intake pipe to a rectifier that stabilizes the air, eliminates the turbulences and makes the air flow that reaches the working section be homogeneous. The air leaves the rectifier by a nozzle, where its speed is accelerated, and it is injected into the working chamber.

Accessories that allow different experiments can be attached to the working section in a comfortable and simple way.

After the working section, the air is driven to an air outlet pipe.

There are up to 45 measuring points in which the pressure can be measured, both along the circuit and in the accessories. For pressure measurements, the recommended element is the Manometer Panel. 16 Manometer tubes, "ATB/MB". The manometer panel is connected to the pressure taps by flexible hoses fitted with quick-release couplings.

SPECIFICATIONS

Anodized aluminum frame and panels made of painted steel.

The unit includes wheels to facilitate its mobility.

Main metal elements made of stainless steel.

Diagram in the front panel with distribution of the elements similar to the real one.

Radial blower with speed control through variable-frequency drive:

Power consumption: 0.5 kW.

Maximum flow rate: 17 m^3/min.

Flow rectifier to reduce turbulences and provide a homogeneous flow.

Nozzle with outlet section of 50 x 100 mm. Maximum speed of the flow at the outlet of the nozzle: 40 m/s.

Vertical working section.

"J" type temperature sensor to measure the air temperature in the inlet pipe.

Two pressure taps and an orifice plate in the inlet pipe to determine the air flow (speed).

Pressure tap at the lower side of the rectifier.

Air flow regulating valve.

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.

Recommended elements:

- ATB/BL. Model to Study the Boundary Layer.
- ATB/DF. Model to Study the Drag Forces.
- ATB/CE. Model to Study the Coanda Effect.
- ATB/VS. Model to Visualize Streamlines.
- ATB/BP. Model to Study Bernoulli's Principle.
- ATB/PDB. Pressure Distribution in a Pipe Bend.
- ATB/FJ. Model to Study a Free Jet.
- ATB/SS. Pressure Distribution in a Streamlined Shape.
- ATB/MB. Manometers Board. 16 Manometric Tubes.

Recommended elements:

ATB/BL. Model to Study the Boundary Layer

The boundary layer is studied to analyze the velocity changes in the contact area between a fluid and an obstacle located in its center or around it. This layer is mainly due to the existence of viscosity, a property inherent of any fluid. This is the reason why the obstacle produces a variation in the movement of the streamlines closest to it. The velocity changes, as indicated by Bernoulli's principle, involves a pressure variation in the fluid, which may lead to effects such as lift and drag forces. The knowledge obtained from the study of the boundary layer is applied in the construction of aircrafts, ships and turbomachinery.

The Model to Study the Boundary Layer, "ATB/BL", allows the study of the boundary layer on a flat plate (with flow along the plate) with two different surfaces (smooth and rough) to analyze different surface conditions in the formation of a boundary layer. The plate can be vertically displaced.

Two lateral bodies can be placed in the working chamber to change the pressure gradient in the direction of flow.

A Pitot tube, which can be horizontally displaced and is adjusted by a micrometer screw, measures the total pressures (and velocities) at different distances from the surface of the plate. The recommended element "ATB/MB ", Manometers Board. 16 Manometric Tubes is recommended to measure pressures.

ATB/DF. Model to Study the Drag Forces

A body immersed in a flow experiences a resultant force due to the action between the flow and the body. This is the force resulting from the shear stresses on the body wall and the normal stresses perpendicular to the surface. The resultant of the forces in horizontal direction is called drag and the force with vertical direction is called thrust or lift. The magnitude of these forces will depend on the shape of the flow around the body and, therefore, the shape of the body, the flow conditions and the relative position of the body with respect to the flow.

The Model to Study the Drag Forces, "ATB/DF", allows the measurement of drag forces in various models to determine their drag coefficients.

This model consists of a conduit transparent at the back and front sides with a radial scale, where the models are supported.

Three drag models are included: a cylinder, a flat plate and an airfoil. The cylinder includes a pressure tap, allowing the additional study of the flow pressure distribution with a Pitot tube. The Pitot tube can be moved in a transverse direction with respect to the direction of flow, allowing to determine the velocity profile behind the cylinder and, therefore, the measurement of the wake depression.

The drag forces are determined with a beam scale, which is adjusted with weights until reaching the balance point.

The recommended element "ATB/MB " Manometers Board. 16 Manometric Tubes is recommended to measure pressures both in the Pitot tube and in the pressure tap of the cylinder.

Recommended elements:

ATB/CE. Model to Study the Coanda Effect

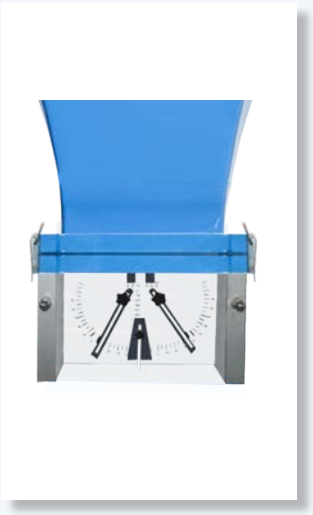
The Coanda effect is a physical phenomenon in which a fluid tends to be attracted to a nearby surface. It is the result of the force exerted by the adjacent medium (fluid or atmosphere) on a jet (high speed fluid). When a nearby surface does not allow the adjacent fluid to be drawn by the jet, it will approach until it follows the trajectory of that surface.

The Coanda effect has many applications, practically in any discipline in which a fluid takes part: from aeronautics (the effect on the wings of an airplane) and the generation of hydroelectric energy to the design of air conditioning systems and the car industry. It also has great application in the direction change of flow in flip-flops in industrial controllers.

The Model for the Study of the Coanda Effect, "ATB/CE", allows the study of the Coanda effect in a pneumatic logic element. The air flows through a channel, whose contour can be modified by sliding elements and a central divider. It can be switched from one side to the other.

The elements can be oriented in large angles to show the deflection of the jet due to the Coanda effect.

In the front side, the accessory has a transparent PMMA plate with vertical, horizontal and radial scales for an accurate placement and measurement of the positions of the elements.



ATB/VS. Model to Visualize Streamlines

Many design problems in the area of fluid flow require a precise knowledge of velocity and pressure distributions, for example, the flow over curved surfaces along the wings of an airplane, the strokes of a pump, in a compressor or on the crest of a floodgate. The knowledge of the flow of a fluid in two or three dimensions offers a wider vision of many real flow situations.

The Model to Visualize Streamlines, "ATB/VS", allows to visualize, using fog, streamlines and the flow separation.

It consists of a conduit with transparent window and black background, for a better observation of the streamlines, where different models can be placed. The generated fog is injected into the conduit through a rake-type inlet. This way, the thin lines of fog emerge and flow around the models. Three models are included: cylinder, orifice plate and airfoil with adjustable angle of attack (a scale is available for the indication of the angle of attack).

ATB/BP. Model to Study Bernoulli's Principle

By modifying the cross section of a flow channel, the flow velocity changes in inverse proportion to the area of the cross section. The Pitot tube is used to measure gas or air flow velocities in channels. It works according to the fluid dynamics principles and is a classic example for the practical application of Bernoulli's equations.

The Model to Study Bernoulli's Principle, "ATB/BP", allows the application of the continuity quation and Bernoulli's principle through the measurement of the total pressure, the static pressure and the flow velocities.

The model consists of a convergent-divergent conduit (formed by lateral walls shaped as a Venturi tube) with a Pitot tube that measures both the total pressure and the static pressure independently. The Pitot tube crosses the axis of the conduit, being able to move in the direction of flow, allowing the study of pressure and velocity distribution in different areas of the cross section. In the front side, the accessory has a transparent PMMA plate with vertical scale that indicates the exact position of the Pitot tube.

The recommended element "ATB/MB " Manometers Board. 16 Manometric Tubes is recommended to measure pressures with the Pitot tube.

Recommended elements:

ATB/PDB. Pressure Distribution in a Pipe Bend

In order to properly project any piping system, the losses in valves and the couplings of the system must be analyzed and evaluated, since a change in the direction of flow in a pipe involves a change in the pressure distribution.

The Pressure distribution in a pipe bend model, "ATB/PDB", consist of a 90° bend with 30 pressure measuring points to study the pressure development as the flow direction changes.

The model has a constant rectangular cross section with ten pressure measuring points on the upper part, ten on the lower part and ten on the curvature.

The recommended element "ATB/MB " Manometers Board. 16 Manometric Tubes is recommended to measure the static pressures at each point.

ATB/FJ. Model to Study a Free Jet

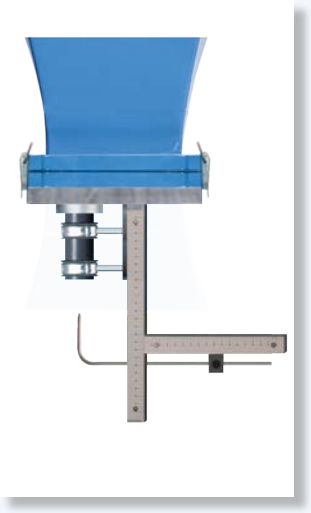
A free jet is considered as a fluid flow flowing from a conduit to a relatively large area containing fluid, which has a velocity with respect to the jet parallel to the direction of flow in the jet. Flow and pressure losses occur at the outlet of the free jet into a stationary environment. The jet loses speed in function of the distance and the diameter of the outlet surface.

The Model to Study a Free Jet, "ATB/FJ", allows the study of the velocity development of a free jet. It consists of a tube mounted on a plate that fits in the nozzle through which the air is released, so that air enters through the tube and leaves through the other end as a jet of air.

The total pressures are measured at different distances from the outlet surface, in vertical and horizontal direction, by a movable Pitot tube.

The recommended element "ATB/MB " Manometers Board. 16 Manometric Tubes is recommended to measure the pressures with the Pitot tube.

The velocity is determined from the pressures read on the manometric tubes.



ATB/SS. Pressure Distribution in a Streamlined Shape

The Pressure Distribution in a Streamlined Shape Model, "ATB/SS", consists of a conduit transparent at the back and front sides with a radial scale, where an airfoil with adjustable angle of attack is supported (it includes a scale that indicates the angle of attack).

The airfoil has 12 pressure taps arranged on its surface to study the pressure distribution around a streamlined shape.

The recommended element "ATB/MB " Manometers Board. 16 Manometric Tubes is recommended to measure the pressures at each point.

Recommended elements:

ATB/MB. Manometers Board. 16 Manometric Tubes	
The "ATB/MB" Manometers Board. 16 Manometric Tubes" consists of a panel with 16 manometric tubes to measure the pressures in the different outlets available. The manometer has a scale and is mounted on an adjustable tilt panel. This allows to take measurements with the inclined tubes, providing greater accuracy in small pressure measurements.	

EXERCISES AND PRACTICAL POSSIBILITIES

ATB/BL. Model to Study the Boundary Layer:

1.- Properties of the boundary layer of the fluid when falling upon a flat plate.

2.- Influence of surface roughness on the formation of a boundary layer.

3.- Measurement of the flow speed with a Pitot tube.

ATB/DF. Model to Study the Drag Forces:

4.- Measurement of drag forces on bodies immersed in an air flow.

5.- Calculation of drag coefficients on bodies immersed in an air flow.

6.- Pressure distribution on a cylinder immersed in an air flow.

7.- Study of the conservation of momentum.

ATB/CE. Model to Study the Coanda Effect:

8.- Study of an air flow that follows the curvature of a surface and demonstration of the Coanda effect.

9.- Study of the operation of a flip-flop.

ATB/VS. Model to Visualize Streamlines:

10.-Visualization of streamlines by smoke injection.

11.-Visualization of air streamlines through a cylinder.

12.-Visualization of air streamlines through an orifice plate (different cross section).

13.-Visualization of air streamlines through an airfoil with adjustable angle of attack.

14.-Air flow separation.

ATB/BP. Model to Study Bernoulli's Principle:

15.-Application of the continuity equation and Bernoulli's principle.

16.-Calculation of the dynamic pressure and the flow velocity from the measured data using Bernoulli's principle.

ATB/PDB. Pressure Distribution in a Pipe Bend:

17.-Study of the air flow development at a 90° pipe bend.

18.-Representation of the pressure distribution at a 90° pipe bend.

19.-Determination of the static pressure.

ATB/FJ. Model to Study a Free Jet:

20.-Study of the behavior of a free jet.

21.-Recording the pressure curve at the outlet of a parallel flow in stationary surroundings.

22.-Representation of velocity profiles at several distances along the jet and the development of the jet diffusion.

ATB/SS. Pressure Distribution in a Streamlined Shape:

23.-Study of the pressure distribution around a streamlined shape.

DIMENSIONS AND WEIGHTS

ATBB:

Base unit:

- Dimensions: 1600 x 800 x 2000 mm approx. (21.65 x 19.68 x 11.02 inches approx.)
- Weight: 80 kg approx. (26.45 pounds approx.)

Electronic Console:

- Dimensions: 490 x 330 x 310 mm approx. (19.29 x 12.99 x 12.20 inches approx.)
- Weight: 10 kg approx. (22 pounds approx.)

RECOMMENDED ELEMENTS

Recommended elements:

- ATB/BL. Model to Study the Boundary Layer.
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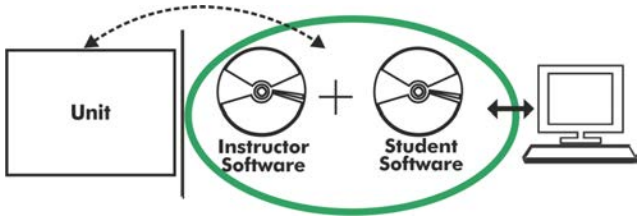
- ATB/MB. Manometers Board. 16 Manometric Tubes.

ATBB/ICAI. Interactive Computer Aided Instruction Software System:



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

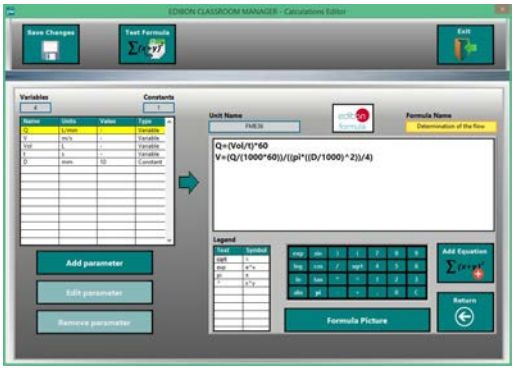
- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

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.

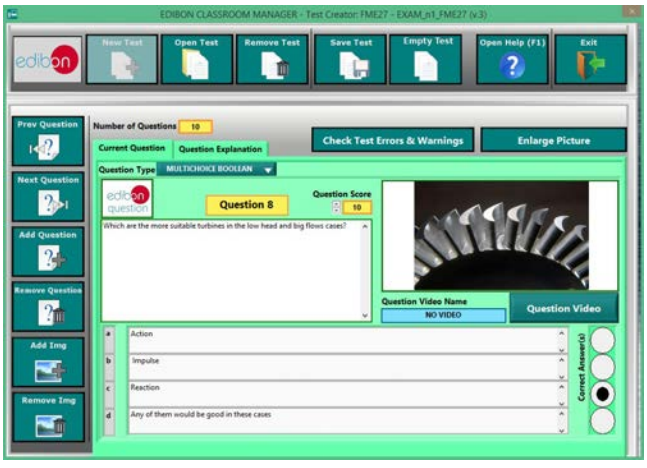
Innovative features:

- **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.

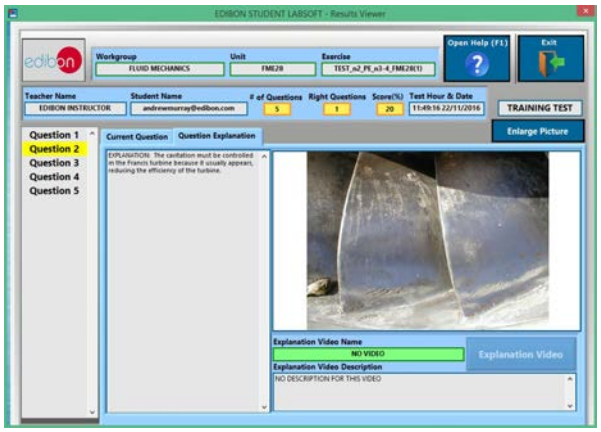
Innovative features:

- **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.**

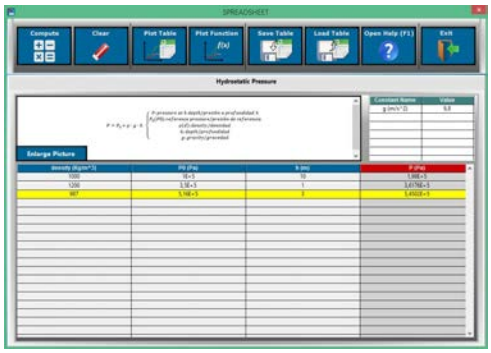
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

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

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: