



CATALOGUE No. 41-A
FLUID MECHANICS



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Fluid Mechanics

export@elettronicaveneta.com
www.elettronicaveneta.com

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GENERAL INTRODUCTION

ELETTRONICA VENETA S.p.A. is designing and manufacturing educational equipment since 1963.

This kind of equipment, covering different fields of technology, allows students and teachers to reach two important aims:

- facilitate students' learning activity with real systems that are able to clarify theory's important aspects, learned during class and deepened on text-books;
- simplify teacher's work with the possibility to demonstrate both theory, practical aspect and applications of the study's topics.

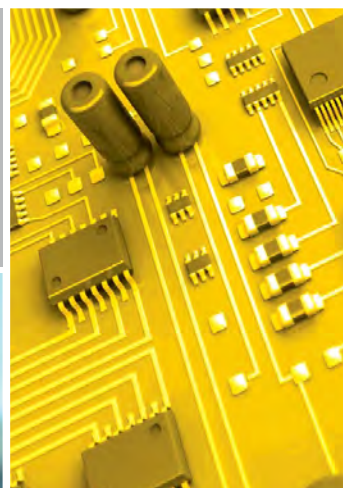
Naturally, increasing educational activity's efficiency, also the introduction of the young students into work reality will be improved and better justifies the investments in material and human resources done in the schools worldwide.

ELETTRONICA VENETA S.p.A. is an international leading player conscious of dealing with educational programs related to the different countries and according also to specific cultures. In order to satisfy different needs, we have designed flexible systems to guarantee a perfect match to the current technologies, technological progress and to the local industrial market inquiries of specific professionals.

Thanks to the modularity and flexibility of the training methodology and design, beside regular school education, laboratories and equipment proposed by EV allow also post-diploma/continuous training and professional re-qualification courses to be implemented.

Our educational equipment covers the most part of technological fields in the didactic programs of vocational technical training, polytechnics institutes and also of the universities both national and international ones.

ELETTRONICA VENETA S.p.A. headquarters is located on Veneto region's green fields, nearby Venice. The modern premises integrate R&D laboratories, factory and a training centre fully equipped with labs suitable for teachers' training.



The integration of our R&D resources and equipment manufacturing pole with the capacity and experience of local school structure, allow us to keep training programs updated and therefore to provide with a high quality education the training institutions matching the professional expectation coming from industries and researches on the various local context.

The ISO 9001 (Quality System Certification) obtained in 1998 and updated in application of the latest edition of the International Standard, is further testament to the quality-driven organisation of **ELETTRONICA VENETA S.p.A.** aimed at providing top standard equipment, training and service.

PRESENTATION

Fluid mechanics is an important field for several scientific subjects but it seems to be less intuitive of solid mechanics because the approach with fluids is often more limited than solids.

The equipment included in this catalogue have been developed in order to have a clear representation of fluid mechanics principles and to verify experimentally what studied in the textbooks.

An hydraulic bench, combined with a wide range of accessories, enables to carry out various experiments of fluid statics and dynamics on the following subjects:

- Fluid flow in pipes
- Fluid flow through orifices, orifice plates, venturi meters, pitot tubes, flow over weirs
- Bernoulli's theorem
- Flow rate measurement methods
- Fluid flow in channels
- Hydraulic machines (pumps, turbines, water hammer etc.)
- Stability of floating bodies and pressure centre
- Free and forced vortex



Example of a Fluid mechanics lab designed and manufactured by Elettronica Veneta.



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FLUID MECHANICS EQUIPMENT

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HYDRAULICS BENCH

Mod. HB/EV with stainless steel tanks
Mod. HB-E/EV with plastic tanks

DESCRIPTION

The hydraulic bench represents a service unit for a wide variety of complementary accessories that enable to perform several experiments of fluid mechanics.

The upper part of the bench consists of a work top equipped with an open channel above which the accessories are placed, and of two tanks that enable to carry out some volumetric measurements of the flow rate by using a level gauge.

The bottom of the volumetric tank is equipped with a valve in order to drain the water in the supply tank. The water is drawn to the top of the bench by a centrifugal pump, whereas the flow rate is adjusted through a control valve and measured with a variable area flowmeter. The variable-area flowmeter enables to compare the flow rate read on the instrument with the flow rate measured through the measuring tanks.

TRAINING PROGRAM:

- Volumetric measurement flow rate
- Calibration of a variable area flowmeter
- Characteristic curve of a centrifugal pump

TECHNICAL CHARACTERISTICS:

- Hydraulics bench, mounted on wheels with brakes, with AISI 304 stainless steel frame, valves and pipes
- Centrifugal pump of stainless steel - 0.37 kW, maximum flow rate of 80 l/min, maximum head of 20 m
- Pressure gauge on the suction and on the discharge of the pump
- AISI 304 stainless steel feeding tank: capacity 120 litres (mod. HB/EV only)
- Feeding tank made of plastic material: capacity 120 litres (mod. HB-E/EV only)
- Variable-area flowmeter, range 0,4-4 m³/h
- AISI 304 stainless steel upper tank for volumetric flow measurement with 10 litres capacity - for low flow rates - and with 40 litres capacity - for high flow rates (mod. HB/EV only)
- Upper tank made of plastic material for volumetric flow measurement with 10 litres capacity - for low flow rates - and with 40 litres capacity - for high flow rates (mod. HB-E/EV only)
- Control valve for adjusting flow rate
- Drain valve on the base of the upper tank for water recycling inside the supply tank
- Work top with open channel



The picture refers to mod. HB/EV

Power supply: 230 Vac 50 Hz single-phase - 0.6 kVA
(Other voltage and frequency on request)

Dimensions: 760 × 1230 × 1180 (h) mm

Weight: 130 kg (mod. HB/EV)
about 105 kg (mod. HB-E/EV)

REQUIRED

UTILITIES (PROVIDED BY THE CUSTOMER)

- Water supply to fill in the supply tank
- Chronometer

SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



DEAD WEIGHT CALIBRATOR Mod. HB1/EV

DESCRIPTION

This equipment enables to calibrate a Bourdon tube gauge by applying prefixed pressures. It consists of a piston running inside a cylinder and connected with a pressure gauge. A supporting plate at the top of the piston enables to fit several weights to the system generating prefixed pressure values. The pressure gauge is equipped with a transparent scale which enables to see the inner mechanical components.



TRAINING PROGRAM:

- Operation principles of a Bourdon tube gauge
- Calibration of a Bourdon tube gauge
- Calibration errors

TECHNICAL CHARACTERISTICS:

- Bourdon tube gauge: range 0 - 2.5 bar
- AISI 304 stainless steel piston: 12 mm
- Loads: 1 x 0.5 bar; 1 x 1 bar

Dimensions: 300 × 210 × 300 (h) mm
Weight: 6 kg

REQUIRED

UTILITIES (PROVIDED BY THE CUSTOMER)

- Distilled water to fill the piston

SUPPLIED WITH

THEORETICAL-EXPERIMENTAL
HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB1/EV



CENTRE OF PRESSURE Mod. HB2/EV



DESCRIPTION

The module enables to determine the hydrostatic thrust caused by a fluid on a submerged surface. It consists of a Plexiglas box containing a toroidal shaped unit mounted on a balance arm. When the quadrant is immersed in the tank, the force caused by the water on the rectangular surface of the quadrant gives rise to a moment with respect to the fulcrum of the scales that provokes a variation in the arm inclination. Some counterweights can be positioned at the end of the arm in order to bring it in a horizontal position. The value of hydrostatic thrust can be determined from the applied weights. A graduated scale drawn on the quadrant enables to determine the hydrostatic thrust of the water when the water level varies inside it.

TECHNICAL CHARACTERISTICS:

- Capacity of plexiglas tank: 6 litres
- Distance between suspended mass and fulcrum: 275 mm
- Inside diameter of quadrant: 100 mm
- Outside diameter of quadrant: 200 mm
- Section of the quadrant: 75 x 75 mm
- Height of fulcrum above quadrant: 100 mm
- Weights supplied: 4 x 100 gr, 1 x 50 gr, 5 x 20 gr, 2 x 10 gr

Dimensions: 260 x 420 x 320 (h) mm
Weight: 6 kg

TRAINING PROGRAM:

- Determining the centre of hydrostatic pressure on a surface completely or partially submerged and comparing with the theoretical position
- Determining the hydrostatic thrust on a plain surface completely or partially submerged and comparing with the theoretical position

SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB2/EV



FLOW OVER WEIRS

Mod. HB3/EV



DESCRIPTION

The module enables to evaluate the characteristics of flow over weirs with different shapes. It consists of 4 weir elements that can be placed at the end of the open channel of the hydraulic bench. The water is feed in the channel through a dispenser in order to reduce liquid turbulence and ensuring a more regular flow. The measurement of level inside the channel is done through a depth gauge that is dropped onto the free surface of water. The used weirs are fastened to the holder mounted at the end of the channel by screws.

TRAINING PROGRAM:

- Demonstration of flow over weirs features with rectangular opening
- Demonstration of flow over weirs features with V opening
- Calculation of discharge coefficient

TECHNICAL CHARACTERISTICS:

- Dimensions of weir plates:
 - height: 160 mm;
 - width of 200 mm
- Rectangular weir
- "V" weir 60°
- "V" weir 90°
- Trapezoidal weir or "Cipolletti" type weirs
- Depth gauge, range: 0-300 mm resolution 0.05 mm

REQUIRED

HYDRAULIC BENCH
MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -



SUPPLIED WITH

THEORETICAL-EXPERIMENTAL
HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB3/EV



STABILITY OF A FLOATING BODY

Mod. HB4/EV

DESCRIPTION

The module consists of a plastic rectangular floating tank whose centre of gravity can be varied by moving two weights along a horizontal and a vertical rod. In this way it is possible to pass from a stable equilibrium situation to another situation of unstable equilibrium, and to determine the metacentre position. A plumb-bob suspended from the mast indicates the inclination of the tank on a graduated scale. The module can be let float in the volumetric tank of the hydraulic bench or in a container with appropriate dimensions.



TRAINING PROGRAM:

- Determining the centre of gravity of the tank
- Determining the metacentric height and therefore the position of the metacentre for the tank stability
- Variation of metacentric height with angle of heel

TECHNICAL CHARACTERISTICS:

- Tank dimensions:
 - length: 350 mm
 - width: 200 mm
 - overall height: 475 mm
- Max. angle of heel: $\pm 13^\circ$

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -

or vessel with suitable dimensions



SUPPLIED WITH

THEORETICAL-EXPERIMENTAL
HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB4/EV



BERNOULLI'S THEOREM DEMONSTRATION Mod. HB5/EV

DESCRIPTION

The equipment enables to study the Bernoulli's theorem through the use of a classical Venturi tube equipped with 6 static tapping points and a Pitot tube for the measurement of dynamic pressure along the duct. The tapping points and Pitot tube are connected with a 7 tubes differential pressure gauge. The water flow rate is controlled by two valves placed at the inlet and outlet of the Venturi meter.



TRAINING PROGRAM:

- Demonstration of Bernoulli's theorem and of its limitations
- Direct measurement of the static and dynamic pressure distribution along a Venturi tube
- Determining the discharge coefficient of the Venturi tube

TECHNICAL CHARACTERISTICS:

- AISI 304 Stainless steel structure
- 7 tubes pressure gauge, range 0-500 mm
- Diameter of Venturi tube: 20 mm
- Venturi tube throat diameter: 10 mm
- Upstream taper: 14°
- Downstream taper: 21°

Dimensions: 650 × 400 × 850 (h) mm

Weight: 14 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



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HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB5/EV



IMPACT OF A JET

Mod. HB6/EV

DESCRIPTION

This apparatus enables to measure the force developed by a jet on a stationary object. It consists of a cylindrical transparent vessel inside which the water jet generated by a nozzle hits an object hold by a stem. The force exerted by the water jet causes a rise of the stem that can be counterbalanced by adding weights in order to bring it to the initial position. Thus the force exerted by the water jet on the stationary object can be determined. A total of three targets are provided: a flat target, a 45° cone, a hemispherical target.



TRAINING PROGRAM:

- Measuring the force exerted by a water jet on different targets and comparing with the results predicted

TECHNICAL CHARACTERISTICS:

- Diameter of cylinder: 180 mm
- Height of cylinder: 300 mm
- 2 interchangeable nozzles diameter: 8 mm, 5 mm
- Distance between nozzle and target: 20 mm
- Diameter of target plate: 30 mm
- Types of targets with different shape:
 - flat target
 - 45° cone
 - hemispherical target
- Set of weights

Dimensions: 300 × 300 × 700 (h) mm

Weight: 10 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV

- NOT INCLUDED -

or water supply (@2 bar) and drain



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HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE

For fluid mechanics equipment
Mod. SW-HB6/EV



FLOW THROUGH ORIFICES

Mod. HB7/EV

DESCRIPTION

The equipment is composed of a graduated tank with constant level on whose base two discharge orifices with different diameter can be installed. The level inside the tank can be changed by adjusting the height of the overflow. A device allows to trace the path of the jet using some rods placed on the free surface of the jet.



TRAINING PROGRAM:

- Determining the velocity coefficient for a small orifice
- Experimental determination of the discharge coefficient for a small orifice with flow under constant head and flow under varying head
- Comparing the measured trajectory of a jet with that predicted by theory of fluid mechanics

TECHNICAL CHARACTERISTICS:

- AISI 304 Stainless steel structure
- Orifice diameters: 4 mm and 8 mm
- Jet trajectory probes: 8
- Height of overflow: 410 mm

Dimensions: 800 × 400 × 800 (h) mm

Weight: 20 kg

REQUIRED

HYDRAULIC BENCH
MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -



SUPPLIED WITH

THEORETICAL-EXPERIMENTAL
HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB7/EV



FLOW THROUGH BOTTOM ORIFICE Mod. HB8/EV

DESCRIPTION

This module consists of a cylindrical tank with an orifice fitted in the base that enables to study the outlet flow. The water fed from the hydraulics bench enters from the top through a system that eliminates the turbulence inside, whereas an overflow keeps the level constant. Under the tank a device enables to position a pitot tube under the jet in different ways. A sharp graduated blade attached to this pitot tube is placed under the jet to measure the outlet jet diameter and the vena contracta diameter, thus the contraction coefficient can be calculated. The static head and the dynamic head across the orifice are shown on manometer tubes placed at the tank side. In addition to the standard orifice, five additional orifices are supplied.



TRAINING PROGRAM:

- Determining the contraction and velocity coefficients
- Calculating the discharge coefficient

TECHNICAL CHARACTERISTICS:

- Orifice diameters: 3,5,8,10 and 13 mm
- Tank diameter: 190 mm
- Tank height: 450 mm
- Height of the overflow: 400 mm
- Manometer: 0-500 mm approx.

Dimensions: 300 × 300 × 700 (h) mm
Weight: 12 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



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OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB8/EV



ENERGY LOSSES IN PIPES

Mod. HB9/EV

DESCRIPTION

The equipment enables to measure the head loss of a liquid flowing through a circular pipe. It consists of a test pipe, oriented vertically, which may be fed directly from the hydraulics bench or from an internal tank with constant level. The flow rate can be adjusted by a valve on the discharge line of the pipe. Head loss between two tapping points in the test pipe is measured by a mercury pressure gauge for high flow rates, and a water pressure gauge for small flow rates. Water discharging from the head tank returns to the supply tank of the hydraulics bench.



TRAINING PROGRAM:

- Determining the friction factor in laminar and turbulent flow regimes

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- AISI 304 stainless steel test pipe: internal diameter 4 mm
- Length of test pipe: 500 mm
- Distance between pressure tapping points: 500 mm
- Mercury manometer range 0-500 mm
- Water manometer range 0-500 mm
- AISI 304 stainless steel tank with constant level

Dimensions: 650 × 400 × 1.000 (h) mm
Weight: 17 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



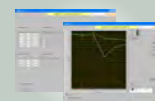
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OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB9/EV



FLOW CHANNEL Mod. HB10/EV

DESCRIPTION

This module enables to study the characteristics of flow in an open channel. The channel is fed with the water coming from the hydraulics bench via a stilling tank that reduces the turbulence of the liquid. The channel made of transparent acrylic material is high and narrow and incorporates weirs of adjustable height at the inlet and at the outlet in order to control the liquid level inside. This equipment is also equipped with a dye injection system that allows a better visualization of the flow on the different hydrodynamic models available in the central part of the channel. The water coming from the flow channel is discharged into the hydraulics bench and it returns to the supply tank of this bench for being recycled.



TRAINING PROGRAM:

- Demonstrating the basic principles of the open channel flow
- Visualization of flow patterns over or around immersed objects of different shape and size

TECHNICAL CHARACTERISTICS:

- Dye injection nozzles: 5
- Dye reservoir capacity: 0.45 l
- Width of channel: 20 mm
- Length of channel: 625 mm
- Depth of channel: 150 mm
- Available hydrodynamic models:
 - broad crested weir
 - narrow crested weir
 - symmetrical aerofoil
 - asymmetrical aerofoil
 - small cylinder
 - large cylinder

Dimensions: 700 × 400 × 800 (h) mm
Weight: 30 kg

REQUIRED

**HYDRAULIC BENCH
MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -**



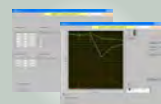
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OPTIONAL

**SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB10/EV**



OSBORNE REYNOLDS' DEMONSTRATION Mod. HB11/EV

DESCRIPTION

The equipment reproduces the Osborne Reynolds' experiment concerning the nature of laminar and turbulent flow. The water coming from the hydraulics bench enters in a tank and is discharged from the bottom through a pipe passing through some glass marbles in order to reduce the water turbulence. The flow rate through the pipe can be adjusted thanks to a valve placed at the outlet and it can be measured using the volumetric tank of the hydraulics bench. Thus the speed of water can be determined and Reynolds' number can be calculated. The equipment uses a dye injection system for an easier observation of flow conditions inside the transparent pipe.

TRAINING PROGRAM:

- Reproducing the experiments carried out by Osborne Reynolds concerning fluid flow condition
- Observing the laminar, transitional, turbulent flow and determining the velocity profile

TECHNICAL CHARACTERISTICS:

- Head tank: 3,5 l
- Diameter of the test pipe: 10 mm
- Length of the test pipe: 700 mm
- Dye reservoir capacity: 250 ml

Dimensions: 300 × 300 × 1.100 (h) mm
Weight: 20 kg



REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



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OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB11/EV



METHODS OF FLOW MEASUREMENTS

Mod. HB12/EV

DESCRIPTION

The equipment enables to carry out measurements of flow rate using a Venturi meter, a calibrated orifice and a variable area flow meter connected in series. A flow control valve enables to vary the flow rate across the circuit. Each element is equipped with two pressure tapping points connected to a differential pressure gauge of six tubes.

TRAINING PROGRAM:

- Direct comparison of flow measurements carried out with a Venturi meter, a variable area flow meter and an orifice plate
- Calibrating each flow meter by using the volumetric tank of the hydraulics bench
- Comparing pressure drops across each instrument

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- Range of pressure gauges: 0-500 mm H₂O
- Number of manometer tubes: 6
- Orifice plate diameter: 14 mm
- Variable area flow meter: 0.1-1 m³/h
- Venturi meter dimensions:
 - throat diameter: 10 mm
 - upstream pipe diameter: 20 mm
 - inlet/outlet angle: 21°/12°

Dimensions: 650 × 400 × 850 (h) mm
Weight: 17 kg



REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



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OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB12/EV



ENERGY LOSSES IN BENDS AND FITTINGS

Mod. HB13/EV

DESCRIPTION

This equipment enables to calculate the energy losses on some elements of a hydraulic circuit such as bends, sudden contractions and enlargements, control valves, etc...

The available elements for the study of energy losses are:

- 90° elbow
- short bend
- large bend
- sudden contraction
- sudden enlargement
- joint

Each element has two pressure tapping points which are connected with a differential pressure gauge manometer of 12 tubes thus enabling to measure the head loss.

Another element of this equipment is a valve equipped with a pressure tapping connected with a manometer.



TRAINING PROGRAM:

- Measuring the energy losses in the different elements varying the flow rate and calculating the respective coefficients
- Comparing the energy losses across each element

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- Pipe diameter: 1/2"
- Enlargement diameter: 3/4"
- Fittings:
 - elbow
 - short bend
 - large bend
 - sudden enlargement
 - sudden contraction
 - joint
- Differential pressure gauge of 12 tubes range: 0-500 mm
- Pressure gauge: 0-3 bar

Dimensions: 650 × 400 × 900 (h) mm
Weight: 15 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB13/EV



FREE AND FORCED VORTEX Mod. HB14/EV

DESCRIPTION

The equipment has been designed to study the characteristics of free and forced vortices inside a cylinder of acrylic material. The free vortex is generated by water discharging through an interchangeable orifice available at the base of the cylinder and the resulting profile is measured with a series of graduated rods placed at a known distance from the centre of the tank. The forced vortex is induced by a blade at the base of the cylinder which is rotated by two jets of water. The speed at any point in the free or forced vortices may be measured with 3 Pitot tubes placed at different distances from the centre.



TRAINING PROGRAM:

- Understanding the difference between free and forced vortex
- Determining the surface profile of a forced vortex
- Determining the surface profile of a free vortex

TECHNICAL CHARACTERISTICS:

- Tank diameter: 250 mm
- Tank height: 300 mm
- Orifice diameters: 8, 12, 16, 24 mm
- Distance from centre of vortex height measuring probes: 0, 30, 50, 70, 90 and 110 mm
- Pitot tubes at: 15, 25, 30 mm radius
- Inlet tubes diameters: 9, 12.5 mm
- Inlet tubes inclination:
 - 60° for diameter of 9 mm
 - 15° for diameter of 12.5 mm

Dimensions: 400 × 400 × 700 (h) mm

Weight: 19 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV

- NOT INCLUDED -

or water supply (@2 bar) and drain



SUPPLIED WITH

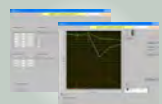
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HANDBOOK**



OPTIONAL

SPREADSHEET SOFTWARE

For fluid mechanics equipment
Mod. SW-HB14/EV



HYDRAULIC RAM

Mod. HB15/EV

DESCRIPTION

This equipment enables to study the effect of the water hammer inside pipes; this occurs when flowing water is suddenly brought to rest inside the pipes. This phenomenon is used to pump water from a lower tank to an upper one. The equipment includes two tanks at different height connected to a long tube where the hydraulic ram is mounted. This pump consists of a pulse valve and of a non-return valve. An air vessel above the valve chamber soothes cyclic fluctuations due to the ram pump. The lower tank is fed by the hydraulics bench, whereas the water flows from the upper tank back to the hydraulics bench. Some weights are supplied so that they can be applied to the pulse valves in order to change the closing pressure and therefore the operating features.

TRAINING PROGRAM:

- Establishing flow/pressure characteristics and determining efficiency of the hydraulic ram

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- Height of the lower tank: 880 mm
- Height of the higher tank: 1150 mm
- Capacity of the pump: 0.025 litres/s

Dimensions: 700 × 400 × 1.600 (h) mm
Weight: 35 kg



REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



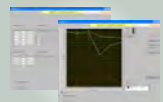
SUPPLIED WITH

THEORETICAL-EXPERIMENTAL
HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB15/EV



DEMONSTRATION OF PELTON TURBINE

Mod. HB16/EV

DESCRIPTION

The equipment consists of a miniature Pelton turbine with spear valve and mounted on bearings. The power produced by the turbine can be measured through a dynamometer.

The bottom of the turbine is open in order to let the water flow inside the hydraulics bench. The front face of the turbine is transparent allowing an easy observation of the behaviour of the water jet on the blades. The pressure at inlet of the nozzle can be read on a pressure gauge.



TRAINING PROGRAM:

- Determining the operating characteristics of a Pelton turbine at various speeds of its rotor

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel Pelton turbine, $d = 100$ mm, n° of blades = 20
- Speed: 0 to 2000 r.p.m. approx.
- Power: 10 Watt
- Pressure gauge: 0 to 2.5 bar
- Two 10-N dynamometers, division 0.1 N
- Portable digital tachometer

Dimensions: 430 × 260 × 600 (h) mm
Weight: 7 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB16/EV



PUMPS IN SERIES AND PARALLEL

Mod. HB17/EV

DESCRIPTION

Introducing a second pump to the Hydraulics Bench enables to study two pumps in series and parallel configuration. The module consists of a fixed speed pump equipped with motor protector and two pressure gauges. The hydraulic bench is equipped with a set of tubes and valves already arranged for the connection to the second pump.



TRAINING PROGRAM:

- Drawing of the curve $H(Q)$ of a centrifugal pump
- Series connection of two pumps with same characteristics
- Parallel connection of two pumps with same characteristics

TECHNICAL CHARACTERISTICS:

- Pump: Centrifugal type
 - max. head: 20 m of H_2O
 - max. flow rate: 80 l/min
- Motor rating: 0.37 kW
- Pressure gauge range: 0 to 6 bar
- Pressure gauge range: -1 to 3 bar

Power supply: 230 Vca 50 Hz single-phase - 0.6 kVA
(Other voltage and frequency on request)

REQUIRED

**HYDRAULIC BENCH
MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -**



SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



OPTIONAL

**SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB17/EV**



CENTRIFUGAL PUMP CHARACTERISTICS

Mod. HB18/EV

DESCRIPTION

Introducing a second pump to the hydraulics bench enables to study two pumps in series and parallel configuration. The module consists of a pump equipped with two pressure gauges and of an inverter. This enables to vary the number of pump rotations and to measure the absorbed power.

TRAINING PROGRAM:

- Drawing of the curve $H(Q)$ for a centrifugal pump
- Plotting the curves of head, power, speed and efficiency versus flow rate
- Series connection of two pumps with same characteristics
- Series connection of two pumps
- Parallel connection of two pumps

TECHNICAL CHARACTERISTICS:

- Centrifugal pump
 - max. head: 20 meters of water column
 - max flow rate: 80 l/min
- Motor power: 0.37 kW
- Variable speed through inverter
- Pressure gauge: 0 to 6 bar
- Pressure gauge: -1 to 3 bar

Power supply: 230 Vca 50 Hz single-phase - 1.4 kVA
(Other voltage and frequency on request)



REQUIRED

HYDRAULIC BENCH
MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -



SUPPLIED WITH

THEORETICAL-EXPERIMENTAL
HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB18/EV



CAVITATION DEMONSTRATION Mod. HB19/EV

DESCRIPTION

The unit contains a Venturi tube made of a transparent acrylic material. When water flow rate increases, pressure at the throat is reduced complying with the Bernoulli equation until the vapour pressure of the liquid is reached. Under these conditions small bubbles of vapour are created and they collapse violently generating this phenomenon called cavitation. The unit is equipped with two pressure gauges and a vacuum gauge in order to measure the pressure before and after the throat of the Venturi tube. In order to adjust the rate and the pressure there are two valves placed at the inlet and outlet of the Venturi tube.



TRAINING PROGRAM:

- Observation of the phenomenon of cavitation in a liquid
- Comparing theoretical and effective pressure in cavitation conditions
- Observation of air release due to gases in the liquid
- Demonstrating how cavitation is reduced by the rise of the static pressure in a liquid

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- Transparent venturi meter
- 2 Bourdon pressure gauges, range 0-2,5 bar
- Vacuum gauge, range -1-0 bar

Dimensions: 650 × 400 × 300 (h) mm
Weight: 17 kg

REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
 - NOT INCLUDED -
 or water supply (@2 bar) and drain



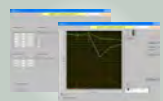
SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



OPTIONAL

SPREADSHEET SOFTWARE
 For fluid mechanics equipment
Mod. SW-HB19/EV



MULTI PURPOSE FLOW CHANNEL Mod. HB20/EV



HB-20-5.0 version

DESCRIPTION

The equipment consists of an open flow channel, with rectangular section available in lengths of 2.5 m and 5 m and made of acrylic transparent material. The channel is mounted on a rigid framework and it can be tilted. The inlet tank is designed to ensure a uniform flow. The level inside the working section of the channel is controlled by an overshoot weir placed at the discharge end. A lot of objects are supplied that can be fixed to the channel base, for a better studying of fluids mechanic. A longitudinal scale available at the top of the channel allows to position the depth gauges and Pitot-static tubes in different points along the channel, in order to perform the speed measurement. The channel has been designed to be used with the hydraulics bench that provides the pumped water flow, the flow control valve and a volumetric tank for flow measurement.

TRAINING PROGRAM:

- Studying the channel flow
- Studying the flow of a tilted channel
- Determining the height of a free surface in relation to the rate and inclination
- Studying the flow on the elements immersed in the channel

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- Dimensions

	HB-20-2.5	HB-20-5.0
- length:	3.2 m	5.7 m
- width:	0.5 m	0.5 m
- height:	1.7 m	1.7 m
• Channel dimensions:		
- width:	70 mm	70 mm
- height:	250 mm	250 mm
- length:	2500 mm	5000 mm

Channel slope: adjustable between -1% and 3%



• **Models supplied:**

- Venturi flume
- Triangular weir
- Sharp crested weir
- Broad crested weir
- Adjustable undershot weir
- 2 Vernier level gauges



• **Optional models available:**

- HB-20-1: Pitot tube and pressure gauge
- HB-20-2: Culvert fitting, one edge square, one rounded
- HB-20-3: Flow splitters of different shape
- HB-20-4: Spillway ski jump
- HB-20-5: Syphon spillway
- HB-20-6: Radial gate
- HB-20-7: Wave generator and wave absorbing beach
- HB-20-8: False floor
- HB-20-9: Artificially roughened bed section with length of 2.5 m
- HB-20-10: Set of weirs (triangular, Cipolletti, Bazin)
- HB-20-11: Broad crested weir
- HB-20-12: Parshall's device

REQUIRED

**HYDRAULIC BENCH
MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -**



SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



OPTIONAL

**SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB20/EV**



FLUID FRICTION APPARATUS

Mod. HB21/EV

DESCRIPTION

The module is used to study fluid friction losses through pipes of different diameters, valves and flow metering devices (Venturi tube, orifice plate and Pitot tube). The pipe to be tested can be selected through a valves system without being disconnected. The measurement of energy losses is carried out with a differential pressure gauge and a mercury pressure gauge.

TRAINING PROGRAM:

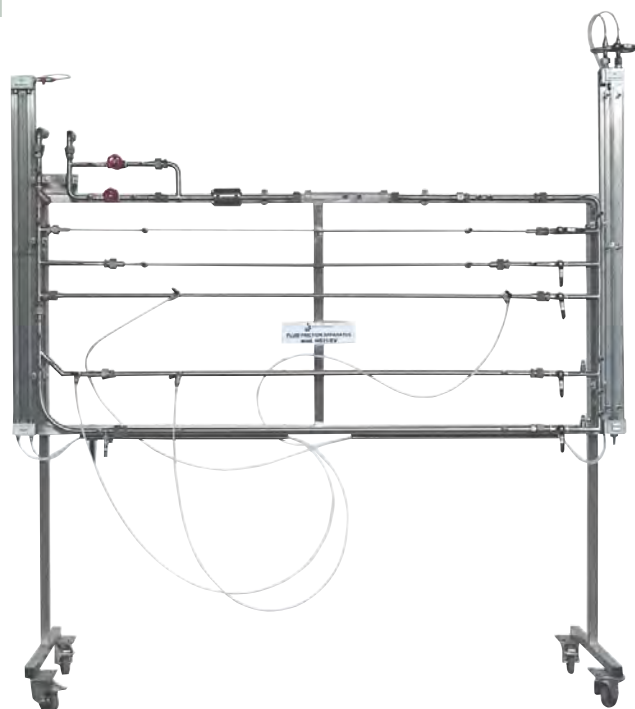
- Demonstrating the relationship between head losses and velocity of fluid
- Determining the head loss of a flow through pipes of different diameters, fittings and metering devices
- Determining the relation between friction coefficients and Reynolds' number for flow through a pipe with roughened bore
- Demonstrating the application of different systems for measuring flow rate and fluid velocity

TECHNICAL CHARACTERISTICS:

- AISI 304 stainless steel structure
- Total number of tapping points= 36
- AISI 304 stainless steel pipes
- Internal diameter of test pipes: 17 mm, 11 mm, 7 mm, 4 mm
- Internal diameter rough pipe: 15 mm
- Length of test pipe: 1000 mm
- AISI 304 stainless steel 90°elbow
- AISI 304 stainless steel 45°elbow
- AISI 304 stainless steel 45° "Y"
- AISI 304 stainless steel "T"
- AISI 304 stainless steel sudden enlargement
- AISI 304 stainless steel sudden contraction
- Gate valve
- Bell valve
- Globe valve
- "Y" strainer
- Transparent venturi meter
- AISI 304 stainless steel orifice plate
- AISI 304 stainless steel Pitot tube
- Water differential pressure gauge, range 0-1000 mm
- Mercury differential pressure gauge, range 0-1000 mm

Dimensions: 1760 × 600 × 2100 (h) mm

Weight: 38 kg



REQUIRED

HYDRAULIC BENCH MOD. HB/EV OR HB-E/EV
- NOT INCLUDED -
or water supply (@2 bar) and drain



SUPPLIED WITH

THEORETICAL-EXPERIMENTAL HANDBOOK



OPTIONAL

SPREADSHEET SOFTWARE
For fluid mechanics equipment
Mod. SW-HB21/EV

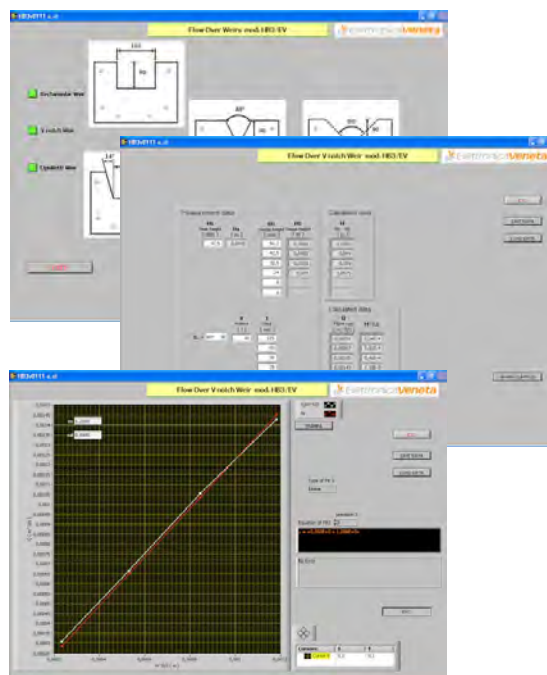


SPREADSHEET SOFTWARE FOR FLUID MECHANICS EQUIPMENT Mod. SW-HBxx/EV

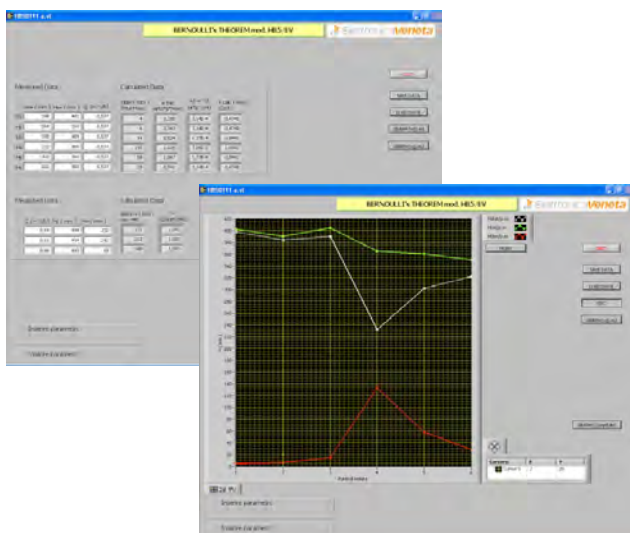
DESCRIPTION

This software features a spreadsheet for each unit mod. HBxx/EV.

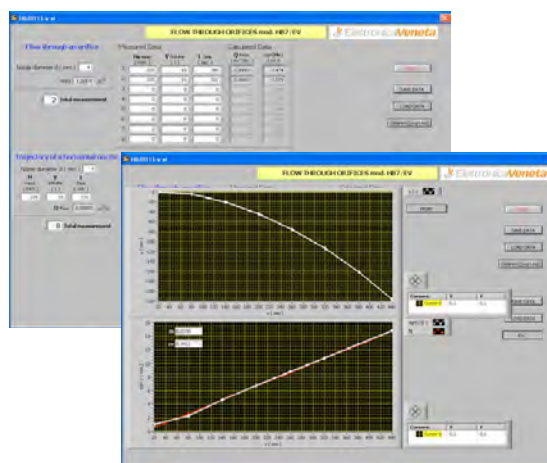
It is possible to input the data obtained with the experiments. Using these figures and with the help of default values formulas, it is possible to calculate and display through graphs the result of each test.



Software mod. SW-HB3/EV - Flow over weirs



Software mod. SW-HB5/EV - Bernoulli's theorem demonstration



Software mod. SW-HB7/EV - Flow through orifices

REQUIRED

ACCESSORIES (NOT INCLUDED)

- Personal Computer running Windows

HYDROSTATIC BENCH

Mod. HYDB/EV

DESCRIPTION

The bench was designed to study the properties of fluids in static conditions and it allows to understand and deepen a wide range of fundamental principles of hydrostatics.

TRAINING PROGRAM:

- Density, specific gravity and viscosity
- Capillarity
- The principle of communicating vessels
- Liquid level measurement
- The relationship between pressure and depth of the liquid
- Determination of the center of pressure (only with optional model mod. HB2/EV)
- Use of a barometer
- Measurement of the pressure with a U-type manometer
- Calibration of a Bourdon gauge (only with optional model mod. HB1/EV)
- Principle of Archimedes
- Metacentric height (only with optional model mod. HB4/EV)

TECHNICAL SPECIFICATIONS:

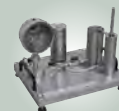
- Frame and worktop with tank made of stainless steel AISI 304
- Stainless steel AISI 304 water tank
- Hand pump
- Hydrometer 0.7 - 2.0 g / ml, 0.01 ml division
- Ball viscometer
- Containers for the study of communicating vessels
- Depth gauge
- Ecological barometer, 975-1050 hPa
- 2 U-type gauges
- Pascal's apparatus
- Apparatus for the observation of a capillary parallel glass phenomena
- Apparatus for the study of capillary tube phenomena
- Hydrostatic balance
- Graduated cylinder
- Thermometer
- Syringe
- Beaker
- Digital stopwatch

Dimensions: 1600 x 700 x 1920 (h) mm
Weight: 200 kg



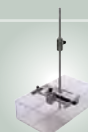
OPTIONAL

**DEAD WEIGHT CALIBRATOR
MOD. HB1/EV**



**CENTRE OF PRESSURE
MOD. HB2/EV**

**STABILITY OF A FLOATING BODY
MOD. HB4/EV**



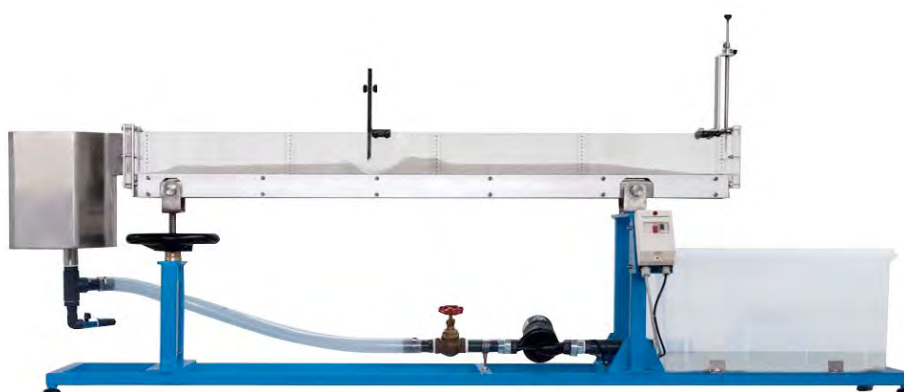
SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
MANUAL**



SEDIMENT TRANSPORT DEMONSTRATION CHANNEL

Mod. STDC/EV



DESCRIPTION

The Sediment Transport Demonstration Channel is designed to perform most of the experiments and demonstrations usually undertaken in much larger laboratory flumes, but at much lower cost and without need of technical support.

Sand is placed along the channel bed, between the inlet tank and the overfall discharge weir. Water is circulated around the system at a selected flow rate. The channel slope is adjusted by means of a screw jack to which is attached a slope indicator. The channel sides are transparent in order that bed profile changes can be readily observed, and a section of one side is provided with graphical grid.

This channel is mounted on to the manual jacking system, which provides positive step adjustment, via a hand wheel, with slope 0 to 10.

TRAINING PROGRAM:

- Preliminary study of dunes and ripples
- Threshold of sediment movements
- Effect of sediment size and density on bed load movements
- Bed load transport
- Suspended sediment transport
- Determination of total sediment load
- Flow visualization

TECHNICAL CHARACTERISTICS:

- Channel, 1600 x 80 x 115 (h) mm, with walls made of transparent Plexiglas
- Circulation pump
- Still tank
- Discharge tank
- Water level gauge
- Support frame
- Three different discharge rates
- Undershot weir
- Bridge pier
- Slope 0 to 10%

Power supply: 230 Vac 50 Hz single-phase - 1 kVA
(Other voltage and frequency on request)

Dimensions: 2500 x 400 x 1100(h) mm approx.

Weight: 110 kg approx

REQUIRED

UTILITIES (PROVIDED BY THE CUSTOMER)

- Water supply: first fill of water

SUPPLIED WITH

**THEORETICAL-EXPERIMENTAL
HANDBOOK**



PARTICLE DRAG COEFFICIENTS

Mod. PDC/EV

DESCRIPTION

The device is designed to show the relationship between the drag coefficients of falling spheres and their Reynolds' number value.

The spheres fall through a number of different liquids contained in 2 vertical glass tubes. As the spheres have a projected area of only 1% max of the tube cross-section, wall effect is reduced to a minimum.

Timing the passage of the particle between two marks on the walls of the glass tubes allows measuring their rate of fall. Different particles covering a range of sizes and densities are supplied.

TRAINING PROGRAM:

- Measurement of drag coefficients of spheres as a function of their Reynolds' number
- Effect of particle shape on rate of fall and on drag coefficient
- Effects of boundary layer separation on motion of spheres

TECHNICAL CHARACTERISTICS:

- Wall mounted compact apparatus
- Two transparent vertical glass tubes, height 1500 mm, internal diameter 92 mm, complete with calibration marks for timing
- Fluorescent lamp on the backside to make easier the visualization of the phenomenon
- Device to insert easily the particles at the top of the tube
- Device to remove easily the particles from the bottom of the tubes
- Spheres of different sizes and materials
- Two streamlined shapes
- Stopwatch
- Glass beaker

Power supply: 230 Vac 50 Hz single-phase - 0.2 kVA
(Other voltage and frequency on request)

Dimensions: 550 x 200 x 1600 (h) mm

Weight: 70 kg approx



SUPPLIED WITH

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MANUAL**



41-A

FLUID MECHANICS

www.elettronicaveneta.com

41A-E-FM

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Elettronica Veneta S.p.A.

Via Postumia, 16

31045 Motta di Livenza (Treviso) Italy

Tel. +39 0422 765 802 - Fax +39 0422 861 901

E-mail: export@elettronicaveneta.com

www.elettronicaveneta.com