Technical Teaching Equipment

Summarized
Catalogue

four (4)

Fluid Mechanics & Aerodynamics

Thermodynamics & Thermotechnics

Process Control

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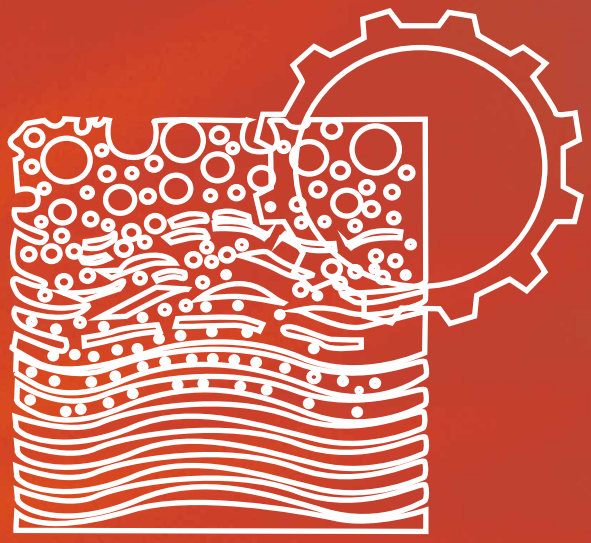

8. Fluid Mechanics & Aerodynamics

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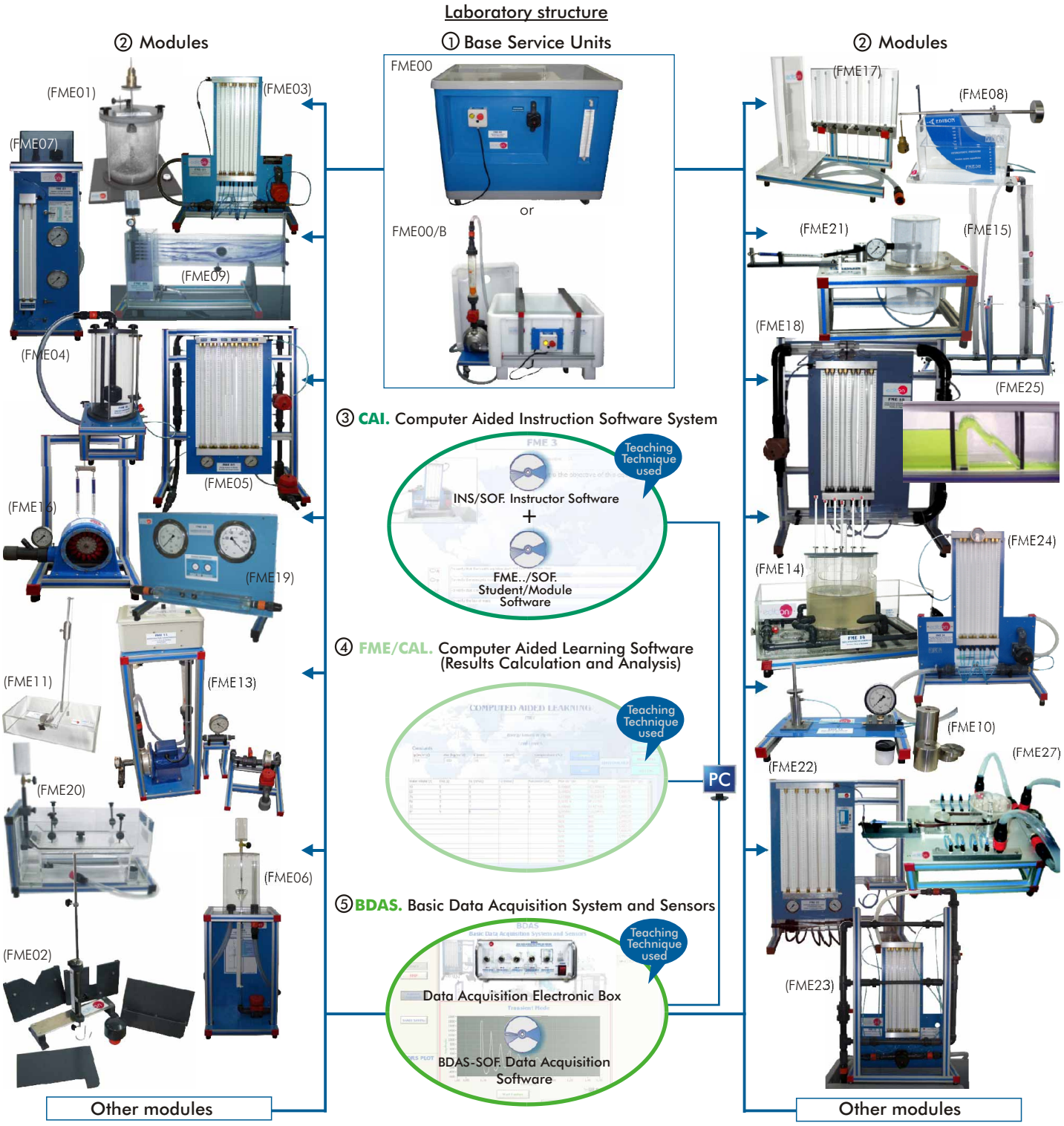
8.- Fluid Mechanics & Aerodynamics

Equipment list

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**



The complete laboratory includes parts 1 to 5 and any part can be supplied individually or additionally. (Base Service Unit + Module/s is the minimum supply)

Available Modules

➤General concepts
-FME01. Impact of a Jet.
-FME02. Flow over Weirs.
-FME04. Orifice Discharge.
-FME14. Free and Forced Vortex.
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-FME30. Vortex Flow Meter.
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-FME19. Cavitation Phenomenon Demonstration.
-FME25. Flow Channel, 1m. length.
-FME18. Flow Meter Demonstration.
-FME17. Orifice and Free Jet Flow.

➤Pipes
-FME05. Energy Losses in Bends.
-FME07. Energy Losses in Pipes.
-FME23. Basic Pipe Network Unit.

➤Hydraulic Machines
-FME12. Series/Parallel Pumps.
-FME13. Centrifugal Pumps Characteristics.
-FME27. Axial Flow Turbine.
-FME16. Pelton Turbine.
-FME28. Francis Turbine.
-FME29. Kaplan Turbine.
-FME21. Radial Flow Turbine.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

① Base Service Units

Every module needs being provided with water in order to run the experiment. There are two options:

FME00. **Hydraulics Bench**

SPECIFICATIONS SUMMARY

Mobile hydraulic bench, made of fibreglass reinforced polyester, and mounted on wheels for its mobility.
Centrifugal pump, 0.37 KW, 30 - 80 l/min at 20.1-12.8 m., single-phase 220V/50 Hz or 110V/60 Hz.
Runner made of stainless steel.
Sump tank capacity: 165 litres. Small channel: 8 litres.
Flow measurement: volumetric tank, gauged from 0 to 7 litres for low flow values and from 0 to 40 litres for high flow values.
Control valve for regulating the flow.
Open channel to place the test module.
Measuring cylinder is provided for the measurement of small flow rates.
Remote hand-operating dump valve in the base of the volumetric tank.
Rapidity and ease for interchanging of the different modules.
Dimensions (approx.): 1130 x 730 x 1000 mm.
Weight: 70 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Flow measurement.

FME00/B. **Basic Hydraulic Feed System**

SPECIFICATIONS SUMMARY

The FME00/B is a service unit for different Fluid Mechanics Units.
Centrifugal pump: 0.37 KW, 30 - 80 l/min at 20.1-12.8m., single-phase 220V. / 50Hz. or 110V. / 60Hz.
Stainless steel impeller.
Tank capacity: 140 litres approx.
Flowmeter. Membrane type flow adjusting valve.
Safety switch ON/OFF.
Supports for accomodating the test module.
This unit incorporates wheels for its mobility.
Dimensions (approx.): 1000 x 600 x 700 mm.
Weight: 40 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Flow measurement.

② Modules

Each module is a set of components that allows the realization of several experiments on Hydraulics. EDIBON offers 35 different models covering the most important topics in the learning of Fluid Mechanics. Each Module has its own manuals (8 manuals are normally supplied), that gives the theoretical background and explains everything the student need to carry out the exercises/experiments.
Connectors, pipes and cables for completing the exercises and practices are supplied.

➤ **General concepts**

FME01. **Impac of a Jet**

SPECIFICATIONS SUMMARY

Jet diameter: 8 mm.
Impact surfaces diameter: 40 mm.
Impact surfaces:
180° hemispherical surface.
120° curve surface.
90° flat surface.
A set of masses of 5, 10, 50 and 100 g. is supplied.
Easy and quick coupling system built-in.
Dimensions (approx.): 250 x 250 x 500 mm.
Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Impact against a flat surface.
2.- Impact against a curve surface of 120°.
3.- Impact against a hemispherical surface.
4.- Use of the fast connectors.

FME02. **Flow over Weirs**

SPECIFICATIONS SUMMARY

Dimensions of the weirs: 230 x 4 x 160 mm.
Neckline angle in the V-shape weir: 90°.
Dimension of rectangular notch: 30 x 82 mm.
Scale of the level meter: 0 to 160 mm.
Dimensions (approx.): 400 x 160 x 600 mm.
Weight: 7 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Study of the flow characteristics through a weir with a rectangular neckline, made on a thin wall.
2.- Study of the flow characteristics through a weir with a V-shape neckline, made on a thin wall.

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

②Modules

➤General concepts

FME04. **Orifice Discharge**

Detail of the
5 type of mouthpieces

SPECIFICATIONS SUMMARY

Transparent cylindrical tank.
Five type of mouthpieces: diaphragm, colloidal, 2 of Venturi and cylindrical.
Height of maximum load: 400 mm.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx.): 450 x 450 x 900 mm.
Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the discharge coefficient for the mouthpiece of thin wall, Venturi type.
2.- Determination of the velocity coefficient for the mouthpiece of thin wall, Venturi type.
3.- Determination of the contraction coefficient for the mouthpiece of thin wall, Venturi type.
4.- Determination of the discharge coefficient for the mouthpiece of thin wall, diaphragm type.
5.- Determination of the velocity coefficient for the mouthpiece of thin wall, diaphragm type.
6.- Determination of the contraction coefficient for the mouthpiece of thin wall, diaphragm type.
7.- Determination of the discharge coefficient for the mouthpiece of thin wall, colloidal type.
8.- Determination of the velocity coefficient for the mouthpiece of thin wall, colloidal type.
9.- Determination of the contraction coefficient for the mouthpiece of thin wall, colloidal type.
10.- Determination of the discharge coefficient for the mouthpiece of thick wall, cylindrical type.
11.- Determination of the velocity coefficient for the mouthpiece of thick wall, cylindrical type.
12.- Determination of the contraction coefficient for the mouthpiece of thick wall, cylindrical type.
13.- Determination of the discharge coefficient for the mouthpiece of thick wall, Venturi type.
14.- Determination of the velocity coefficient for the mouthpiece of thick wall, Ventury type.
15.- Determination of the contraction coefficient for the mouthpiece of thick wall, Ventury type.

FME14. **Free and Forced Vortex**

SPECIFICATIONS SUMMARY

Tank diameter: 300 mm.
Tank height: 300 mm.
Mouthpieces orifice diameters: 8, 16 and 24 mm.
Distance between centers: 0, 30, 50, 70, 90 and 110 mm.
Pitot tube with measuring points at: 15, 20, 25 and 30 mm radius and a scale.
Measurement bridge.
Inlet pipes: 9 and 12.5 mm. diameter.
Diameter measurement system by Nonius.
Blind mouthpiece with X-shaped crosses.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx.): 600 x 550 x 1400 mm.
Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Study of forced vortex without discharge orifice.
2.- Study of forced vortex with discharge orifice.
3.- Study of free vortex.
4.- Analysis of the influence of the jet inlet direction.
5.- Analysis of the influence of the vortex on the discharge velocity.

FME08. **Hydrostatic Pressure**

SPECIFICATIONS SUMMARY

Tank capacity: 5.5 l.
Distance between the suspended masses and the support point: 285 mm.
Area of the section: 0.007 m^2.
Total depth of the submerged quadrant: 160 mm.
Height of the support point on the quadrant: 100 mm.
A set of masses of different weights is supplied (4 of 100 gr, 1 of 50 gr, 5 of 10 gr, and 1 of 5 gr).
Dimensions (approx.): 550 x 250 x 350 mm.
Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the center of pressures with an angle of 90°, partially submerged.
2.- Determination of the resultant force with an angle of 90°, partially submerged.
3.- Determination of the center of pressures, angle <> 90° partially submerged.
4.- Determination of the equivalent force with an angle <>90° partially submerged.
5.- Determination of the center of pressures with an angle of 90° totally submerged.
6.- Determination of the resultant force with an angle of 90° totally submerged.
7.- Determination of the center of pressures, angle <>90° totally submerged.
8.- Determination of the resultant force, angle <>90° totally submerged.
9.- Balance of momentum.

FME10. **Dead Weight Calibrator**

SPECIFICATIONS SUMMARY

Pressure manometer: Bourdon type: 0 - 2.5 bar.
Masses (approx. weights): 0.5 kg. 1.0 kg. 2.5 kg. 5 kg.
Piston diameter: 18 mm. Piston weight: 0.5 kg.
Anodized aluminium structure.
Dimensions (approx.): 500 x 400 x 500 mm.
Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Bourdon type manometer calibration.
2.- Hysteresis curve determination.

8.1- Fluid Mechanics (Basic)

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

②Modules

➤General concepts

FME11. **Metacentric Height**

SPECIFICATIONS SUMMARY

Maximum angle: +/-13°.
Corresponding lineal dimension: +/- 90 mm.
Dimension of the float:
Length: 353 mm. Width: 204 mm. Total height: 475 mm.
Dimensions (approx.): 750 x 400 x 750 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Study of the stability of a floating body. Angular displacements.
2.- Study of the stability of a floating body. Different positions of the center of gravity.
3.- Determination of the metacentric height.

FME26. **Depression Measurement System** (vacuum gauge)

SPECIFICATIONS SUMMARY

Anodized aluminium structure.
Pressure-vacuum gauge adjusted from -1 to 0 bar.
Quick connections.
Dimensions (approx.): 220 x 110 x 420 mm. Weight: 2 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- To measure the depression caused for the fluid aspiration by an hydraulic pump.
2.- We can observe the different negative readings due to the different methods of fluid aspiration for its subsequent impulsion.

FME32. **Pitot Static Tube Module**

SPECIFICATIONS SUMMARY

Pitot static tube:
Head diameter: 2.5 mm.
Transparent pipe:
32 mm. internal diameter and 600 mm. length approx.
Hose connections.
Water manometer, 500 mm. length.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 800 x 450 x 700 mm. Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Study of the function of a pitot static tube.
2.- To use a pitot static tube.
3.- Determination of tube flow speed profiles.
4.- Demonstration that the flow speed is proportional to the pressure difference between the total pressure and the static pressure.
5.- Error determination in flow measurements using the Pitot tube as measurement instrument.
6.- Factor C_d determination in the Pitot tube.

FME34. **Fluid Statics and Manometry**

SPECIFICATIONS SUMMARY

The module is mounted on an aluminium structure and painted steel panels and consists on a vertical tank containing water that is connected to different vertical manometer tubes:
Two parallel tubes (scale length 460 mm).
An "U" tube (scale length 460 mm).
A tube with varying cross section (scale length 460 mm).
An inclined tube with different inclinations (scale length 460 mm).
These tubes can be used individually or in combination for the different demonstrations.
Hook and point gauge with Vernier scale.
Dimensions (approx.): 500 x 160 x 1225 mm.
Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- To study the basic principles of hydrostactis and to demonstrate the behaviour of liquids at rest.
2.- Demonstrations of different types of manometers.
3.- To use manometer tubes to measure differential pressure.
4.- To use a manometer tube to measure head.
5.- To use a 'U' tube manometer to measure pressure differences in a gas (air over liquid).
6.- To use a U-shaped manometer for determining the differential pressure.
7.- To use liquids with different densities to change the 'U' tube manometer sensitivity.
8.- To use an inverted pressurized 'U' tube manometer to measure pressure differences in a liquid.
9.- To use an inclined manometer with diferent inclinations.
10.- Level measurement using Vernier hook and point gauge.
11.- Level measurement using a micro- manometer.
12.-To measure the liquid level using a scale.
13.-Frictional losses study.

FME35. **Fluid Properties**

SPECIFICATIONS SUMMARY

Anodized aluminium structure and panels in painted steel.
Universal hydrometer and two hydrometer jars.
Barometer.
Parallel plate capillary module.
Capillary tube module with tubes of different size.
Two falling sphere viscometer tubes and set of spheres.
Archimedes apparatus (displacement vessel, bucket and cylinder).
Measuring cylinder (250 ml).
Glass beakers (600 ml).
Density bottle. Thermometer.
Scale lever balance for using with the Archimedes module.
Dimensions (approx.): 650 x 200 x 600 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- To study the effect of capillary elevation between flat plates.
2.- To study and measure the effect of capillary elevation inside capillary tubes.
3.- To study and verify the Archimedes principle using a bucket and cylinder with a lever balance.
4.- To measure the fluid density and relative density of a liquid using a hydrometer and using a density bottle.
5.- To measure the atmospheric pressure using a barometer.
6.- To measure the fluid viscosity using a falling sphere viscometer.
7.- Measuring of liquid levels.

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

➤**Laws**

②Modules

FME03. **Bernoulli's Theorem Demonstration**

SPECIFICATIONS SUMMARY

Manometer range: 0 to 300 mm of water.
Number of manometer tubes: 8
Upstream diameter of the throat: 25 mm.
Narrowing:
Downstream: 21°. Upstream: 10°.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 800 x 450 x 700 mm.
Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the exact section in Venturi's tube.
2.- Demonstration of Bernoulli's Theorem. Divergent-convergent position.
3.- Determination of Bernoulli's Theorem equation. Convergent-divergent position.
4.- Observation of differences between convergent and divergent position.

FME22. **Venturi, Bernoulli and Cavitation Unit**

SPECIFICATIONS SUMMARY

Manometer (Bourdon type), range: 0-2.5 bar.
Manometer (Bourdon type), range: 0-(-1) bar.
2 tanks, height: 135 mm and internal diameter: 64 mm.
Venturi tube with 6 tappings (Divergent/Convergent).
Differential manometers: 0-500 mm.
5 Manometric tubes.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 750 x 400 x 850 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- How to fill the manometric tubes.
2.- Flow calculation.
3.- Determination of the exact section in Venturi's tube. Bernoulli's theorem study.
4.- Cavitation study.
5.- Pressure reduction in a tank.
6.- Aspiration pump.
7.- Aspiration pump for mixing two liquids.
8.- Using for air and water mixing.

FME06. **Osborne- Reynolds' Demonstration**

SPECIFICATIONS SUMMARY

Tube inner diameter: 10 mm.
Tube outer diameter: 13 mm.
Visualization pipe length: 700 mm.
Capacity of the dye tank: 0.3 litres.
Tank capacity: 10 litres.
Flow control valve: diaphragm type.
The coloured fluid is regulated with a needle valve.
Easy and quick coupling system built-in.
Anodized aluminium structure and panels in painted steel.
Dimensions (approx.): 450 x 450 x 1250 mm.
Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Observation of the laminar, transition and turbulent regime.
2.- Study of the velocity profile, reproducing the Osborne-Reynolds's experiment.
3.- Reynolds's number calculation.

FME31. **Horizontal Osborne-Reynolds Demonstration**

SPECIFICATIONS SUMMARY

Horizontal transparent pipe section:
Internal diameter: 16 mm. Length: 700 mm.
Dye or colouring tank.
The colouring is regulated with a valve.
Supply tank for the generation of a constant initial pressure, capacity: 2 litres.
Flow regulation valve.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 1000 x 500 x 700 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Observation of the laminar, transition and turbulent regime.
2.- Study of the velocity profile, reproducing the Osborne-Reynolds's experiment.
3.- Reynolds's number calculation.

FME24. **Unit for the study of Porous Beds in Venturi Tubes (Darcy's Equation)**

Detail of the Venturi´s tubes with porous bed

SPECIFICATIONS SUMMARY

Manometer range: 0-300 mm. of water.
Number of manometric tubes: 8.
Strangulation diameter upstream: 25 mm.
Narrowing: upstream: 10°, downstream: 21°.
Venturi's tube with Pitot tube.
Venturi's tube with porous bed of a grain diameter of 1.0 to 1.5 mm (FME24/A).
Venturi's tube with porous bed of a grain diameter of 2.5 to 3.5 mm (FME24/B).
Venturi's tube with porous bed of a grain diameter of 5.5 to 7.0 mm (FME24/C).
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 800 x 450 x 700 mm. Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of Bernoulli's theorem and its limitations in divergent-convergent position.
2.- Demonstration of Bernoulli's theorem and its limitations in convergent-divergent position.
3.- Direct measurement of the static height and of the total distribution of heights in Venturi's tubes.
4.- Determination of the exact section in a Venturi's tube.
5.- Head losses in the porous bed (elements FME24/A, FME24/B and FME24/C).

8.1- Fluid Mechanics (Basic)

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

②Modules

➤**Laws**

FME33. **Pascal's Module**

SPECIFICATIONS SUMMARY

This module is mounted on a metallic structure.
Body incorporating a horizontal diaphragm to which a glass vessels can be fitted.
Lever arm with a sliding weight, and a level to measure the force at the base of the vessel.
Three different vessel, with common diammeter at the base but with different shape.
Movable index in a vertical rod to enable the height of water in the vessels to be set at the same level.
Dimensions (approx.): 600 x 250 x 450 mm. Weight: 3 Kg.

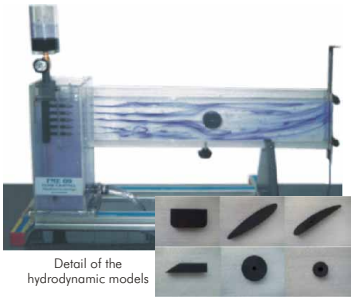
More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of Pascal´s principles.
2.- To demonstrate that the pressure in a liquid contained in a vessel varies with depth is not affected by the shape of the vessel by comparing three different vessels.

➤**Demonstration**

FME09. **Flow Visualization in Channels**



Detail of the hydrodynamic models

SPECIFICATIONS SUMMARY

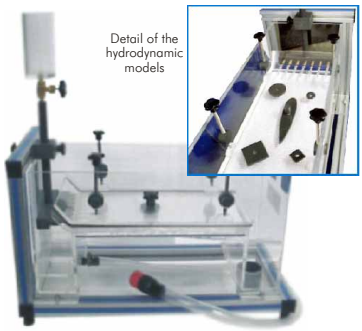
Capacity of the dye tank: 0.3 litres.
Width/length of the channel approx.: 15/630 mm.
Depth of channel approx.: 150 mm.
Damping tank that eliminates the turbulences.
Hydrodynamic models: 2 lengthened, 2 circular of 25 and 50 mm. dia., rectangle with rounded edges and wedge.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx.): 900 x 450 x 500 mm. Weight: 7 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Leakage of liquids by thin-wall weirs.
2.- Liquid leakage by thick-wall weirs.
3.- Models with wing profile submerged in a fluid current.
4.- Circular models submerged in a fluid current.
5.- Demonstration of the phenomenon associated to the flow in open channels.
6.- Visualization of the flow lines around different submerged hydrodynamic models.

FME20. **Laminar Flow Demonstration**



Detail of the hydrodynamic models

SPECIFICATIONS SUMMARY

Capacity of dye tank: 0.3 litres.
Width/length of the table: 400/210 mm.
Depth of the table: adjustable depending on the models.
Hydrodynamic models:
Two circular ones of 25 and 50 mm. diameter.
Two rectangular ones of 25 x 25 and 50 x 50 mm.
Wedge.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx.): 870 x 450 x 400 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Ideal flow around a submerged cylinder.
2.- Ideal flow around a submerged profile.
3.- Ideal flow around a body in peak.
4.- Ideal flow in a convergent channel.
5.- Ideal flow in a divergent channel.
6.- Ideal flow in an elbow of 90°.
7.- Ideal flow in a sudden contraction.
8.- Ideal flow in a sudden broadening.
9.- Substitution of a line of current for a solid edge.

FME30. **Vortex Flow Meter**

SPECIFICATIONS SUMMARY

Vortex flow meter.
Dye or colouring container with metering valve.
Variable area flow meter.
Range: 0-30 l./min. approx.
Valves.
Graduated measuring vessel (2 l. capacity approx).
Digital scale.
Collecting tank with constant height.
Chronometer.
Easy and quick coupling system built-in.
Anodized aluminium structure and panels in painted steel.
Dimensions(approx.): 1000 x 400 x 1000 mm.
Weight: 30 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Study and experiments with a vortex flow meter.
2.- Study and experiments with a variable area flow meter.
3.- Measurement of volumetric volume flow rate.
4.- Measurement of gravimetric volume flow rate.
5.- Comparison of methods on several volumetric and mass flow measurements.
6.- Flow meters calibration.

FME15. **Water Hammer**

SPECIFICATIONS SUMMARY

Constant level deposit, in methacrylate.
Unload deposit, in methacrylate.
Pipe circuits in PVC.
Valves to select the circuit.
2 adjustable equilibrium chimneys and subjection clips.
Connections system to the Hydraulics Bench (FME00) or Basic Hydraulic Feed System (FME00/B) with fast plugs.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx).:1215 x 270 x 1430 mm.
Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Subduing of the water hammer effects.
2.- Study of the subduing depending on the diameter of the chimney.
3.- Calculations of the energy losses in pipes.

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

②Modules

➤**Demonstration**

FME19. **Cavitation Phenomenon Demonstration**

SPECIFICATIONS SUMMARY

Manometer range: 0 to 2.5 bar.
Vacuum gauge range: from -1 to 0 bar.
Throat section: 36 mm^2.
Normal section: 150 mm^2.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 750 x 400 x 750 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Study of cavitation.
2.- Visualization of the cavitation phenomenon with forced conduction.

FME25. **Flow Channel, 1m. length**

SPECIFICATIONS SUMMARY

Channel of rectangular section with transparent walls in methacrylate, length: 1 m.
Rigid and flexible pipes. Regulating valves.
Storage tank. Tank with soothing of flow.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx.): 1500 x 500 x 500 mm. Weight: 40 Kg.
Available accessories:
FME25TP. Pitot tube.
FME25CV. Vertical plane gate.
FME25SDL. Syphon.
FME25RMC. Markings for measurement of the water height.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- To study and demonstrate the properties of fluids in open channels.
2.- Measurement of water height and velocity along the channel.
3.- Flow control by floodgates.
4.- Level control using syphons.
5.- Calculation of water flow.

Other possible practices:

6.- Filling of the Pitot tube.
7.- Use of markings for measuring the water height.

FME18. **Flow Meter Demonstration**

SPECIFICATIONS SUMMARY

Manometer range: 0 to 500 mm. of water column.
Number of manometric tubes: 8.
Orifice plate diameter: 25 mm.
Flowmeter: 2 to 30 l/min.
Venturi dimensions:
Throat diameter: 20 mm. Upstream pipe diameter: 32 mm.
Downstream taper: 21°. Upstream taper: 14°.
Orifice Plate dimensions:
Upstream pipe diameter: 35 mm.
Downstream orifice diameter: 19 mm.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 750 x 450 x 950 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Filling of the manometric tubes.
2.- Determination of the error in flow measurements using the Venturi.
3.- Determination of the C_d factor in the Venturi.
4.- Determination of the strangulation in the Venturi.
5.- Determination of the error in flow measurements using the orifice plate.
6.- Determination of the C_d factor in the orifice plate.
7.- Determination of the effective area in an orifice plate.
8.- Comparison of the energy loss in the three different elements.
9.- Comparison among the Venturi, the orifice plate and the flowmeter.

FME17. **Orifice and Free Jet Flow**

SPECIFICATIONS SUMMARY

Orifices with diameters of 3.5 and 6 mm.
Jet trajectory Probes: 8.
Maximum height: 500 mm.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Dimensions (approx.): 600 x 550 x 1400 mm.
Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the orifice velocity coefficient.
2.- Obtaining of the orifice discharge coefficient in permanent regime.
3.- Obtaining of the orifice discharge coefficient in variable regime.
4.- Obtaining of the tank discharge time.

➤**Pipes**

FME05. **Energy Losses in Bends**

SPECIFICATIONS SUMMARY

Range of the two Bourdon type manometers: 0 to 2.5 bar.
Differential manometers range: 0 to 500 mm.
Number of manometric tubes: 12.
PVC Rigid pipes:
Internal dia.: 25 mm., external dia.:32 mm.
Flexible pipes:
Pressure taking-differential manometer.
External diameter: 10 mm.
Pressurizing equipment. External diameter: 6 mm.
Drain. External diameter: 25 mm.
Fittings:
45° angle, 90° curve, 90° medium elbow, 90° short elbow, 90° long elbow, broadening of 25/40, narrowing of 40/25.
Membrane valves. Diameter 25 mm. Antireturn: 6 mm.
Easy and quick coupling system built-in.
Anodized aluminium structure and panel in painted steel.
Dimensions (approx.): 750 x 550 x 950 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Filling of the manometric tubes.
2.- Measurement of the flow.
3.- Measurement of load losses for a short elbow of 90°.
4.- Measurement of load losses for a medium elbow of 90°.
5.- Measurement of load losses for a curve of 90°.
6.- Measurement of load losses for a broadening of 25/40.
7.- Measurement of load losses for a narrowing 40/25.
8.- Measurement of load losses for an angle of 45°.
9.- Measurement of load losses for a membrane valve.

8.1- Fluid Mechanics (Basic)

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

②Modules

➤**Pipes**

FME07. **Energy Losses in Pipes**

SPECIFICATIONS SUMMARY

Test pipe of 4 mm. of inner diameter, 6 mm. of external diameter and 500 mm. of length.
1 Differential manometer of water column.
Manometer scale: 0 to 500 mm (water).
2 Bourdon type manometers, range: 0 to 2 bar.
Constant height tank.
Easy and quick coupling system built-in.
Anodized aluminium structure and panels in painted steel.
Dimensions (approx.): 330 x 330 x 900 mm.
Weight: 30 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Energy loss in pipes for a turbulent regime.
2.- Determination of the energy loss in a turbulent regime.
3.- Determination of the number of Reynolds for a turbulent regime.
4.- Energy loss in pipes for a laminar regime.
5.- Determination of the energy loss factor *f* for a pipe in laminar regime.
6.- Determination of Reynolds number for the laminar regime.
7.- Determination of the kinematic viscosity of water.

FME23. **Basic Pipe Network Unit**

SPECIFICATIONS SUMMARY

Anodized aluminum structure where the pipe network is located and the subjection panel of the manometers.
Test pipes:
  Three PVC pipes, with different diameters.
  One methacrylate pipe.
8 eight pressure intakes, connected to a manometric tubes panel of pressurized water.
Pressurization system.
Manometric tubes panel:
  Number of manometric tubes: 8.
  Range: 0 to 470 mm of water.
Inlet pipe. Outlet pipe.
Regulation valves for controlling the flow through the network.
Adjustable legs for leveling the unit.
Easy and quick coupling system built-in.
Dimensions (approx.): 600 x 350 x 800 mm. Weight: 30 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Load loss in a PVC pipe.
2.- Load loss in a methacrylate pipe.
3.- Study of the load loss in pipes made of the same material.
4.- Study of the load loss depending on the material.
5.- Friction coefficient in a PVC pipe.
6.- Friction coefficient in a methacrylate pipe.
7.- Study of the friction coefficient depending on the material.
8.- Study of the friction coefficient depending on the diameter.
9.- Configuration of network in parallel for pipes of the same material but different diameter.
10.- Configuration of network in parallel for pipes of the same diameter but different material.

➤**Hydraulic Machines**

FME12. **Series/Parallel Pumps**

SPECIFICATIONS SUMMARY

Centrifugal pump: 0.37 KW, 30-80 l/min. at 20.1-12.8 m., single-phase, 220V./50 Hz or 110V./60 Hz.
Absolute pressure manometer placed at the pump admission. Range - 1 to 3 bar.
2 Manometers (manometric pressure), one of them placed in the discharge and the another one in the discharge accessory. Range: 0 - 4 bar.
Membrane valve for flow regulating.
Two way valve: 2 positions: open or close.
Accessories:
  Two flexible pipes with quick connections.
  Reinforced pipe with quick connections.
Discharge accessory.
Easy and quick coupling system built-in.
Anodized aluminium structure and panels in painted steel.
Dimensions of the FME12 module (approx.): 500 x 400 x 400 mm.
Dimension of the discharge accessory (approx.): 500 x 400 x 250 mm.
Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Water flow calculation.
2.- H (Q) curve obtaining of a centrifugal pump.
3.- Series coupling of two pumps with the same characteristics.
4.- Parallel coupling of two pumps with the same characteristics.

FME13. **Centrifugal Pumps Characteristics**

SPECIFICATIONS SUMMARY

Centrifugal pump: 0.37 KW, 30 - 80 l/min. at 20.1 - 12.8 m. with speed variator.
Bourdon type manometers.
Control panel for the variator, allowing to modify the speed, with visualization display that enables to know the r.p.m. and the power consumed, and with on/off switch.
Discharge accessory, with manometer, flow control valve and diffuser.
Vacuum meter.
Easy and quick coupling system built-in.
Anodized aluminium structure and panels in painted steel.
Dimensions (approx.): 450 x 500 x 1250 mm.
Weight: 40 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Obtaining of the curves H(Q), N(Q), Eff%(Q) of a centrifugal pump.
2.- Making of the map of a centrifugal pump.
3.- Representation of the adimensional curves H*, N* and rpm*.
4.- Series coupling of two pumps of similar characteristics.
5.- Series coupling of two pumps of different characteristics.
6.- Parallel coupling of two pumps of similar characteristics.
7.- Parallel coupling of two pumps of different characteristics.

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

②Modules

➤**Hydraulic Machines**

FME27. **Axial Flow Turbine**

SPECIFICATIONS SUMMARY

Nozzle:
Inlet dia. of the throat: 2.5 mm., outlet dia. of the throat: 2.5 mm., discharge angle: 20° and 30°.
Turbine rotor:
External dia.:53 mm., internal dia.: 45 mm., number of blades: 40, inlet angle of the blades: 40°, outlet angle of the blades: 40°, used material: brass.
Brake:
Pulley diameter: 60 mm., real diameter: 50 mm.
Bourdon type manometer.
8 Ball valves.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Tachometer.
Dimensions (approx.): 800 x 500 x 600 mm. Weight: 50 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Flow calculation.
2.- Determination of the discharge coefficient of the nozzle.
3.- Determination of the curve N(Q, n), P_m(Q, n) and η (Q, n); (20° nozzle).
4.- Determination of the curve N(Q, n), P_m(Q, n) and η (Q, n); (30° nozzle).
5.- Adimensional analysis.

FME16. **Pelton Turbine**

SPECIFICATIONS SUMMARY

Speed range: 0 - 2000 r.p.m. Torque: 10 W.
Manometer range: 0 - 2.5 bar.
Number of buckets: 16.
Drum radius: 30 mm.
Dynamometers range: 0 - 20 N.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Tachometer.
Dimensions (approx.): 750 x 400 x 750 mm. Weight: 15Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the operative characteristics of the Pelton Turbine.
2.- Determination of the operation mechanical curves.
3.- Determination of the operation hydraulic curves.
4.- Adimensionalization.

FME28. **Francis Turbine**

SPECIFICATIONS SUMMARY

Functional model of Francis turbine.
Velocity range: 0-1000 r.p.m. Power: 5 W.
Diameter of the turbine: 52 mm.
Number of blades of the turbine: 15.
Number of adjustable guide vanes of the distributor: 10.
Manometer range: 0-250 mbar.
Braking system connected to 2 dynamometers:
dynamometers range: 0-10 N.
Feed chamber. Draft tube.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Tachometer.
Dimensions (approx.): 500 x 350 x 600 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- To determine the operating characteristics of a Francis turbine at different velocities.
2.- Determination of the typical turbine curves (operating mechanical curves and operating hydraulic curves).
3.- Turbine power output versus speed and flow rate at various heads.
4.- Effect of guide vane setting on turbine performance.
5.- Adimensionalization.

FME29. **Kaplan Turbine**

SPECIFICATIONS SUMMARY

Functional model of Kaplan Turbine.
Velocity range: 0-1000 r.p.m. Power: 10 W.
Number of blades of the turbine: 4.
Turbine diameter: 52 mm.
Number of adjustable guide vanes of the distributor: 8.
Manometer range: 0-200 mm. of water.
Braking system connected to 2 dynamometers:
dynamometers range: 0-10 N.
Feed chamber. Draft tube.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Tachometer.
Dimensions (approx.): 500 x 350 x 600 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the operative characteristics of Kaplan Turbine at different velocities.
2.- Flow calculation.
3.- Determination of the operation mechanical curves.
4.- Determination of the operation hydraulic curves.
5.- Adimensional analysis.

FME21. **Radial Flow Turbine**

SPECIFICATIONS SUMMARY

Nozzles:
Inlet dia.: 21 mm., outlet dia.: 2.0 mm., discharge angle: 180°.
Turbine rotor:
External dia.:69 mm., internal dia.: 40 mm., number of nozzles: 2, inlet angle to the nozzle: 180°, outlet angle to the nozzle: 180°, used material: aluminium.
Brake:
Pulley diameter :60 mm., effective diameter: 50 mm.
Easy and quick coupling system built-in.
Anodized aluminium structure.
Tachometer.
Dimensions (approx.): 800 x 500 x 600 mm. Weight: 50 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

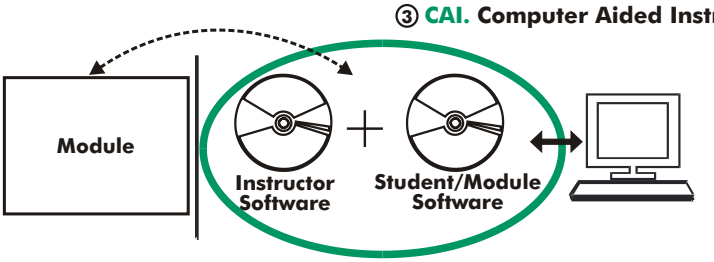
PRACTICAL POSSIBILITIES

1.- Flow calculation.
2.- Obtaining of the M (n, H_a), N (n, H_a), η (n, H_a) curves.
3.- Obtaining of the M (n, Q), Nm (n, Q), η (n, Q) curves.
4.- Adimensionalization.

8.1- Fluid Mechanics (Basic)

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

③ CAI. Computer Aided Instruction Software System



With no physical connection between module and computer, this complete package consists on an Instructor Software (INS/SOF) totally integrated with the Student/Module Software (FME../SOF). Both are interconnected so that the teacher knows at any moment with is the theoretical and practical knowledge of the students. These, on the other hand, get a virtual instructor who helps them to deal with all the information on the subject of study.

- INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Print reports.
- Develop own examinations.
- Detect student's progress and difficulties.

...and many other facilities.

The Instructor Software is the same for all the modules, and working in network configuration allows controlling all the students in the classroom.

- FME../SOF. Computer Aided Instruction Softwares (Student/Module Software):

It explains how to use the module, run the experiments and what to do at any moment. Each module has its own Student Software.

- The options are presented by pull-down menus and pop-up windows.
- Each Software contains:

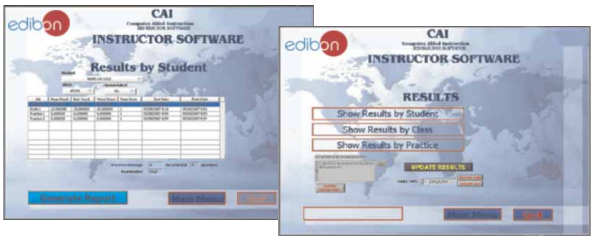
  Theory: that gives the student the theoretical background for a total understanding of the studied subject.

  Exercises: divided by thematic areas and chapters to check out that the theory has been understood.

  Guided Practices: presents several practices to be done, alongside the module, showing how to complete the circuits and get the right information from them.

  Exams: set of questions presented to test the obtained knowledge.

Instructor Software



Student/Module Software

Available Student/Module Softwares:

➤General concepts
-FME01/SOF. Impact of a Jet.
-FME02/SOF. Flow over Weirs.
-FME04/SOF. Orifice Discharge.
-FME14/SOF. Free and Forced Vortex.
-FME08/SOF. Hydrostatic Pressure.
-FME10/SOF. Dead Weight Calibrator.
-FME11/SOF. Metacentric Height.
-FME26/SOF. Depression Measurement System (vacuum gauge).
-FME32/SOF. Pitot Static Tube Module.
-FME34/SOF. Fluid Statics and Manometry.
-FME35/SOF. Fluid Properties.
➤Laws
-FME03/SOF. Bernoulli's Theorem Demonstration.
-FME22/SOF. Venturi, Bernoulli and Cavitation Unit.
-FME06/SOF. Osborne-Reynolds' Demonstration.
-FME31/SOF. Horizontal Osborne-Reynolds Demonstration.
-FME24/SOF. Unit for the study of Porous Beds in Venturi Tubes (Darcy's Equation).
-FME33/SOF. Pascal's Module.
➤Demonstration
-FME09/SOF. Flow Visualization in Channels.
-FME20/SOF. Laminar Flow Demonstration.
-FME30/SOF. Vortex Flow Meter.
-FME15/SOF. Water Hammer.
-FME19/SOF. Cavitation Phenomenon Demonstration.
-FME25/SOF. Flow Channel, 1m. length.
-FME18/SOF. Flow Meter Demonstration.
-FME17/SOF. Orifice and Free Jet Flow.
➤Pipes
-FME05/SOF. Energy Losses in Bends.
-FME07/SOF. Energy Losses in Pipes.
-FME23/SOF. Basic Pipe Network Unit.
➤Hydraulic Machines
-FME12/SOF. Series/Parallel Pumps.
-FME13/SOF. Centrifugal Pumps Characteristics.
-FME27/SOF. Axial Flow Turbine.
-FME16/SOF. Pelton Turbine.
-FME28/SOF. Francis Turbine.
-FME29/SOF. Kaplan Turbine.
-FME21/SOF. Radial Flow Turbine.

④ FME/CAL. Computer Aided Learning Software (Results Calculation and Analysis)

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use, specifically developed by EDIBON.

CAL is a class assistant that helps in making the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL will perform the calculations.

CAL computes the value of all the variables involved.

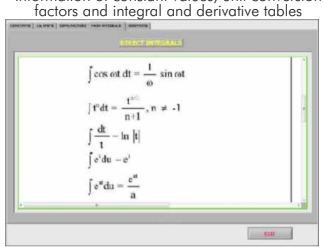
It allows to plot and print the results. Between the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

Calculations

Information of constant values, unit conversion factors and integral and derivative tables



Plotting options

Available Softwares:

➤General concepts
-FME01/CAL. Impact of a Jet.
-FME02/CAL. Flow over Weirs.
-FME04/CAL. Orifice Discharge.
-FME14/CAL. Free and Forced Vortex.
-FME08/CAL. Hydrostatic Pressure.
-FME10/CAL. Dead Weight Calibrator.
-FME11/CAL. Metacentric Height.
-FME26/CAL. Depression Measurement System (vacuum gauge).
-FME32/CAL. Pitot Static Tube Module.
-FME34/CAL. Fluid Statics and Manometry.
-FME35/CAL. Fluid Properties.
➤Laws
-FME03/CAL. Bernoulli's Theorem Demonstration.
-FME22/CAL. Venturi, Bernoulli and Cavitation Unit.
-FME06/CAL. Osborne-Reynolds' Demonstration.
-FME31/CAL. Horizontal Osborne-Reynolds Demonstration.
-FME24/CAL. Unit for the study of Porous Beds in Venturi Tubes (Darcy's Equation).
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➤Demonstration
-FME09/CAL. Flow Visualization in Channels.
-FME20/CAL. Laminar Flow Demonstration.
-FME30/CAL. Vortex Flow Meter.
-FME15/CAL. Water Hammer.
-FME19/CAL. Cavitation Phenomenon Demonstration.
-FME25/CAL. Flow Channel, 1m. length.
-FME18/CAL. Flow Meter Demonstration.
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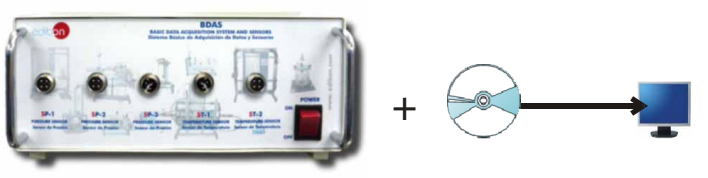
➤Pipes
-FME05/CAL. Energy Losses in Bends.
-FME07/CAL. Energy Losses in Pipes.
-FME23/CAL. Basic Pipe Network Unit.
➤Hydraulic Machines
-FME12/CAL. Series/Parallel Pumps.
-FME13/CAL. Centrifugal Pumps Characteristics.
-FME27/CAL. Axial Flow Turbine.
-FME16/CAL. Pelton Turbine.
-FME28/CAL. Francis Turbine.
-FME29/CAL. Kaplan Turbine.
-FME21/CAL. Radial Flow Turbine.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsbasic/LIFLUBA.pdf

LIFLUBA. **Basic Fluid Mechanics Integrated Laboratory:**

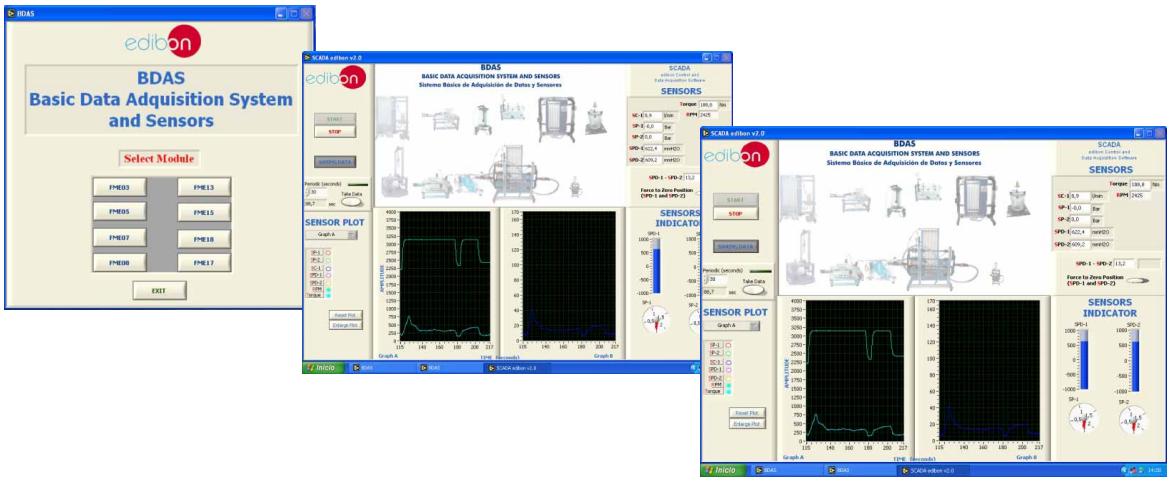
⑤ BDAS. Basic Data Acquisition System and Sensors



Data Acquisition Electronic Box + Data Acquisition Software + Computer (not included in the supply)

For being used with modules type "FME".
The system is formed by:

- Data Acquisition Electronic Box.
- Data Acquisition Board.
- Data acquisition Software.
- Module adaptation with the suitable sensors.



BHI. **Hydrostatics Bench & Fluid Properties**

Some modules included

FME11. Metacentric Height

FME02. Fluid Level Meter and Flow over Weirs

FME08. Hydrostatic Pressure

FME10. Dead Weight Calibrator

SPECIFICATIONS SUMMARY

Self-contained and mobile unit for demonstration of the properties of fluids and hydrostatics.
Structure in anodized aluminium, assembled on wheels with a panel (painted steel) at the top (front panel).
Process diagram in the front panel.
Tank where water is stored, in the lower part of the bench.
Methacrylate tank at the upper part of the bench.
Plastic deposit.
Thermometer.
4 Ubbelhode capillary viscosimeters of 0.6-3 cp, 2-10 cp, 10-50 cp and 60-300 cp.
3 Graduated cylinders.
Set of glass elements. Elements set for demonstration of free surface in static conditions (3 elements).
Bourdon manometers calibration. Manometer range: 0-2.5 bar.
Manometers (range: 0-500mm).
Module to determine the Metacentric Height (FME11):
- Maximum angle: +/-13.
- Corresponding lineal dimension: +/- 90 mm.
- Dimension of the float: L=353mm, W=204mm, total H=475mm.

Module for studying the Hydrostatic Pressure (FME08):
- Tank capacity: 5.5 l.
- Distance between suspended masses and the support point: 285 mm.
- Area of the section: 0.007 m^2.
- Total depth of submerged quadrant: 160 mm.
- Height of support point on the quadrant: 100 mm.
- Set of masses of different weights.

Dead Weight Calibrator Module (FME10):
- Pressure manometer: Bourdon type. 0 - 2.5 bar.
- Set of masses of different weights.
- Piston diameter: 18 mm. Piston weight: 0.5 Kg.
- Module levelling through adjustable feet.

Fluid Level Meter (hook and point gauge) and Flow over Weirs (FME02):
- Scale of the level meter: 0 to 160 mm.
- Dimensions of the weirs: 160 x 230 x 40 mm.
- Neckline angle in the V-shape weir: 90°.
- Dimension of rectangular notch: 30 x 82 mm.

Module for studying Archimedes principle (lever balance with displacement vessel, bucket and cylinder).
Set of weights (5, 10, 50, 100, 400, 1000, 2000, 5000 gr.).
One air pump and 2 water pumps.
Universal hydrometer (0-70 Baumé , 0.700 - 2.000 Sp/gr).
Stop clock.
Two 600 ml beakers.
Spare parts for the viscosimeter elements.
Valves.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 1500 x 800 x 1900 mm. Weight: 200 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/BHI.pdf

PRACTICAL POSSIBILITIES

1.- Density and specific gravity measurements.
2.- Viscosity measurement.
3.- Capillarity effect observation.
4.- Capillarity raising measurement.
5.- Free surface of a static liquid.
6.- Effect of a liquid on a free surface.
7.- Measurement of liquid levels.
8.- Pressure center in a smooth surface.
9.- Center of pressures for partial immersion.
10.- Center of pressures for total immersion.
11.- Calibration of a Bourdon manometer.
12.- Hysteresis curve determination.
13.- Use of a water manometer.
14.- Use of an air manometer.
15.- Use of a U-shaped manometer for determining the differential pressure.
16.- Archimedes principle.
17.- Determination of the metacentric height.
18.- Study of stability of a floating body. Angular displacements.
19.- Study of stability of a floating body. Different positions of the center of gravity.
20.- Operation and comparison of results obtained with different measuring instruments.

Other possible practices:

21.- Table of the atmospheric pressure in function of the height.
22.- Use instructions of the scale of Archimedes.

LFA. **Laminar Flow Visualization and Analysis Unit**

SPECIFICATIONS SUMMARY

The Laminar Flow Visualization Unit (LFA) allows a complete study of the two-dimensional problems associated with the laminar flow by means of the visualization of the different models of flow that can be visualized with the help of an efficient system of injection of coloured liquid.
It is equipped with wheels for mobility and with brake to immobilize the unit during the practices.
Anodized aluminium and steel structure. Process diagram in the front panel with similar distribution to the elements in the real unit.
Laminar flow visualisation table. Flow visualisation area.
8 sources and 8 drains.
Control valves of the drains and sources. Input control valves.
Tank of ink. Manifold of ink. Draining valve.
Tank at the input and output of the work section.
Grid to facilitate the visualisation of the lines of flow.
The top glass sheet of the visualisation area has handles to be able to lift it with easiness for its correct operation or to install the different hydrodynamic models.
The central drain of the inferior badge, placed in the visualisation area, has a double-shape, that is to say, two orifices in vicinity.
The control systems allow that every, or some, of the drains and sources are fed at the same time.
Coloured liquid injection system, for a better visualization of the lines of flow: 19 needles, placed among the glass sheets at the input. Through each needle an appropriate quantity of colouring is injected and the direction is visualized with clarity.
It includes a set of hydrodynamic models formed by: 3 circular models: 40, 60 and 80 mm diameter. 3 square models: 40, 60 and 80 mm of length.1 wing-shape model.
Manuals: This unit is supplied with 8 manuals
Dimensions (approx.): 1600 x 1000 x 1250 mm. Weight: 60 Kg.
Dimensions of the working area: 600 x 900 mm.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/LFA.pdf

PRACTICAL POSSIBILITIES

Ideal flow around submerged bodies:

1.- Ideal flow around a cylinder.
2.- Ideal flow around a surface.
3.- Ideal flow around a body in pick.

Ideal flow in channels and edges:

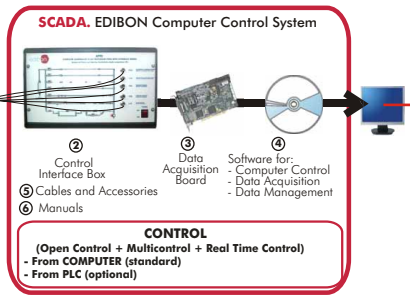
4.- Ideal flow in a convergent channel.
5.- Ideal flow in a divergent channel.
6.- Ideal flow through a curve of 90º.
7.- Ideal flow through a sudden contraction.
8.- Ideal flow through a sudden broadening.
9.- Substitution of a current line for a solid border.

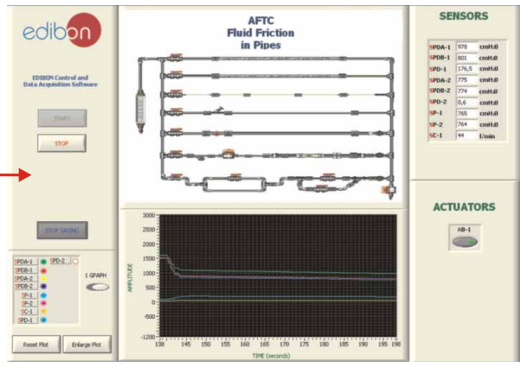
Ideal flow associated to drains and sources:

10.- Formation of a half-body of Rankine.
11.- Formation of a Rankine oval.
12.- Superposition of drains and sources.

AFTC. Computer Controlled **Fluid Friction in Pipes, with Hydraulics Bench (FME00)**∗

① Unit: AFTC. Fluid Friction in Pipes, with Hydraulics Bench (FME00)





SPECIFICATIONS SUMMARY

Items supplied as standard

① AFTC. Unit:

This unit allows the detailed study of fluid friction head losses which occur when a fluid flows through pipes, fittings and flow metering elements.

Anodized aluminium structure and panel in painted steel.

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

Quick connections.

Rapidity and facility to replace parts of the unit, in the case of failure or breaking.

Transparent elements.

Rough pipe 17 mm. dia. (PVC). Rough pipe 23 mm. dia. (PVC).

Smooth pipe 6.5 mm. dia. (methacrylate). Smooth pipe 16.5 mm. dia. (PVC).

Smooth pipe 26.5 mm. dia. (PVC).

Pressure sensors: 2 differential pressure sensors and 2 pressure sensors.

34 pressure tappings.

Flow sensor.

Inclined seat valve. Floodgate valve. Ball valve. Flow regulation valves.

Inline strainer.

Membrane valve.

Abrupt broadening. Abrupt contraction.

Venturi tube of transparent plastic.

Diaphragm of transparent plastic.

Symmetrical bifurcation. Two 90° elbows (in S). T-junction. Inclined T-junction. 45° elbow. 90° elbow.

Pipes in parallel configuration.

Pipe section with a pitot tube and static tapping.

Hydraulics Bench(FME00):

Mobile hydraulic bench, made in polyester reinforced with fibreglass, and mounted on wheels for its mobility.

Centrifugal pump (computer controlled), 0.37 KW, 30 - 80 l/min at 20.1-12.8 m., single phase 220V. / 50Hz or 110V. /60Hz.

Sump tank capacity: 165 litres.

Small channel: 8 litres.

Flow measurement: volumetric tank, gauged from 0 to 7 litres for low flow values and from 0 to 40 litres for high flow values.

Control valve for regulating the flow.

Remote hand-operating dump valve in the base of the volumetric tank.

② AFTC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/ Outputs.

④ AFTC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 2100 x 850 x 2000 mm. Weight: 200 Kg.

Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/AFTC.pdf

PRACTICAL POSSIBILITIES

1.- Load loss by friction in a rough pipe of 17 mm of interior diameter.
2.- Load loss by friction in a rough pipe of 23 mm of interior diameter.
3.- Load loss by friction in a smooth pipe of 6.5 mm of interior diameter.
4.- Load loss by friction in a smooth pipe of 16.5 mm of interior diameter.
5.- Load loss by friction in a smooth pipe of 26.5 mm of interior diameter.
6.- Influence of the diameter in the load loss by friction in rough pipes.
7.- Influence of the diameter in the load loss by friction in smooth pipes.
8.- Load loss by friction in smooth and rough pipes.
9.- Friction coefficient in a rough pipe of 17 mm of interior diameter.
10.- Friction coefficient in a rough pipe of 23 mm of interior diameter.
11.- Friction coefficient in a smooth pipe of 6.5 mm of interior diameter.
12.- Friction coefficient in a smooth pipe of 16.5 mm of interior diameter.
13.- Friction coefficient in a smooth pipe of 26.5 mm of interior diameter.
14.- Influence of the diameter in the friction coefficient in rough pipes.
15.- Influence of the diameter in the friction coefficient in smooth pipes.
16.- Friction coefficient in smooth and rough pipes.
17.- Load losses in the inclined seat valve.
18.- Load losses in the floodgate valve.
19.- Load losses in the filter.
20.- Load losses in the membrane valve.
21.- Load losses in an abrupt broadening.
22.- Load losses in the venturimeter.
23.- Load losses in the diaphragm.
24.- Load losses in an abrupt contraction.
25.- Load losses in the accessories.
26.- Flow measurements by load loss in a venturimeter.
27.- Flow measurements by load loss in a diaphragm.
28.- Flow measurements by means of load loss.
29.- Load losses in a symmetrical bifurcation.
30.- Load losses after two 90° elbows.
31.- Load losses in a T-junction.
32.- Load losses for a 90° elbows.
33.- Load losses on the ball valve.
34.- Load losses for an elbow of 45°.
35.- Load losses in an inclined T-junction.
36.- Study of laminar regime.
37.- Study of turbulent regime.

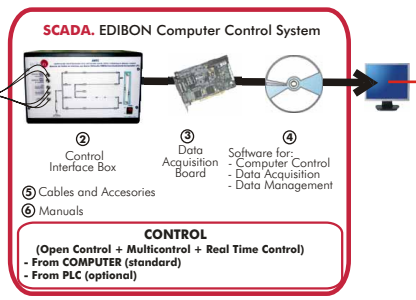
Other possible practices:

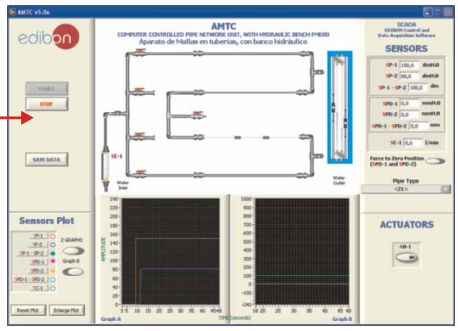
38.- Sensors calibration.
39-57.- Practices with PLC.

∗ Non computer controlled version available too.

AMTC. Computer Controlled **Pipe Network Unit, with Hydraulics Bench (FME00)**∗

① Unit: AMTC. Pipe Network Unit, with Hydraulics Bench (FME00)





SPECIFICATIONS SUMMARY

Items supplied as standard

① AMTC. Unit:

Pipe Network Unit (AMTC) has been designed for enabling different pipe network installations, measuring the flow and pressure, always using water as test fluid.

Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.

Pipe network. Lateral panel where all test elements are located.

Test pipes:

Aluminium pipe of 16 mm outer dia. 3 PVC pipes of 25 mm outer dia., 20 mm outer dia., and 16 mm outer dia. Methacrylate pipe of 16 mm outer dia.

Test Connections:

Connection of 4 pipes with drain or outlet valve. Connection of 3 pipes. Straight connection of a pipe with outlet valve. Pipe connection with outlet pipe in the shape of a siphon. Connection of 2 pipes with outlet valve. (3 units). Connection of 2 pipes with pressure taking. Connection of 2 pipes without pressure taking.

Pressure sensors. Pressure takings in the test elements. Valves for distributing the flow to the network. Flow sensor.

Hydraulics Bench (FME00):

Mobile Hydraulics Bench, mounted on wheels for its mobility. Centrifugal pump (computer controlled): of 0.37 KW, 30-80 l/min at 20.1-12.8 m., single phase 220V./ 50 Hz or 110V./60 Hz. Sump tank capacity: 165 litres. Small channel: 8 litres. Flow measurement: volumetric tank, gauged from 0 to 7 litres for low flow values and from 0 to 40 litres for high flow values. Control valve for regulating the flow. Remote hand-operating dump valve in the base of the volumetric tank.

② AMTC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ AMTC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1500 x 1000 x 2100 mm. Weight: 200 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/AMTC.pdf

PRACTICAL POSSIBILITIES

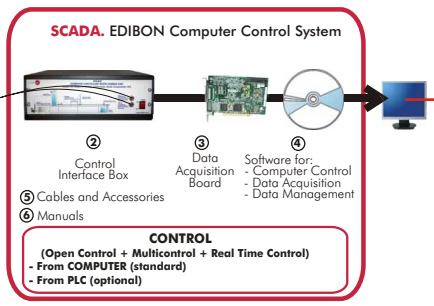
1.- Head losses in a PVC pipe.
2.- Head losses in an aluminium pipe.
3.- Head losses in a methacrylate pipe.
4.- Study of head losses in pipes of the same material.
5.- Study of head losses in function of the material.
6.- Friction coefficient in a PVC pipe.
7.- Friction coefficient in an aluminium pipe.
8.- Friction coefficient in a methacrylate pipe.
9.- Study of the friction coefficient in function of the material.
10.- Study of the friction coefficient in function of the diameter.
11.- Parallel network configuration for pipes of same material and different diameter.
12.- Parallel network configuration for pipes of different material and same diameter.
13.- Series network configuration for pipes of different material and different diameter.
14.- Series network configuration for pipes of different material and same diameter.
15.- Characteristics of a circular circuit.
16.- Double piping circuit.

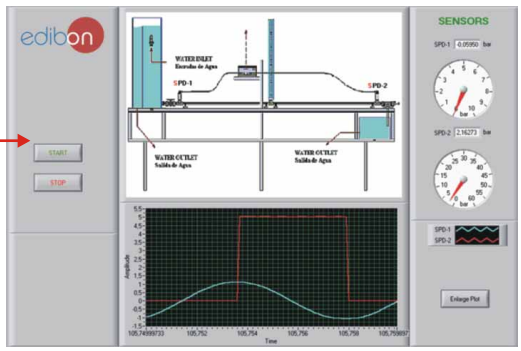
Other possible practices:

17.- Sensors calibration.
18-36.- Practices with PLC.

EGAC. Computer Controlled **Water Hammer Unit**

① Unit: EGAC. Water Hammer Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

①EGAC. Unit:

This unit is designed to demonstrate the effects of the instantaneous or gradual variation of the speed in a fluid. It is possible to study the hydraulic ram, which is the consequence of a quick change in a fluid speed.

Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.

Constant level tank. Discharge tank. Circuits in PVC and stainless steel pipe. Valves to select the circuit. Flow meter. Ball valves. 3 Impact valves. 2 Pressure sensors. 3 Equilibrium chimneys and subjection clips.

Basic Hydraulic Feed System (FME00/B):

Centrifugal pump: 0.37kW, 30-80 l/min at 20.1-12.8m., single-phase 220V./50 Hz. or 110V./ 60 Hz. Tank capacity: 140 litres approx. Flow meter. Membrane type flow adjusting valve. Safety differential switch.

②EGAC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EGAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 3665 x 500 x 2150 mm. Weight: 100 Kg. Control Interface: 490 x 330 x 175 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/EGAC.pdf

PRACTICAL POSSIBILITIES

1.- Characterization of the water hammer phenomenon in pipes.
2.- Subduing the water hammer effects.
3.- Calculation of energy losses in pipes.
4.- Influences of the pipe diameter on the speed propagation.
5.- Subduing of the effects of the water hammer through abrupt expansions.

Other possible practices:

6.- Sensors calibration.
7-25.- Practices with PLC.

∗ Non computer controlled version available too.

HMM. **Manometers & Multimanometers:**

HMM-W500. **U-Shape Double Manometer**

SPECIFICATIONS SUMMARY

This multimanometer has been designed for operating with Pitot' s tube.
It allows finding the pressure between two points or two fluids.
Anodized aluminium structure and panel in painted steel.
2 U-shape Glass Manometers of 500 mm. length.
Millimeter precision rules of 500 mm. length.
3 points for pressure measurement.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 250 x 500 x 870 mm. Weight: 3 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HMM.pdf

HMM-U1000. **U-Shape Manometer**

SPECIFICATIONS SUMMARY

Designed for wall assembly.
Anodized aluminium structure and panel in painted steel.
U-shape manometer of 1000 mm. length.
Millimeter precision rules of 1000 mm. length.
Upper collector. Lower collector.
Drain valve.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 170 x 40 x 1400 mm. Weight: 2 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HMM.pdf

HMM-I1000. **Inclined Multimanometer with 20 manometric tubes of 250 mm. length**

SPECIFICATIONS SUMMARY

Anodized aluminium structure.
Approx. 30° inclination. 20 manometric tubes of 250 mm. length. Tubes inner diameter: 8 mm, to avoid bubbles. Water tank for filling. 20 points for differential pressure measurement, with key. Common collector. Drain valve. Millimeter precision rules of 250 mm. length.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 1400 x 1400 x 700 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HMM.pdf

HMM-V500. **Multimanometer with 8 manometric tubes of 500 mm. length, vertical position**

SPECIFICATIONS SUMMARY

Anodized aluminium structure and panel in painted steel.
Vertical position. 8 Manometric tubes of 500 mm. length. Tubes inner diameter: 8 mm, to avoid bubbles. Air pump for pressurization. 8 points for differential pressure measurement, with key. Common collector. Non-return valve. Drain valve.
Millimeter precision rules of 500 mm. length.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 300 x 500 x 870 mm. Weight: 4 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HMM.pdf

HMM-V500-12. **Multimanometer with 12 manometric tubes of 500 mm. length, vertical position**

SPECIFICATIONS SUMMARY

Anodized aluminium structure and panel in painted steel.
Vertical position.
12 Manometric tubes of 500 mm. length. Tubes inner diameter: 8 mm., to avoid bubbles. Air pump for pressurization.12 points for differential pressure measurement, with key. Common collector. Non-return valve. Drain valve.
Millimeter precision rules of 500 mm. length.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 400 x 500 x 870 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HMM.pdf

HMM-4B. **4 Bourdon type Manometers Unit**

SPECIFICATIONS SUMMARY

Bench-top unit. Anodized aluminium structure and panel in painted steel.
Diagram in the front panel.
Non-return valve. Polyurethane tubes. Vacuum-meter of range (-9800 [mm H_2O] to 0). Vacuum-meter of range (-1000 [mm H_2O] to 0). Manometer of range (0 to 1000 [mm H_2O]). Manometer of range (0 to 2.5 [bars]). Mobile Piston (syringe). 8 valves.
This system is supplied with atm, bares, psi, mm Hg, mm H_2O, conversion tables.
This system allows the calibration of 6 sensors (same type) simultaneously.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 720 x 300 x 570 mm. Weight: 15 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HMM.pdf

HEMP. **Pressure Measurement Unit**

SPECIFICATIONS SUMMARY

This unit enables a wide range of investigations and studies into pressure measurement techniques, using Bourdon type vacuum and pressure gauges and different U-tube manometers, to understand the operation the characteristic of the devices, and to study the principles of calibration and to do practical exercises and experiments about it.
The unit includes the two following modules:
"U" manometers and Bourdon type gauges module:
Bourdon gauge for measuring vacuums.
Bourdon gauge for measuring positive pressure.
Vertical U-tube manometer, with scale in mm.
Inclined U-tube manometer, with scale in mm.
Syringe for pressurising and reducing the pressure in the measurement devices.
Bourdon gauge with dead-weight calibrator module:
Dead-weight calibrator consists of a piston, with is free to move vertically, in cylinder. Flexible hose connects the cylinder with the Bourdon pressure gauge.
Bourdon type gauge with internal mechanism clearly visible.
Accessories included:
A set of weights for the dead-weight calibrator. "T" pieces. Artery clamps. Funnel. Nylon tubes.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.):
"U" manometers and Bourdon type gauges module: 780 x 600 x 780 mm. Weight: 20 Kg.
Bourdon gauge with dead-weight calibrator module: 500 x 350 x 350 mm. Weight: 10 Kg.

More information in: wwww.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HEMP.pdf

PRACTICAL POSSIBILITIES

1.- Familiarisation with different pressure measurement methods.
2.- Function and characteristics of a Bourdon type gauge.
3.- Function and characteristics of a "U" tube manometers.
4.- Pressure measurements with U-tube manometers.
5.- Pressure measurements with Bourdon type manometers.
6.- Comparison of different types of pressure measurement.
7.- Comparison of different pressure measurement methods.
8.- Calibration of a pressure gauge.
9.- Determination of gauge errors.

HCMP. **Precision Pressure Gauge Calibrator**

SPECIFICATIONS SUMMARY

The HCMP unit is a seft-contained and portable dead weight precision pressure gauge calibrator.
This unit allows pressure gauges to be accurately calibrated within the range 1 - 300 bar.
Calibrates gauges 1-300 bar range to ±0.015% of reading.
Two pistons allow calibration over a wide range of pressures.
Oil is used as the hydraulic fluid.
Minimum standard weight increment is 0.05 bar.
A set of weights, adaptors and spare seals are supplied.
Laboratory calibration certificate.
Carrying case.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 500 x 350 x 400 mm. Weight: 35 Kg.

More information in: wwww.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HCMP.pdf

TMCP. **Pressure Measurement and Calibration Unit**

SPECIFICATIONS SUMMARY

TMCP. Pressure Measurement and Calibration Unit is designed to study pressure and how different methods and techniques can be used to measure this variable.
This unit introduces students to pressure, pressure scales and common devices available to measure pressure.
Bench-top unit mounted on an anodized aluminum structure and panel in painted steel.
Dead-weight pressure calibrator, using water, consists of a precision piston and a cylinder, with a set of weights to generate different pressures.
Bourdon type manometer, connected to the dead-weight calibrator.
Electronic pressure sensor, connected to the dead-weight calibrator.
Both Bourdon manometer and pressure sensor are mounted on a manifold block with a separate reservoir (to contain water) .
Valves for allowing the priming, restricted flow of water to demonstrate the application of damping and the connection of other alternative devices for calibration.
Electronic console: Protection devices. Sensor connectors. Digital meter with selector switch to display the output from the pressure sensor and the conditioned reading in engineering units. Conditioning circuit with span and zero controls to allow the output to be displayed as a direct reading pressure meter calibrated in units of pressure.
Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.):
Unit: 500 x 350 x 350 mm. Weight: 15 Kg.
Electrical console: 310 x 220 x 145 mm. Weight: 3 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/TMCP.pdf

PRACTICAL POSSIBILITIES

1.- Study the concept of pressure.
2.- Study of the concepts of measurement and calibration (gauge and absolute pressures, zero error, non-linearity, scale error, conversion of arbitrary scale into energy units).
3.- Study of pressure scales.
4.- Study of the function of a dead-weight pressure calibrator.
5.- Study of the operation of a Bourdon type manometer.
6.- Study of the characteristic behaviour of a Bourdon type manometer.
7.- Calibration of a Bourdon type manometer in engineering units.
8.- Calibration of a Bourdon type manometer in arbitrary units (angular displacement of needle).
9.- Study of the characteristic behaviour of a pressure sensor.
10.- Calibration of a pressure sensor and signal conditioning circuit in engineering units
11.- Calibration of a pressure sensor (voltage output from sensor).
12.- Study of the sources of error in measurement and calibration (signal conditioning, display resolution; wear, friction and backlash, etc.).
13.- Study of calibration of conditioning circuits and display using a reference signal.

HVB. **Falling Sphere Viscosimeter and Drag Coefficient**

SPECIFICATIONS SUMMARY

The unit " HVB" makes it possible to measure kinematic viscosity, and thus to deduce dynamic viscosity from it, from liquids.

This unit consists of two precision transparent tubes fixed onto a frame.

The viscosity of a fluid characterizing its resistance to flow, it is considered that the displacement study of a body in a motionless liquid is identical to that the flow of the fluid around this static body.

By measuring the falling speed of a sphere in a vertical tube filled with the fluid to study, it is possible to deduce kinematic viscosity.

During the phase of the uniform rectilinear motion, the forces which apply to the sphere, gravity, the pressure of Archimedes and the force of the trail related to viscous friction, are in balance.

Anodized aluminium structure.

Support panel.

2 Precision transparent methacrylate tubes of 125 mm. diameter and 1500 mm length.

There are two liquids with different viscosities inside the tubes.

At the upper part of the tubes there is a device for introducing particles to be tested.

At the bottom part of the tubes there is a device for recovering the tested bodies, without emptying the tubes.

Fluorescent tube for a better visualization of the particles. 2 vats and 2 valves for recovery of the balls and draining of tubes.

1 set of balls (spheres) of various diameters and materials (stainless steel, aluminium, plastic).

Stop watch.

Falling particles/spheres clearly visible.

Accurate determination of drag coefficient and viscosities.

Variety of particles for comparison.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.): 300 x 400 x 1700 mm. Weight: 30 Kg.

More information in: wwww.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HVB.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the viscosity of liquids.

2.- Drag coefficient of various particles of spheres.

3.- Determination of the drag coefficient of various geometric shapes (to be produce by students).

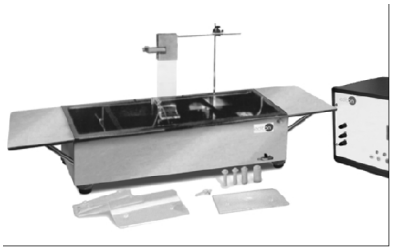
4.- Measurements of the spheres resistance coefficients vs Reynold's number.

5.- The viscosity of the liquids place in the tubes by measurement of the terminal velocities of the spheres in free fall in the liquids.

6.- Kinematic viscosity.

7.- Dynamic viscosity.

UVF. **Hydrogen Bubble Flow Visualisation Unit**



SPECIFICATIONS SUMMARY

This unit has been designed to allow the visualization of the flow patterns associated with water flowing past solid objects or boundaries.

Bench-top unit.

A compact, unit comprising: a flow tank, hydrogen bubble generator, designed for direct flow visualisation of fluid mechanics phenomena.

Hydrogen bubbles generated by an interchangeable fine platinum wire cathode ensure a faithful visualization of undistorted flow.

A powerful light source illuminates the hydrogen bubbles in the working section.

Light source: several high intensity leds.

A variable speed pump controlling a unique fluid-drive unit.

A set of polished acrylic flow guides.

Pulse generator range: 3 to 2500 mS (on/off period).

Cathodes: 35, 50 and 75 mm lengths.

Flow tank capacity: 20 litres. approx.

Working section: length: 430 mm., width: 290 mm., depth: 36 mm. approx.

Current generator: 0 to 100 mA.

Wide range of polished acrylic flow guides & models.

Electronic console, incorporating:

- Display for operating parameters.
- Control for pump.
- Source lamp.
- Hydrogen bubbles generator.

This console provides all the necessary electrical services for the unit.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.):

- Flow table: 1000 x 400 x 550 mm. Weight: 50 Kg.
- Electronic console: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/UVF.pdf

PRACTICAL POSSIBILITIES

1.- Visualising two-dimensional flow using hydrogen bubbles.

2.- Analogy of aerodynamic flow.

3.- Understanding laminar and turbulent flow.

4.- Visualization of boundary layer.

5.- Demonstration of the boundary layer growth.

6.- Quantitative observing of flow measuring devices.

7.- Demonstration of boundary layer separation and eddy formation.

8.- Quantitative analysis of flow patterns using pulsed bubbles.

9.- Observation of flow around standard shapes (cylinder, aerofoil, etc.).

10.- Observation of flow around user created models.

FMDU. **Flow Meters Demonstration Unit**

SPECIFICATIONS SUMMARY

A self-contained unit to demonstrate the characteristics of flow meters used in measurement of water flow through pipes or open channels.
Anodized aluminium structure and panel in painted steel.
Diagram in the panel with similar distribution to the elements in the real unit.
Pipe circuit, including:
- Flow regulation valve.
- Several pressure measurement tappings.
- Air entrainment device.
- Flexible pipe to connect to the Hydraulics Bench.
- Additional pipes to change the pipe circuit configuration.

Water manometer of 1 m. length and 2 Bourdon type manometers from 0 to 2.5 bar, precision 1%., to measure the pressure drop.
Meters included:
- FMDU-1. Orifice plate.
- FMDU-2. Venturi.
- FMDU-3. Shunt gapmeter.
- FMDU-4. Pitot.
- FMDU-5. Volumetric rotary piston.
- FMDU-6. Swinging flap.
- FMDU-7. Helical rotary.
- FMDU-8. Electro-magnetic.
- FMDU-9. Current velocity meter.
- FMDU-10. Inferential multistream:
- FMDU-11. Broad crested weir.
- FMDU-12. Crump weir.
- FMDU-13. "H" flume.
- FMDU-14. Washington flume.
- FMDU-15. Channel for FMDU-10, FMDU-11, FMDU-12, FMDU-13 and FMDU-14.
- FMDU-16. Digital manometer.
- FMDU-17. Hook and point gauge.

Auxiliary supply box (for FMDU-7, FMDU-5 and FMDU-8).
Reference flow meter permanently fitted: a turbine flow meter or an electro-magnetic meter.
Quick and easy removal of pipes with test flow meters for evaluation and inspection.
Meters can be used independently to support research or student project work.
Hydraulics Bench:
- Mobile hydraulic bench, made in polyester reinforced with fibreglass, and mounted on wheels for mobility.
- Centrifugal pump, 0.55 KW, 2.5 Bar, 150 l/min., single phase 220V./ 50Hz or110V./ 60Hz.
- Sump tank capacity: 165 litres.
- Small channel: 8 litres.
- Flow measurement: volumetric tank, gauged from 0 to 7 litres for low flow values and from 0 to 40 litres for high flow values.

Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 3200 x 1300 x 1500 mm.
Weight (approx.): 300 Kg.

Other Available Versions:

FMDU\B Unit:
Only are included the following Meters: FMDU-1 + FMDU-2 + FMDU-3 + FMDU-4 + FMDU-8.
Rest of specifications as FMDU. Unit.

FMDU\Q Unit:
Only are included the following Meters: FMDU-1 + FMDU-2 + FMDU-3 + FMDU-4 + FMDU-5 + FMDU-6 + FMDU-8 + FMDU-16.
Rest of specifications as FMDU. Unit.

FMDU\C Unit:
Only are included the following Meters: FMDU-7 + FMDU-8 + FMDU-9 + FMDU-10 + FMDU-11 + FMDU-12 + FMDU-15 + FMDU-17.
Rest of specifications as FMDU. Unit.

FMDU\A Unit:
Only are included the following Meters: FMDU-7 + FMDU-9 + FMDU-10 + FMDU-12 + FMDU-13 + FMDU-14 + FMDU-15 + FMDU-17.
Rest of specifications as FMDU. Unit.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/FMDU.pdf

PRACTICAL POSSIBILITIES

1.- To demonstrate the important characteristics of fourteen types of flow meters used in the measurement of water flow through pipes or open channels.
2.- Comparing the use, application and limitations of different types of flowmeters.
3.- To study the application of Bernoulli's Theorem.
4.- Understanding the principles on which various types of flow meters are based.
5.- Implications of performance, convenience, accuracy, head loss, etc. on flow meters selection.
6.- Effect of the air in the hydraulic stream on flow meter performance.
7.- To use manometers to measure pressure drop.
8.- Relating pressure drop across a flow meter to flow rate.
9.- Measure error determination using the venturimeter.
10.- Factor C_d determination in the venturi.
11.- Strangulation determination in the venturi.
12.- Measure error determination using the orifice plate.
13.- Factor C_d determination in the orifice plate.
14.- Effective area determination in the orifice plate.
15.- Measure error determination using the Pitot tube.
16.- Factor C_d determination in the Pitot tube.
17.- Measure error using the swinging flap meter.
18.- Measure error using the rotary piston meter.
19.- Measure error using the shunt gapmeter.
20.- Energy loss comparison in the different meters.
21.- Measure error using the helical rotary type flowmeter.
22.- Measure error using the inferential multistream type flowmeter.
23.- Broad crested weir.
24.- Crump weir.
25.- "H" flume.
26.- Washington flume.

HSMAP. **Air Pressure Maintained Water System Trainer**

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsgeneral/HSMAP.pdf

PRACTICAL POSSIBILITIES

1.- To use pressure regulator for high buildings.

2.- Determination of air pressure tank and pump.

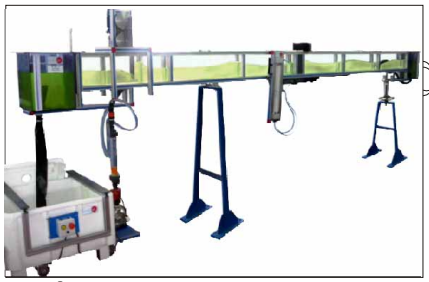
3.- Study and investigation of air pressure tank supported water system.

4.- Adjustment of pressure switch.

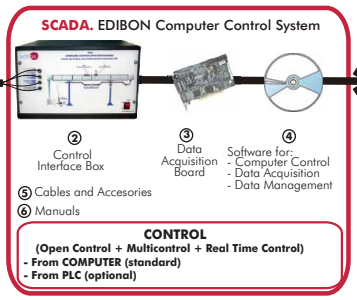
HECA. **Air Flow Studies Unit**

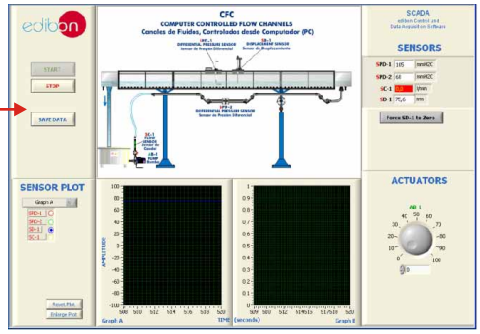
8.3- Fluid Mechanics (Flow Channels)

CFC. Computer Controlled **Flow Channels (section: 80 x 300 mm)**∗



① Unit: CFC. Flow Channels (section: 80 x 300 mm)





Available Versions:
-CFC80/2. Computer Controlled Flow Channel (section: 80 x 300 mm), length: 2.5 m.
-CFC80/5. Computer Controlled Flow Channel (section: 80 x 300 mm), length: 5 m.

SPECIFICATIONS SUMMARY
Items supplied as standard

① CFC. Unit:
Channel of rectangular section with transparent walls, formed by methacrylate transparent sections.
There are several channel versions to chose:
-CFC80/2. Computer Controlled Flow Channel (section: 80 x 300 mm), length: 2.5 m.
-CFC80/5. Computer Controlled Flow Channel (section: 80 x 300 mm), length: 5 m.
The channel is assembled on supports, with a system to control the inclination of the channel.
Channel slope: adjustable.
Inlet tank (capacity: 38 litres), with stilling of flow and with drain valve.
Reception tank (capacity: 38 litres), with drain valve.
Flow control valve. Pipes.
FME00/B. Basic Hydraulic Feed System:
Storage tank (capacity: 140 litres approx).
Impulsion pump with speed regulation, (computer controlled): Single-phase, 220V/50Hz or 110V/60Hz. 0.37 KW. 2800 r.p.m. 30-80 l./min. at 20.1-12.8m.
Flowmeter. Flow control valve. Flow sensor.
Pressure sensors.
Displacement sensor.
Available a wide range of accessories.

② CFC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in other the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ CFC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = CFC80/2. Unit: 3600 x 1000 x 1700 mm. Weight: 250 Kg.
CFC80/5. Unit: 6050 x 1000 x 1700 mm. Weight: 350 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsflowchannels/CFC.pdf

PRACTICAL POSSIBILITIES

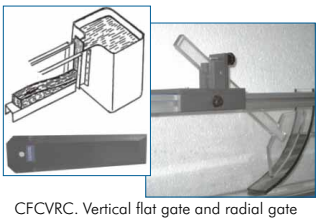
1.- Measurement of the water height and the velocity along the channel.
2.- Measurement of the flow with weirs of thin wall.
3.- Measurement of flow with changes in the channel section.
4.- Measurement of flow using Venturi flume.
5.- Control of the flow by gates.
6.- Level control using syphons.
7.- Flow on overflow dams.
8.- Flow among the pillars of a bridge.
9.- Connection of a channel to a culvert.
10.- Characterization of the hydraulic jump.
11.- Profiles of the water free surface.
12.- Investigation of flow and supercritical flow states.
13.- Measurement of water levels.
14.- Discharge processes on an underwater weir.
15.- Amount of energy in flows in open channels.
16.- Function of a syphon weir.
17.- Flow rate and drain coefficients of a syphon weir.
18.- Pipe flows.
19.- Comparison of overflow and syphon weirs.
20.- Observation of the throw of the water.
21.- Generation of different flow states by damming the down-stream water.
22.- Observation of the flow under an undershot weir:
-Observation of hydraulic motion on discharge.
23.- Relationship between dam height and discharge.
24.- Observation of discharges under a radial gate:
-Observation of hydraulic motion on discharge.
25.- Hydrostatic pressure on a weir.
26.- Investigations on waves.
27.- Behaviour of structures in rough sea.
28.- Applying and understanding Manning's formula.
29.- Understanding sub- and super-critical flow.
30.- Learning how to apply force-momentum and steady flow energy equations to simple flow situations.
31.- Investigation of the transition from running to shooting flow.
Other possible practices:
32.- Sensors calibration.
33.- Filling of the Pitot tube.
34.- Filling of the venturi meter with analog output.
35.- Calculation of water flow.
36.- Use of level gauge for measurement of the water height.
37-55.- Practices with PLC.

Available accessories:


CFTPC. Pitot tube and manometer board

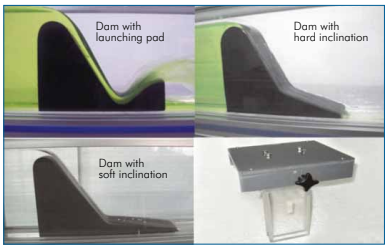

CFRMC. Level gauge for measurement of the water height (hook and point gauges)


CFVDGC. Broad and thin crested weirs


CFCVRC. Vertical flat gate and radial gate

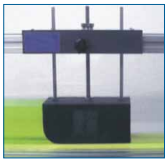

CFSDLC. Syphon spillway


CFSDSC. Air regulated syphon



CFPVPC. Dams spillway and flow splitters (3 different models of dams)

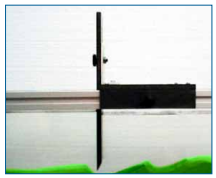

CFVCC. Crump weir

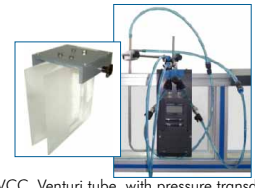

CFCAC. Culvert fitting


CFVENC. Venturi flume


CFPLRC. Artificial roughened bed (3 different models)

CFGOC. Wave generator

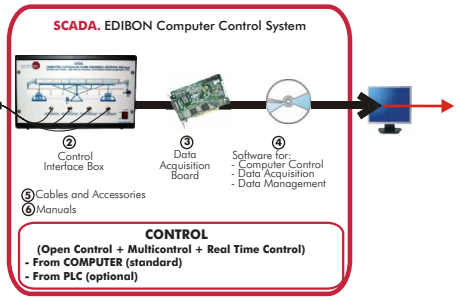

CFPRC. Adjustable undershot weir


CFTVCC. Venturi tube, with pressure transducers, converter and differential pressure digital indicator for input flow measurement

∗ Non computer controlled version available too.

CFGC. Computer Controlled **Flow Channels (section: 300 x 450 mm)** ✱

① Unit: CFGC. Flow Channels (section: 300 x 450 mm)



Available Versions:

-CFGC300/5. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 5 m.
-CFGC300/7. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 7.5 m.
-CFGC300/10. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 10 m.
-CFGC300/12. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 12.5 m.

SPECIFICATIONS SUMMARY

Items supplied as standard

① CFGC. Unit:

Metallic structure and supports in painted steel.
Main metallic elements in stainless steel.
Channel of rectangular section with transparent walls.
There are several channel versions to chose:
-CFGC300/5. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 5 m.
-CFGC300/7. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 7.5 m.
-CFGC300/10. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 10 m.
-CFGC300/12. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 12.5 m.
The channel is assembled on supports, with a motorized (electric motor) system to control the inclination of the channel, computer controlled.
Storage tanks. (Number of tanks in function of the Channel version). Capacity of each tank: 400 l. approx.
Impulsion pump, with variable speed, computer controlled. (Power of the pump in function of the Channel version).
Inlet tank, with drain valve.
Reception tank, with drain valve.
Flow control valves.
Pipes.
Flow measurement system.
Pressure sensors.
Wide range of accessories available.

② CFGC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in other the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ CFGC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsflowchannels/CFGC.pdf

PRACTICAL POSSIBILITIES

1.- Measurement of the water height and the velocity along the channel.
2.- Measurement of the flow with weirs of thin wall.
3.- Measurement of flow with changes in the channel section.
4.- Measurement of flow using Venturi flume.
5.- Control of the flow by gates.
6.- Level control using syphons.
7.- Flow on overflow dams.
8.- Flow among the pillars of a bridge.
9.- Connection of a channel to a culvert.
10.- Characterization of the hydraulic jump.
11.- Profiles of the water free surface.
12.- Investigation of flow and supercritical flow states.
13.- Measurement of water levels.
14.- Discharge processes on an underwater weir.
15.- Amount of energy in flows in open channels.
16.- Function of a syphon weir.
17.- Flow rate and drain coefficients of a syphon weir.
18.- Pipe flows.
19.- Comparison of overflow and syphon weirs.
20.- Observation of the throw of the water.
21.- Generation of different flow states by damming the down-stream water.
22.- Observation of the flow under an undershot weir:
-Observation of hydraulic motion on discharge.
23.- Relationship between dam height and discharge.
24.- Observation of discharges under a radial gate:
-Observation of hydraulic motion on discharge.
25.- Hydrostatic pressure on a weir.
26.- Investigations on waves.
27.- Behaviour of structures in rough sea.
28.- Applying and understanding Manning's formula.
29.- Understanding sub- and super-critical flow.
30.- Learning how to apply force-momentum and steady flow energy equations to simple flow situations.
31.- Investigation of the transition from running to shooting flow.

Other possible practices:

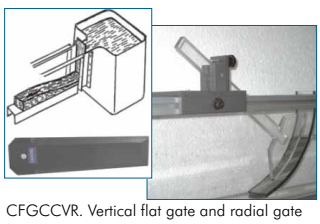
32.- Filling of the Pitot tube.
33.- Filling of the venturi meter with analog output.
34.- Calculation of water flow.
35.- Use of level gauge for measurement of the water height.
36-54.- Practices with PLC.

Available accessories

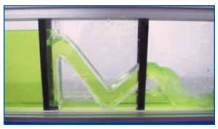
CFGCTP. Pitot tube and manometer board

CFGCRM. Level gauge for measurement of the water height (hook and point gauges)

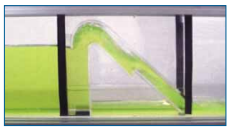
CFGCVDG. Broad and thin crested weirs



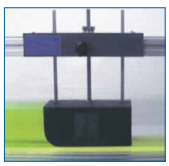
CFGCCVR. Vertical flat gate and radial gate



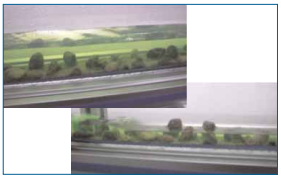
CFGCSDL. Syphon spillway



CFGCSDS. Air regulated syphon



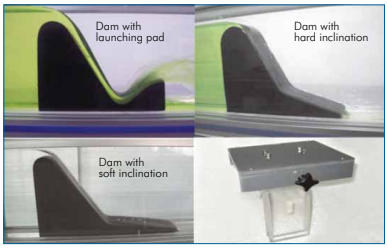
CFGCCA. Culvert fitting



CFGCPLR. Artificial roughened bed (3 different models)

CFGCVC. Crump weir

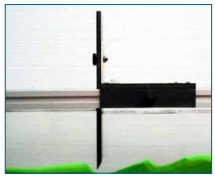
CFGCVEN. Venturi flume



CFGCPVP. Dams spillway and flow splitters (3 different models of dams)

CFGCGO. Wave generator

CFGCTVC. Venturi tube, with pressure transducers, converter and differential pressure digital indicator for input flow measurement



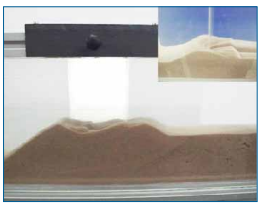
CFGCPR. Adjustable undershot weir

✱ Non computer controlled version available too.

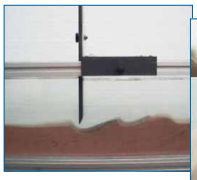
CAS. **Sediment Transport Demonstration Channel**

Some available accessoires:

CFRM. Level gauge for measurement of the water height (hook and point gauges)



CFPS. Single bridge pier



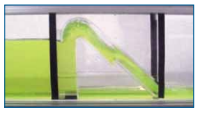
CFPR. Adjustable undershot weir

CFDA. Sand Distributor

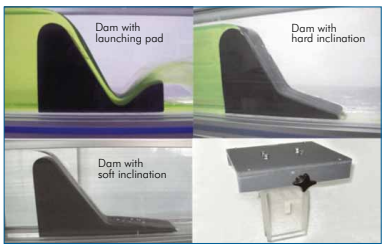
CFTP. Pitot tube and manometer board

CFVDG. Broad and thin crested weirs

CFSDL. Syphon spillway



CFSDS. Air regulated syphon



CFPVP. Dams spillway and flow splitters (3 different models of dams)

SPECIFICATIONS SUMMARY

The EDIBON Sediment Transport Demonstration Channel "CAS" allows demonstration of the full range of bedforms that arise in a mobile bed as the slope and/or flow are increased.

This unit can play a useful role in any course concerting the mechanics of open channel flow and sediment transport.

For demonstrating scour effects of structures on rivers beds, solids models, as an adjustable undershot weir and bridge pier are supplied.

Transparent, inclinable flow channel through which water can be recirculated by a pump over a mobile bed to demonstrate the whole range of bed forms from incipient particle movement to bed wash-out.

Anodized aluminium structure and supports in painted steel.

Channel of rectangular section with transparent walls, formed by folded methacrylate transparent pieces.

The channel is assembled on two supports, with a system to control the inclination of the channel.

Channel section: 80 mm, lenght: 2.5 m.

Inlet tank (capacity: 38 litres), with stilling of flow and with drain valve.

Pipes.

Diaphragm flow meter.

Sediment filter in tank and inlet section.

Manometric tubes panel. It is formed by two methacrylate tubes of 500 mm. of length, with a graduated panel. Hand pump.

The grain diameter of the sediment oscillates among 0.1 to 0.3 mm.

Accessories included:

- CFRM. Level gauge for measurement of the water height (hook and point gauges), to calibrate the overshot weir.
- CFDA. Sand distributor.
- CFPR. Adjustable undershot weir.
- CFPS Single bridge pier.
- CFCV. Vertical flat gate.

The speed of discharge can be selected.

Basic Hydraulic Feed System (FME00/B):

Centrifugal pump: 0.37 KW, 30 - 80 l/min at 20.1-12.8m., single-phase 220V./50 Hz. or 110V./60 Hz.

Tank capacity: 140 litres approx.

Flowmeter.

Membrane type flow adjusting valve.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.): 3600 x 1000 x 1700 mm.

Weight (approx.): 250 Kg.

Optional accessories: (not included in the standard supply)

- CFTP. Pitot tube and manometer board.
- CFVDG. Broad and thin crested weirs. (One broad weir and 2 thin weirs)
- CFCVR. Vertical flat gate and radial gate.
- CFSDL. Syphon spillway.
- CFPVP. Dams spillway (3 different models) and flow splitters.
- CFCA. Culvert fitting.
- CFVC. Crump weir.
- CFVEN. Venturi flume.
- CFSDS. Air regulated syphon.
- CFFS. False floor sections.
- CFPLR. Artificial roughened bed (3 different models).

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsflowchannels/CAS.pdf

PRACTICAL POSSIBILITIES

Flow over a mobile sand-bed
(bedforms associated with increasing flow intensity and sediment transport rate)

1.- Lower Regime (bedforms exhibed):
- Plane- bed (no motion).
- Ripples and dunes.
- Washed- out dunes.
- Ripples.
- Dunes.

2.- Upper Regime(bedforms exhibed):
- Plane- bed (with motion).
- Chutes and pools.
- Anti- dunes.
- Breaking anti- dunes.
- Standing waves.

Flow over fixed, gravel-bed

3.- Although the channel can not transport gravel, this can be used to investigate flow resistance in gravel and polder- bed rivers.

4.- We can calculate the flow resistance coeficients, using equations such as those of Bray, Limerinos, Hey, Lacey, Thompson and Campbell and Bathurst and the results compared to the actual values obtained by observation.

Flow structures

5.- We can examine the structure of turbulence in the flow, using dye injection, interesting for the dune bedform configuration and clearly demonstrates separation on the lee face.

Fixed, smooth bed flow:
(the channel may be used without sediment on the bed to demonstrate several flow phenomena and equations)

6.- Rapid, super- critical flow- dominance of intertial over gravity forces, shock waves from flow obstructions.

7.- Turbulence.

8.- Governing equations of open channel flow-Reynold's number, Froude number, continuity, Bernoulli's equation, weir equations.

9.- Tranquil, sub-critical flow-movement of surface waves upstream against flow.

10.- Hydraulic jump- transition from super to sub critical flow, air entrainment, mixing.

11.- Flow measurement- using sharp crested weirs.

Bedform hysteresis

12.- If the discharge in the channel changes quickly, there is no sufficient time for bedforms to adjust to the new flow regime. Hence, if a flood hydrograph is simulated by increasing and then decreasing the discharge, different depths will occur for the same discharge on the rising and falling limbs.

Data collection and numerical evaluation (computational work)

13.- In addition to illustrating flow and sediment phenomena, we can use the channel for basic data collection and numerical evaluation of the following:
- Flow resistance:
  Manning, Chezy and Darcy-Weisbach fricion factors for several bedform configuration.
- Bedform prediction:
  Velocity-Hjulstrom diagram.
  Suspended load-movement by suspension.
  Shields parameter-Bogardi diagram.
  Stream power-Simons and Richarson charts.
  Boundary shear stress-Leeder chart.
- Initiation of motion:
  Shields diagram.
  Hjulstrom's curve.

Mechanics of sediment transport

14.- We can observe the movement of grains, starting from a plane- bed with no motion, on the following:
- Initiation of motion.
- Trajectory of initial motion.
- Movement by rolling and sliding (contact load).
- Movement by hopping (saltation load).
- Movement by suspension.

Depositionary features and facies

15.- We can observe the deposition of sediment load and the resulting patterns of grains within the sand body may be identified.

Local scour

16.- Scour under boils and vortices in the flow is observed under both the lower and upper regime bedforms. Obstructions may be introduced to represent bridge piers, sills, revetments, etc, and the resulting pattern of scour examined.

Other possible practices:

17.- Behaviour study of the connection to the drain of a channel with sendiment.

18.- Turbulence study by means coloration.

19.- Calculation of water flow.

HVFLM. **Mobile Bed and Flow Visualisation Unit**

SPECIFICATIONS SUMMARY

This unit has been designed to allow investigations of mobile bed situations both in relation to water courses or structures of engineering and to perform practices and tests involving two dimensional flow visualization by means of dust indicator technique or by other methods of flow visualisation.
Three are 2 versions:
- HVFLM-2. Mobile Bed and Flow Visualisation Unit (working section: 2000 x 610 mm).
- HVFLM-4. Mobile Bed and Flow Visualisation Unit (working section: 4000 x 610 mm).

Metallic structure and supports.
Diagram in the panel with similar distribution to the elements in the real unit.
Self contained recirculating water tank for flow visualisation and mobile bed studies and practices. Tank made of corrosion resistant transparent material, composed of inlet tank, working section and discharge reservoir tank.
Dimensions of the working section:
For HVFLM-2 Version: 2000 x 610 mm.
For HVFLM-4 Version: 4000 x 610 mm.
Sump capacity: 300 l.
Sand bed thickness approx.: 60 mm.
Accuracy of flow metering: +-15% of full scale deflection.
The inlet tank incorporates a baffle plate to spread the flow across the width of the tank.
An adjustable overshot weir with upstream sand trap is located within the discharge tank.
Depth gauge for measuring the water level and for mapping the sand bed contours.
Hook and point and Vernier scale to determine levels accurately.
Centrifugal pump, made of corrosion proof material.
Regulating control valve.
Pipes.
Sheet of coloured glass to allow quick changeover from mobile bed to flow visualisation mode.
Console with all controls, with motor starter and digital meter.
Accessories and models included:
Asymetrical aeroil shape model.
Bridge piers models of different shape (2 rectangular, 2 with rounded ends, 2 cylindrical and 2 profiled).
2 model gate guides.
8 baffles to direct the water flow.
Set of 12 "T" shape profiles and 6 equal angular forms.
Set of accessories: tin of aluminium dust, dye crystals, tube of polythene, plasticine etc.
Cables and Accessories, for normal operation.
Manuals: This unit is supplied 8 Manuals.
A wide range of optional models available.
Dimensions (approx.) = HVFLM-2: 3800 x 750 x 1700 mm.
Weight: 500 Kg.
HVFLM-4: 5800 x 750 x 1700 mm.
Weight: 650 Kg.

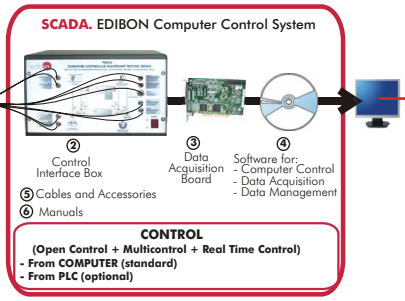
More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/fluidmechanicsflowchannels/HVFLM.pdf

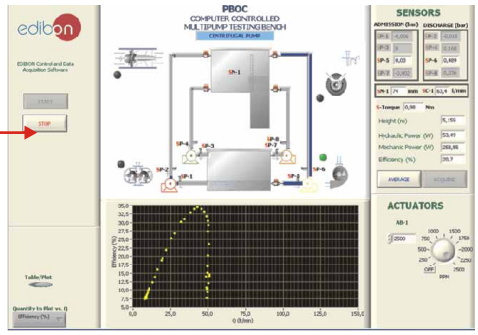
PRACTICAL POSSIBILITIES

1.- Flow around model engineering structures.
2.- Mobile bed experiments.
3.- Meandering water courses characteristics.
4.- Visualisation of the behaviour of boundary layers.
5.- Demonstration of boundary layer suction.
6.- Experiments of erosion.
7.- Experiments of deposition.
8.- Velocity distribution in duct flow.
9.- Practices and tests with models for engineering.
10.- Two dimensional flow visualization by the Ahlborn technique.
11.- Hydraulic analogy to compressible flow.
12.- Sediment erosion and deposits.

PBOC. Computer Controlled **Multipump Testing Bench**

① Unit: PBOC. Multipump Testing Bench





SPECIFICATIONS SUMMARY

Items supplied as standard

① PBOC. Unit:

The Multipump Testing Bench (PBOC) allows the students to study the operating characteristics of several types of pumps (Centrifugal pump, Axial flow pump, Gear pump and Peripherical pump, included in the minimum supply, and other optional pumps). It allows to control and to measure the most representative parameters of these types of pumps.

Anodized aluminium structure and panels in painted steel.

Main metallic elements in stainless steel.

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

4 Pumps (computer controlled): Centrifugal pump, Axial flow pump, Gear pump and Peripherical pump:

Centrifugal pump: pedestal or of free axis type, with a reinforced runner that works in an extension of the main head and held by a double ball bearing.

Axial flow pump: with propeller, which works in an acrylic casing with thin interstices between the propeller and the casing.

Gear pump: of positive displacement, with casing of a melted piece and two rotors in form of a straight cylindrical gear.

Peripherical pump: also known as Regenerator or Turbine pump, with a runner of straight blades inside an annular casing and an axis of activation on two lubricated ball bearings.

Motor for each pump, with independent operating.

Admission pressure sensor and discharge pressure sensor for each pump (8 sensors).

Control software for the direct reading of speed (r.p.m.) and torque (Nm).

Variation of speed by frequency converter, computer control.

Calibrated volumetric tank of 0-10 litres for low flows and of 0-45 litres for high flows.

Flow sensor. "U" Shape weir. 2 Stilling baffles in the open channel. Water storage tank, with capacity of 160 litres approx. Valves for centrifugal, peripherical and gear pumps. Control valve for axial pump.

Optional pumps (not included in standard supply):

-PBOC-2BC. Second Centrifugal pump, and including the additional valves required to perform a Series/Parallel pump demonstration.
-PBOC-BIF. Flexible impeller pump.
-PBOC-BD. Diaphragm pump.
-PBOC-BE. Plunger pump.
-PBOC-VA. Vane pump.

② PBOC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PBOC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1650 x 800 x 1850 mm. Weight: 240 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PBOC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the flow by a weir of thin wall in U-shape.
2.- Determination of unloading coefficient of a weir of thin wall in a U-shape.
3.- Determination of the curve Q vs r.p.m. for the centrifugal pump.
4.- Determination of the curve Q vs r.p.m. for the peripherical pump.
5.- Determination of the curve Q vs r.p.m. for the gear pump.
6.- Determination of the curve Q vs r.p.m. for the axial pump.
7.- Determination of the curve H vs Q for different r.p.m. for the centrifugal pump.
8.- Determination of the curve H vs Q for different r.p.m. for the peripherical pump.
9.- Determination of the curve H vs Q for different r.p.m. for the gear pump.
10.- Determination of the curve H vs Q for different r.p.m. for the axial pump.
11.- Determination of the mechanical power vs flow for different r.p.m. for the centrifugal pump.
12.- Determination of the mechanical power vs flow for different r.p.m. for the gear pump.
13.- Determination of the mechanical power vs flow for different r.p.m. for the peripherical pump.
14.- Determination of the mechanical power vs flow for different r.p.m. for the axial pump.
15.- Determination of the curve η vs the flow for different r.p.m. for the centrifugal pump.
16.- Determination of the curve η vs the flow for different r.p.m. for the peripherical pump.
17.- Determination of the curve η vs the flow for different r.p.m. for the gear pump.
18.- Determination of the curve η vs the flow for different r.p.m. for the axial pump.
19.- Determination of the map of a centrifugal pump.
20.- Determination of the map of a peripherical pump.
21.- Determination of the map of a gear pump.
22.- Determination of the map of an axial pump.
23.- Determination of the adimenssional characteristic curves for different types of pumps.
24.- Determination of the specific speed of different types of pumps.
25.- Verification of the similarity rules for pumps of different geometry.

Other possible practices:

26.- Sensors calibration.
27-45.- Practices with PLC.

Optional pumps:

PBOC-2BC.
Second Centrifugal pump

PBOC-BIF.
Flexible impeller pump

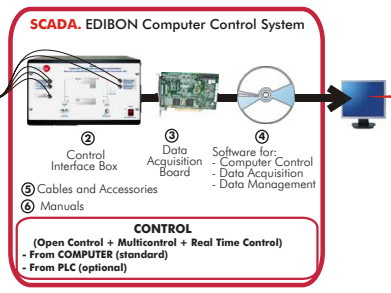
PBOC-BD.
Diaphragm pump

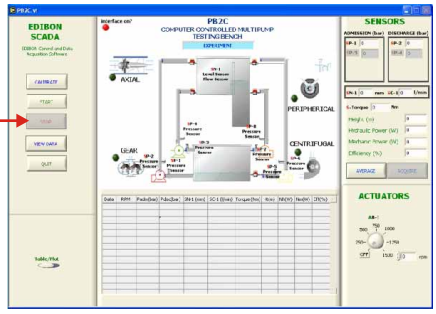
PBOC-BE.
Plunger pump

PBOC-VA.
Vane pump

PB2C. Computer Controlled **Multipump Testing Bench**

① Unit: PB2C. Multipump Testing Bench





SPECIFICATIONS SUMMARY
Items supplied as standard

① PB2C. Unit:
The Multipump Testing Bench (PB2C) allows the students to study the operating characteristics of the centrifugal and gear pumps. It allows to control and to measure the most representative parameters of these types of pumps.
Measures that can be taken using this unit are: pump manometric height, flow, torque motor and turning speed.
Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
2 Pumps:
Centrifugal pump, computer controlled.
Gear pump, computer controlled.
Motor for each pump, with independent operating.
Admission pressure sensors and discharge pressure sensors for each pump (4 sensors).
Control software for the direct reading of speed (r.p.m.) and torque (Nm).
Variation of speed by frequency converter, computer control.
Calibrated volumetric tank of 0-10 litres for low flows and of 0-45 litres for high flows. Water storage tank, with capacity of 160 litres approx.
Flow sensor. "U" Shape weir. Stilling baffle in the open channel.
Valves for centrifugal and gear pumps.

② PB2C/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PB2C/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

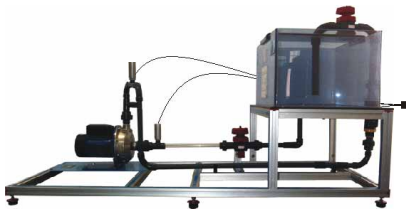
Dimensions (approx.)= Unit: 1650 x 800 x 1850 mm. Weight: 200 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PB2C.pdf

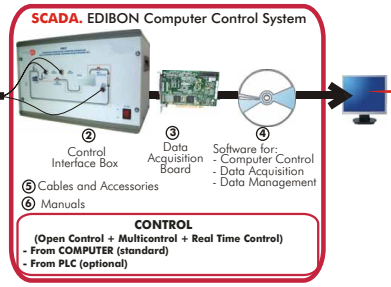
PRACTICAL POSSIBILITIES

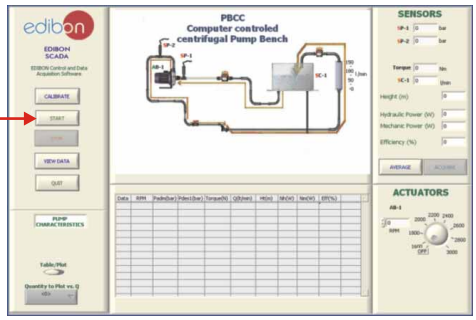
1.- Determination of the flow by a weir of thin wall in an U-shape.
2.- Determination of the unloading coefficient of a weir of thin wall in an U-shape.
3.- Determination of the curve Q vs r.p.m. for the centrifugal pump.
4.- Determination of the curve Q vs r.p.m. for the gear pump.
5.- Determination of the curve H vs Q for different r.p.m. for the centrifugal pump.
6.- Determination of the curve H vs Q for different r.p.m. for the gear pump.
7.- Determination of the mechanical power vs flow for different r.p.m. for the centrifugal pump.
8.- Determination of the mechanical power vs flow for different r.p.m. for the gear pump.
9.- Determination of the curve η vs the flow for different r.p.m. for the centrifugal pump.
10.- Determination of the curve η vs the flow for different r.p.m. for the gear pump.
11.- Determination of the map of a centrifugal pump.
12.- Determination of the map of a gear pump.
13.- Determination of the adimensional characteristic curves for the different pumps.
14.- Determination of the specific speed for the different pumps.
15.- Verification of the similarity rules for pumps of different geometry.
Other possible practices:
16.- Sensors calibration.
17-35.- Practices with PLC.

PBCC. Computer Controlled **Centrifugal Pump Bench** ✱



① Unit: PBCC. Centrifugal Pump Bench





SPECIFICATIONS SUMMARY
Items supplied as standard

① PBCC. Unit:
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Centrifugal pump, computer controlled: maximum flow: 80 l/min., maximum height (approx.): 20 mwc (meter of water column), pump-and-engine-set coupled to an AC motor, pump speed adjustable from the computer (PC).
Torque measurement and speed measurement.
Discharge pressure sensor (0 to 2.5 bar). Admission pressure sensor (-1 to 0 bar). Flow sensor (0-150 l./min).
By the previous sensors we can make the measurement of the most representative parameters of the pump:
Speed. Torque. Total impelled flow. The admission and discharge pressure.
Water transparent tank, capacity: 60 l.

② PBCC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PBCC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1500 x 700 x 800 mm. Weight: 90 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PBCC.pdf

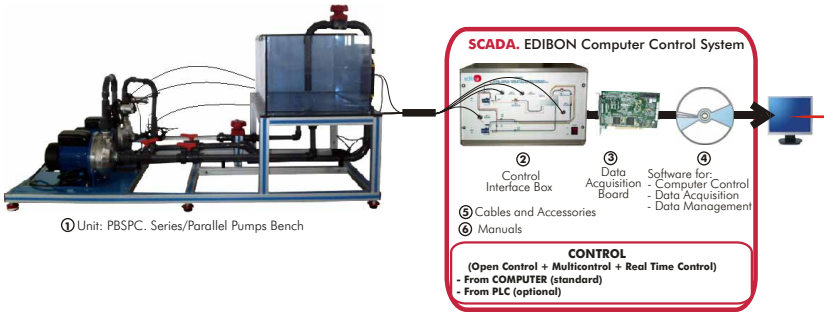
PRACTICAL POSSIBILITIES

1.- Demonstration of a centrifugal water pump in operation.
2.- Introduction to pump speed laws.
3.- Obtaining of curves H(Q), N(Q) and Eff%(Q).
4.- Simultaneous representation of H(Q), N(Q) and Eff%(Q).
5.- Obtaining the map of a centrifugal pump.
6.- Adimensional study of magnitudes H*, N* and Q*.
7.- Cavitation test and obtaining of curves NPSH,.
Other possible practices:
8.- Sensors calibration.
9-27.- Practices with PLC.

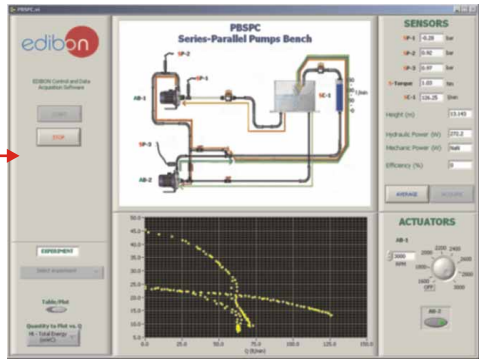
✱ Non computer controlled version available too.

8.4- Hydraulic Machines (Pumps)

PBSPC. Computer Controlled **Series/Parallel Pumps Bench** ✱



① Unit: PBSPC. Series/Parallel Pumps Bench



SPECIFICATIONS SUMMARY

Items supplied as standard

① PBSPC. Unit:
Unit designed to demonstrate the operational advantages of parallel or series operation, depending on the required duty.
The centrifugal pumps can operate: alone, coupled in series or in parallel.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel.
2 Centrifugal pumps: maximum flow: 120 l./min., maximum height (approx.): 25 mwc (meter of water column). A three-phase motor activates a pump with continuous speed adjustment with inverter of frequency/voltage; and other single-phase motor activates the other pump. Valves that allow connecting the pumps separately, in series or in parallel.
Torque measurement and speed measurement. Discharge pressure sensor (0 to 2.5 bar). Discharge pressure sensor (0 to 6 bar). Admission pressure sensor (-1 to 0 bar). Flow sensor (0-150 l./min.).
By the previous sensors we can make measurement of the most representative parameters of the pumps and their couplings (series/parallel): speed, torque, total impelled flow, admission and discharge pressure.
The speed of one pump is adjustable from the computer.
Water tank, capacity: 60l.

② PBSPC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PBSPC/CCSOF. Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1530 x 700 x 800 mm. Weight: 105 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PBSPC.pdf

PRACTICAL POSSIBILITIES

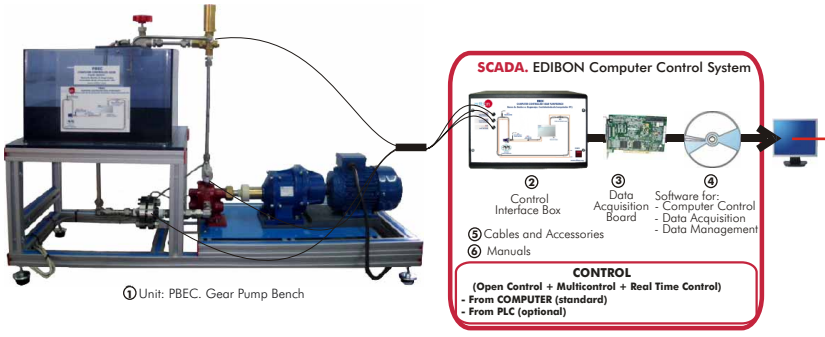
1.- Obtaining of curves H(Q), N(Q), Eff%(Q).
2.- Three simultaneous representations of H(Q), N(Q) and Eff%(Q).
3.- Obtaining of the map of a centrifugal pump.
4.- Adimensional study of magnitudes H*, N* and Q*.
5.- Cavitation test and obtaining of curves NPSH,.
6.- Series coupling of two pumps with same characteristics.
7.- Series coupling of two pumps of different characteristics.
8.- Parallel coupling of two pumps with same characteristics.
9.- Parallel coupling of two pumps of different characteristics.

Other possible practices:

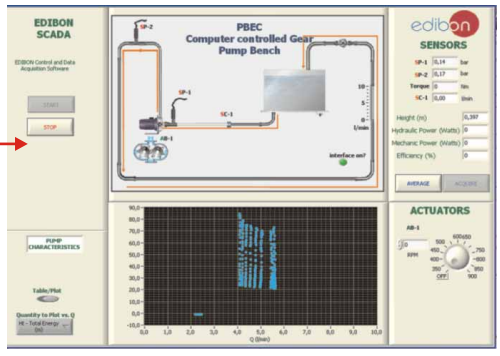
10.- Sensors calibration.

11-29.- Practices with PLC.

PBEC. Computer Controlled **Gear Pump Bench**



① Unit: PBEC. Gear Pump Bench



SPECIFICATIONS SUMMARY

Items supplied as standard

① PBEC. Unit:
Anodized aluminium structure and panels in painted steel. Diagram in the front panel.
Gear pump (motor - pump), computer controlled: Maximum flow: 15 l./min., maximum height (approx.): 50 mwc.
Electric AC motor: 0.5 HP (horsepower).
The pump velocity adjustable with a frequency inverter, controlled from the computer (PC).
Sensors: discharge pressure sensor: from 0 to 6.2 bar, admission pressure sensor: from -1 to 0 bar, flow sensor: from 0 to 15l./min.
By the previous sensors we can make the measurement of the most typical parameters of the pump:
Speed motor. Torque. Total impelled flow. The admission and discharge pressure.
Flow regulation valve.
Transparent water tank, capacity: 40 l. approx.

② PBEC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PBEC/CCSOF. Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1100 x 450 x 800 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PBEC.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of a gear pump in operation.
2.- Obtaining of curves H(Q), N(Q), Efficiency (Q) of the gear pump.
3.- Simultaneous representation of H(Q), N(Q) and Efficiency (Q).
4.- Adimensional study of magnitudes H*, N* and Q*.
5.- Determination of the curve H vs Q at different r.p.m.
6.- Determination of the mechanical power vs flow at different r.p.m.
7.- Determination of the efficiency curve vs the flow at different r.p.m.
8.- Determination of the map of a gear pump.

Other possible practices:

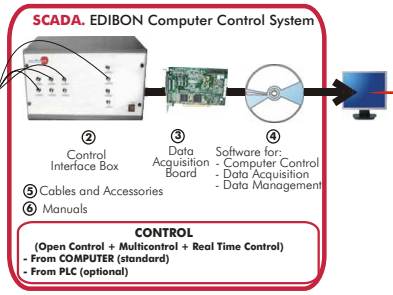
9.- Sensors Calibration.

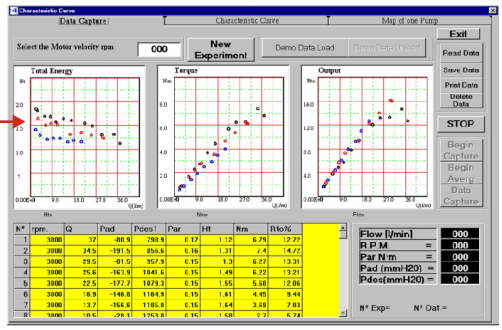
10-28.- Practices with PLC.

✱ Non computer controlled version available too.

PBAC. Computer Controlled **Axial Pump Bench**

① Unit: PBAC. Axial Pump Bench





SPECIFICATIONS SUMMARY
Items supplied as standard

① PBAC. Unit:
Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.
Axial flow pump, computer controlled, shaft maximum speed: 4500 r.m.p., working pressure: 0.5 bar, transversal section of admission and unload: 19.63 cm^2, level different (un-ad): 6.5 cm, maximum flow: 40 l/m approx., shaft diameter: 5 cm.
Pressure sensors (admission): 0-1psi (differential). Pressure sensors (unload): 0-1 psi (differential). Sensors for: flow, speed. Torque measurement, admission pressure, unload pressure.
Regulation valves. Water transparent tank and pipes.

② PBAC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PBAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1530 x 770 x 900 mm. Weight: 80 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PBAC.pdf

PRACTICAL POSSIBILITIES

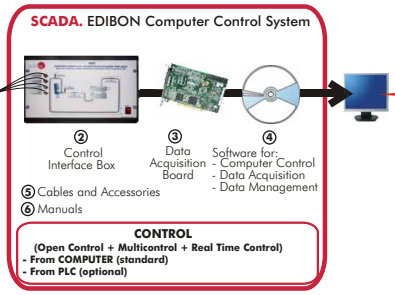
1.- Demonstration of an axial pump in operation.
2.- Obtaining of curves H(Q), N(Q), η(Q) of an axial pump.
3.- Determination of the curve H vs Q for different r.m.p.
4.- Determination of mechanical power vs flow for different r.m.p.
5.- Determination of the curve η vs the flow for different r.p.m.
6.- Determination of the map of an axial pump.
7.- Determination of the characteristic curves.
8.- Determination of the specific speed.

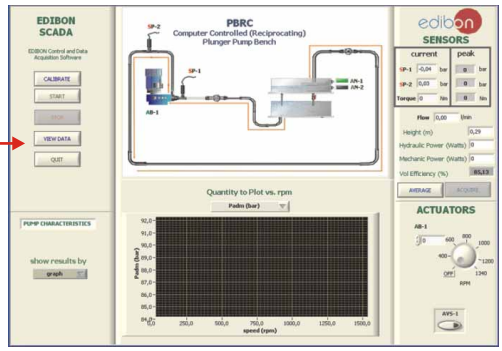
Other possible practices:

9.- Sensors calibration.
10-28.- Practices with PLC.

PBRC. Computer Controlled **Piston Pump Bench**

① Unit: PBRC. Piston Pump Bench





SPECIFICATIONS SUMMARY
Items supplied as standard

① PBRC. Unit:
The piston pump is a positive displacement pump and is used in dosage applications in order to feed exact small quantities of liquid at different pressures.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Piston pump, whose main characteristics are:
Transparent pump head for visibility. Flow: 50 l/hour. Pressure: 9 bar. Stroke: 12.5 mm. Impulses: 58 impulses/min.
A.C. single-phase motor:
Power: 0.25 kW. Velocity: 1.340 rpm (at 50 Hz).
The pump velocity, adjustable with a frequency inverter, controlled from the computer (PC).
2 Regulation valves to control the process.
2 Pressure sensors of 0-10 bar. Flow meter tank calibrated for taking flow measurements (upper tank). 2 Level switches to measure the flow, located in the flow meter tank.
Feed tank (lower tank). Damping chamber.
Solenoid valve, computer controlled, to discharge the flow meter tank (upper tank). Relief valve.

② PBRC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any time and in a real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PBRC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1000 x 350 x 900 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinespumps/PBRC.pdf

PRACTICAL POSSIBILITIES

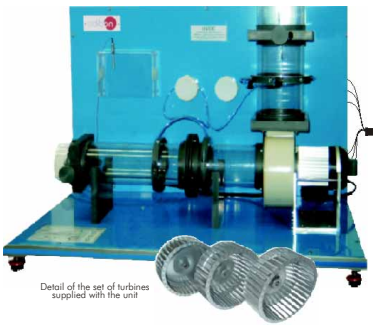
1.- Demonstration of a piston pump in operation.
2.- Measurement of plunger displacement.
3.- Measurement of cylinder pressure.
4.- Measurement of pump outlet pressure.
5.- Measurement of the volumetric efficiency.
6.- Obtain the curves of the pump H(n), N(n).
7.- Obtain the pump map.
8.- Study of safety valve for overpressure in operation.
9.- Study of the pressures influence at the exit when the piston pump works with a damping chamber.
10.- Pump efficiency calculation.
11.- Study of the effect to incorporate the damping chamber.

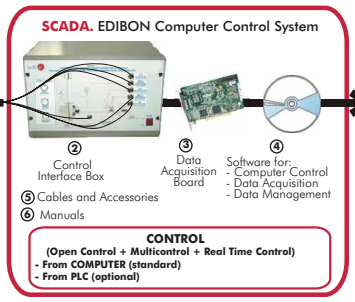
Other possible practices:

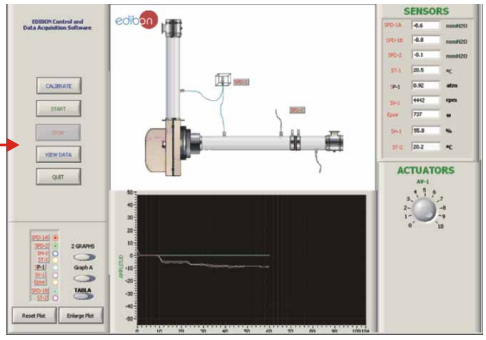
12.- Sensors calibration.
13-31.- Practices with PLC.

8.5- Hydraulic Machines (Fans and Compressors)

HVCC. Computer Controlled **Centrifugal Fan Teaching Trainer** ✱







①Unit: HVCC. Centrifugal Fan Teaching Trainer

SPECIFICATIONS SUMMARY

Items supplied as standard

①HVCC. Unit:

Anodized aluminium structure and panels in painted steel. Diagram in the front panel.

Centrifugal fan with speed control from the computer (PC):

Maximum flow rate: 1000 m^3/h. Speed range: 0-3000 rpm.

Aspiration and discharge transparent ducts.

Orifice plate with differential pressure sensor, for measuring the air flow.

Butterfly valves for regulating flow and pressure.

Set of valves to facilitate the measurements of the fan pressure, the fan aspiration and the differential pressure.

Sensors: Speed sensor, range: 0-3000 rpm. Pressure sensors (0-1 psi). Temperature sensor. Humidity sensor.

Power measurement from the computer (PC).

The unit is supplied with a set of 3 interchangeable turbines: with the blades forwards, with the blades backwards and with flat blades.

Available a wide range of optional accessories.

②HVCC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/ Outputs.

④HVCC/CCSOF. Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1000 x 600 x 700 mm. Weight: 50 Kg.

Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesfans/HVCC.pdf

PRACTICAL POSSIBILITIES

1.- Measurement of constant-speed fan performance in terms of static and total pressures, rotor speed and motor shaft power, as a function of inlet flow.

2.- Calculation of flow with an orifice plate.

3.- Calculation of the fan efficiency.

4.- Introduction to similarity laws for scale-up.

5.- Calculation of the flow by static pressure measurement, dynamic pressure measurement and total pressure depending of the test.

6.- Practices with the different of turbines: with the blades forwards, with the blades backwards and with flat blades.

7.- Determination of the fan characteristics curves.

8.- Calculation of the typical curve of a fan at a constant turning speed (turbine with blades forwards).

9.- Calculation of the typical curve of a fan at a constant turning speed (turbine with blades backwards).

10.- Calculation of the typical curve of a fan at a constant turning speed (turbine with flat blades).

11.- Measurement of performance at constant speeds.

12.- Static pressure increasing.

13.- Sensors calibration.

Other possible practices (with the optional Set of Accessories):

14.- Calculation of flow. Test with discharge duct and nozzle.

15.- Calculation of flow. Test with aspiration duct and nozzle.

16.- Calculation of the differential flow according to the turbines position in the discharge duct.

17.- Calculation of the differential flow according to the turbines position in the aspiration duct.

18.- Determination of the fan characteristics curves (with the optional Set of Accessories).

19.- Measuring a cooling curve.

20.- Determination of the coefficient of heat transfer from the cooling curve.

21.- Measurement of the pressure distribution around a cylinder in a transverse flow.

22.- Measurements behind a cylinder in a transverse flow.

23.- Pressure loss measurements at a bend.

24.- Pressure loss measurements on pipe sections.

25.- Pressure loss measurements at an elbow.

26.- To investigate the influence of different shaped pipe inlets.

27-45.- Practices with PLC.

Optional Set of Accessories:

HVCC-C2TP.
144mm. duct with two static pressure takings

HVCC-C1TP.
144mm. duct with one static pressure taking

HVCC-CTPP.
94mm. duct and pressure taking with Pitot

HVCC-CTPG.
144mm. duct and pressure taking with Pitot

HVCC-EFCG.
144mm. flow straightener by cells

HVCC-EFCP.
94mm. flow straightener by cells

HVCC-EFS.
Flow straightener by sectors

HVCC-OS.
Simmetrical shutter

HVCC-AA7.
Angle adapter (less than 7°)

HVCC-AA3.
Angle adapter (less than 3°)

HVCC-T2D.
Nozzle of two diameters: 94mm. and 144 mm

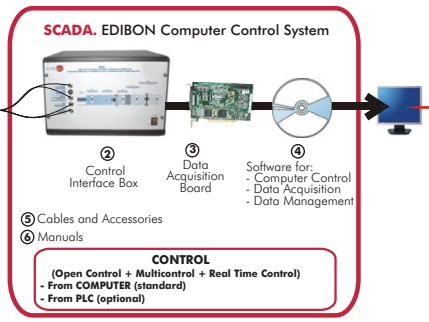
Other accessories:

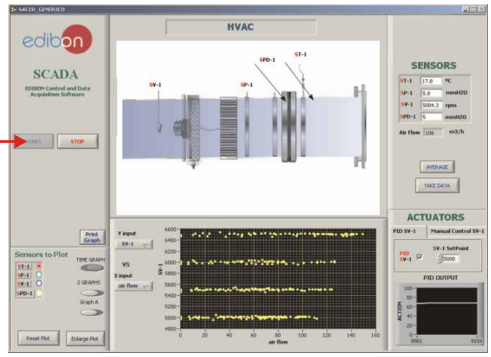
- HVCC-CDP. Cylinder pressure distribution.
- HVCC-TC. Heat transfer model.
- HVCC-TA. Pipe fittings.

✱ Non computer controlled version available too.

HVAC. Computer Controlled **Axial Fan Teaching Trainer** ✱

①Unit: HVAC. Axial Fan Teaching Trainer





SPECIFICATIONS SUMMARY
Items supplied as standard

①HVAC. Unit:

The HVAC unit allows the observation and the working process analysis of an axial-flow fan. Likewise, it allows the possibility of displaying and controlling the variables of the process, in real time.

Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.

Bench desktop unit. Transparent straight duct with a diameter of 115 mm with: a sector rectifier, symmetrical seal, hole plate with a static pressure taking. Single stage axial fan, driven by a 12W output AC induction motor.

Adjustable aperture system for varying the air flow rate. Differential Pressure sensor. 2 Pressure sensors. Speed sensor. Temperature sensor.

②HVAC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④HVAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1800 x 580 x 700 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesfans/HVAC.pdf

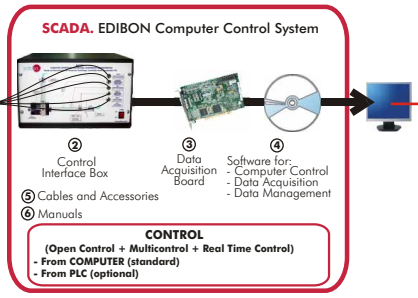
PRACTICAL POSSIBILITIES

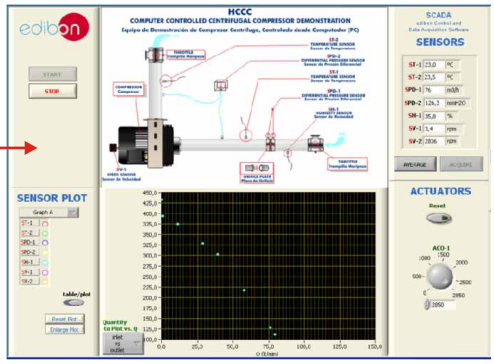
1.- Measurement of overall efficiency and estimation of impeller power efficiency.
2.- Measurement of performance at constant speeds.
3.- Study of the axial fan regulation varying its turning speed.
4.- Measurement of inherent-speed machine performance in terms static and total pressure, rotor speed and motor input power, as an inlet flow function.
5.- Introduction to similarity laws for scale-up.
6.- Obtaining of the characteristic curves of an axial fan.
7.- Calculation of the Flow on a Hole Plate.
8.- Calculation of the Flow through a Symmetrical Seal. Test with an Outlet Duct and a Nozzle.
9.- Calculation of the Fan Output.
10.- Introduction to the Scaling Similitude Law.
11.- Flow calculation through a measurement of the static, dynamic and total pressure.
12.- Typical curve calculation of a fan with a constant turning speed depending on the flow used by the symmetrical seal.

Other possible practices:
13.- Sensors calibration.
14-32.- Practices with PLC.

HCCC. Computer Controlled **Centrifugal Compressor Demonstration Unit**

①Unit: HCCC. Centrifugal Compressor Demonstration Unit





SPECIFICATIONS SUMMARY
Items supplied as standard

①HCCC. Unit:

The Centrifugal Compressor Demonstration Unit (HCCC) allows the students to measure the operation characteristics of a multistage centrifugal compressor. For that purpose, the unit carries out the real measurements of the compressor's inlet flow, the compressor speed, the differential pressure to know the pressure increment in the compressor, the inlet and the outlet air temperature, etc.

Unit mounted on anodized aluminium structure and panels in painted steel. Diagram in the front panel.

Multi-stage centrifugal compressor, computer controlled: maximum speed: 3000 rpm approx., max. flow range: 72 m^3/h., seven stages in the compressor.

Transparent inlet duct and transparent outlet duct. Throttles (butterfly valves) to regulate the air flow.

Orifice plate with differential pressure sensor to measure the air flow.

2 Differential pressure sensors. Humidity sensor. 2 Air temperature sensors, located at the inlet and outlet of the system. Speed sensor. Power measurement from the computer (PC). Consumed power sensor. Generated power measurement. Efficiency measurement.

②HCCC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④HCCC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1000 x 600 x 800 mm. Weight: 65 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesfans/HCCC.pdf

✱ Non computer controlled version available too.

PRACTICAL POSSIBILITIES

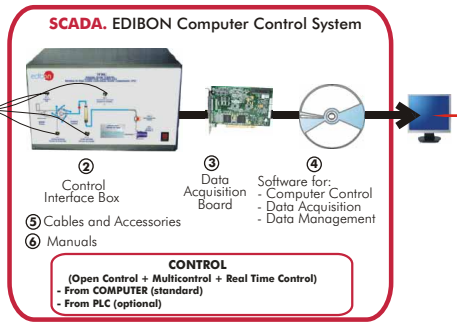
1.- Performance of a compressor.
2.- Demonstration of the phenomenon of air compression, after passage through the compressor impeller.
3.- Study of the variation of compressor performance with speed.
4.- Measurement of compressor efficiency and estimation of impeller power efficiency.
5.- Measurement of constant-speed machine performance in terms of static and total pressures, rotor speed and motor shaft power, as a function of inlet flow.
6.- Introduction to similarity laws for scale-up.
7.- Measurement of performance at constant speeds.
8.- Compressor curve for different stages.
9.- Calculation of the flow by means of the orifice plate.
10.- Calculation of the characteristic curve of a centrifugal compressor at a constant turn speed according to the flow used by the symmetrical stopper.
11.- Study and comparison of the computer results with the students calculations.

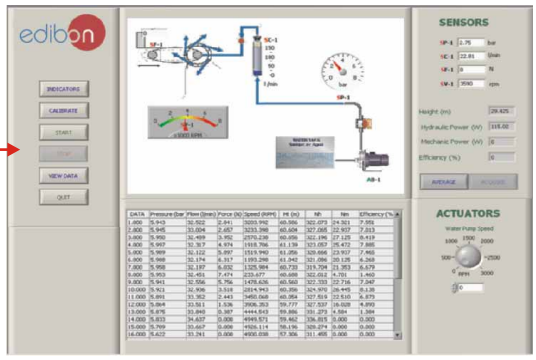
Other possible practices:
12.- Sensors calibration.
13-31.- Practices with PLC.

8.6- Hydraulic Machines (Turbines)

TFRC. Computer Controlled **Radial Flow Turbine**

① Unit: TFRC. Radial Flow Turbine





SPECIFICATIONS SUMMARY
Items supplied as standard

①TFRC. Unit:
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Nozzle: Inlet diameter: 21 mm., outlet diameter: 4 mm., discharge angle: 180°.
Turbine rotor: external diameter: 69 mm., internal diameter: 40 mm., number of nozzle: 2, inlet angle of the nozzle: 180°, outlet angle of the nozzle: 180°.
Brake: pulley diameter: 60 mm., effective radio: 50 mm. Load cell: 0-2 Kg. Force sensor: 0-20N (maximum).
Water pump, computer controlled: maximum water flow: 116 l/min at 2.4 bar, maximum pressure: 7 bar.
Pressure sensor: 0 to 100 psi. Flow sensor: 0 to 150 l/min. Speed sensor: 0 to 20000 rpm.
Water transparent tank, capacity: 100 l. approx.

②TFRC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TFRC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 800 x 900 x 800 mm. Weight: 80 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

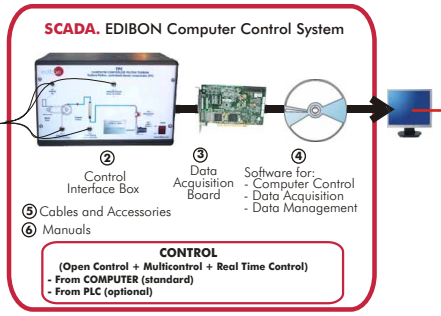
More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/TFRC.pdf

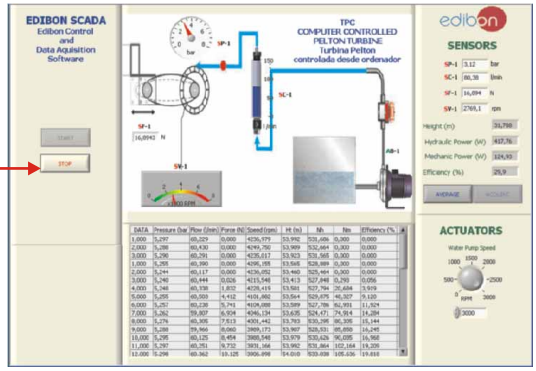
PRACTICAL POSSIBILITIES

1.- Determination of the curves M (n, H_a), N (n, H_a), η (n, H_a).
2.- Determination of the curves M (n, Q), Nm (n, Q), η (n, Q).
3.- Adimensional analysis.
4.- Sensors calibration.
5-23.- Practices with PLC.

TPC. Computer Controlled **Pelton Turbine**

① Unit: TPC. Pelton Turbine





SPECIFICATIONS SUMMARY
Items supplied as standard

①TPC. Unit:
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Pelton turbine: speed range: 0-3000 r.p.m., torque: 20N (maximum), number of buckets: 16, drum radius: 30 mm.
Brake: pulley diameter: 60 mm., effective radio: 50 mm.
Water pump, computer controlled: maximum pressure: 7 bar, maximum water flow: 80l./min at 5.4 bar.
Pressure sensor: 0 to 100 psi. Load cell: 0-2 Kg. Force sensor: 0-20N (maximum). Flow sensor: 0 to 150 l./min. Speed sensor: 0-20000 r.p.m. Water transparent tank: 100 l. approx.

②TPC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, it, other electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TPC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 800 x 900 x 800 mm. Weight: 80 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/TPC.pdf

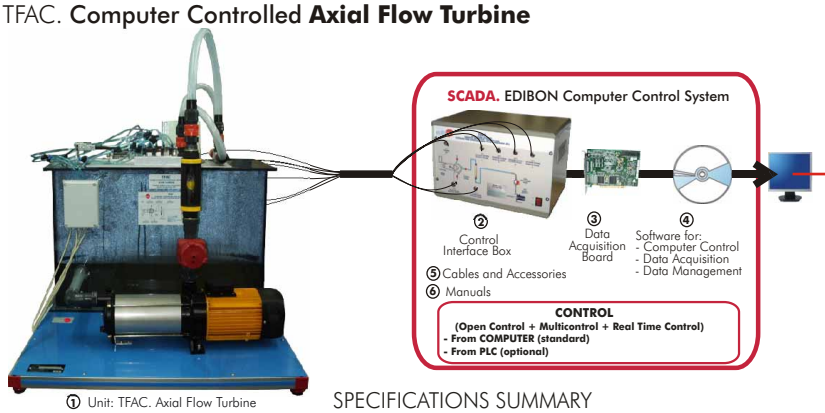
PRACTICAL POSSIBILITIES

1.- Determination of the operative characteristics of Pelton´s Turbine.
2.- Obtaining the hydraulic and mechanical power.
3.- Determination of the operation mechanical curves.
4.- Determination of the operation hydraulic curves.
5.- Obtaining the Efficiency curves.
6.- Adimensionalization.
7.- Flow calculation.

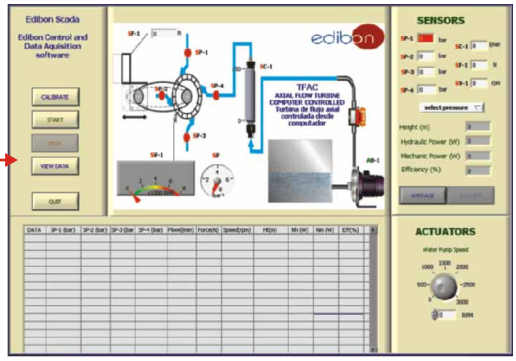
Other possible practices:

8.- Sensors calibration.
9-27 .- Practices with PLC.

TFAC. Computer Controlled **Axial Flow Turbine**



① Unit: TFAC. Axial Flow Turbine



SPECIFICATIONS SUMMARY

Items supplied as standard

①TFAC. Unit:

Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit. Nozzle: throat inlet diameter: 2.5 mm., throat outlet diameter: 2.5 mm., discharge angle: 20° and 30°. Turbine Rotor: external diameter: 53 mm., internal diameter: 45 mm., number of blades: 40, inlet angle of the blades: 40°, outlet angle of the blades: 40°. Brake: pulley diameter: 60 mm., effective radio: 50 mm. 4 Pressure Sensors: 0 to 100 psi. Load cell: 0-2 Kg. Force Sensor (Torque): 0-20 N (maximum). Flow Sensor: 0 to 150 l./min. Speed Sensor: 0 to 20000 r.p.m. Water Pump, computer controlled: maximum pressure: 7 bar, maximum water flow: 116 l./min. at 2.4 bar. Water transparent tank: 100 l. approx.

②TFAC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TFAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 800 x 900 x 800 mm. Weight: 80 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/TFAC.pdf

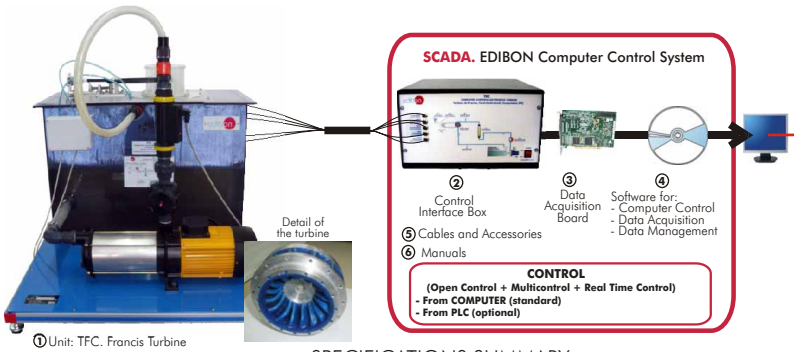
PRACTICAL POSSIBILITIES

1.- Determination of the nozzle discharge coefficient.
2.- Determination of operating characteristics of the axial turbine at different speed values (20° nozzle).
3.- Determination of operating characteristics of the axial turbine at different speed values (30° nozzle).
4.- Determination of the axial turbine characteristic curves (20° nozzle).
5.- Determination of the axial turbine characteristic curves (30° nozzle).
6.- Determination of torque, efficiency and power curves at a constant value (20° nozzle).
7.- Determination of torque, efficiency and power curves at a constant value (30° nozzle).
8.- Determination of curves in relation to the turning speed (20° nozzle).
9.- Determination of curves in relation to the turning speed (30° nozzle).
10.- Determination of curves in relation to the flow (20° nozzle).
11.- Determination of curves in relation to the flow (30° nozzle).
12.- Adimensionalization.
13.- Flow calculation.

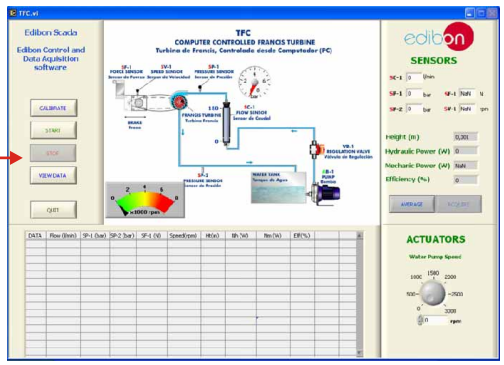
Other possible practices:

14.- Pressure sensors calibration.
15.- Flow sensor calibration.
16-34.- Practices with PLC.

TFC. Computer Controlled **Francis Turbine**



① Unit: TFC. Francis Turbine



SPECIFICATIONS SUMMARY

Items supplied as standard

①TFC. Unit:

Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Functional model of Francis turbine, with a distributor with adjustable guide vanes that allows to control the water angle of incidence of the turbine:

Diameter of the turbine: 52 mm., speed range: 0-1200 r.p.m. approx. Rotor: number of blades of the turbine: 15. Stator: number of adjustable guide vanes of the distributor: 10.

Band brake with adjustable braking tension. Load cell-force sensor, range: 0-20N.

Computer controlled water pump, with variable speed. Transparent water tank, capacity 130 l. approx.

2 Pressure sensors. Flow sensor. Speed sensor.

②TFC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TFC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 800 x 900 x 950 mm. Weight: 85 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/TFC.pdf

PRACTICAL POSSIBILITIES

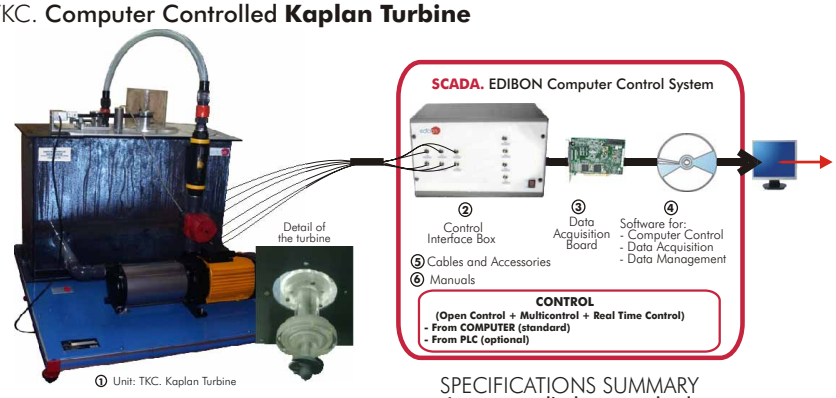
1.- To determine the operating characteristics of a Francis turbine at different speeds.
2.- Determination of typical turbine curves.
3.- Determination of the Francis turbine's power N(n), Torque M_m(n) and efficiency η(n) curves at constant flow with guide vanes open.
4.- Determination of the Francis turbine's power N(n), Torque M_m(n) and efficiency η(n) curves at constant flow with guide vanes closed.
5.- Determination of the power N(Q), Head H(Q) and efficiency η(Q) curves at constant rotation speed and guide vanes opened.
6.- Determination of the power N(Q), Head H(Q) and efficiency η(Q) curves at constant rotation speed and guide vanes closed.
7.- Turbine power output versus speed and flow rate at various heads.
8.- Effect of guide vane setting on the turbine performance.
9.- Investigation of the conversion of hydraulic energy into mechanical energy.
10.- Adimensional analysis.
11.- Calculating the turbine power.
12.- Determining the turbine hydraulic efficiency.
13.- Determining the torque and speed of the turbine.
14.- Flow calculation.

Other possible practices:

15.- Sensors calibration.
16-34 .- Practices with PLC.

8.6- Hydraulic Machines (Turbines)

TKC. Computer Controlled **Kaplan Turbine**



① Unit: TKC. Kaplan Turbine

SPECIFICATIONS SUMMARY

Items supplied as standard

①TKC. Unit:

Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Functional model of Kaplan turbine, with a distributor with adjustable guide vanes that permits to control the water flow in the turbine:

Turbine diameter: 52 mm. Velocity range: 0-1000 r.p.m. approx. Number of blades of the turbine: 4. Number of adjustable guide vanes of the distributor: 8.

Braking system. Load cell: 0-2 Kg. Force sensor: 0-20 N (maximum).

Water pump, computer controlled. Water transparent tank, capacity 100 l. approx.

Pressure sensor. Flow sensor. Speed sensor.

②TKC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TKC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 800 x 900 x 800 mm. Weight: 80 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/TKC.pdf

PRACTICAL POSSIBILITIES

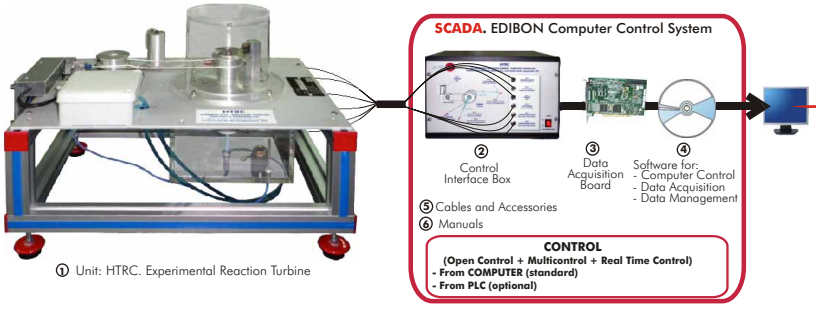
1.- To determine the operating characteristics of a Kaplan turbine at different velocities.
2.- Determination of the typical turbine curves.
3.- Turbine power output versus speed and flow rate at various heads.
4.- Effect of guide vane setting on turbine performance.
5.- Flow calculation.
6.- Adimensional analysis.
7.- Investigation of the conversion of hydraulic energy into mechanical energy.
8.- Determining torque and speed of the turbine.
9.- Calculating the turbine power.
10.- Determining the hydraulic turbine efficiency.

Other possible practices:

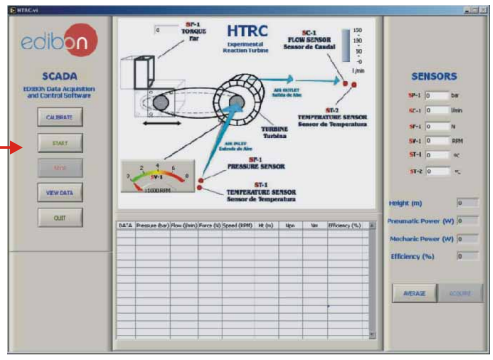
11.- Sensors calibration.

12-30.- Practices with PLC.

HTRC. Computer Controlled **Experimental Reaction Turbine**



① Unit: HTRC. Experimental Reaction Turbine



SPECIFICATIONS SUMMARY

Items supplied as standard

①HTRC. Unit:

Anodized aluminium structure and metallic panels. Diagram in the front panel with similar distribution to the elements in the real unit.

Nozzle: diameter: 21 mm, discharge angle: 180°.

Turbine rotor: external dia: 80 mm, internal dia: 40 mm., Number of nozzles: 2; nozzle internal angle: 180°, nozzle external angle: 180°. Brake: pulley dia: 60 mm., effective radius: 50 mm.

Pressure sensor: 0 to 250 psi. Load cell: 0 - 20 N. Force sensor. Flow sensor: 150 l/min. Speed sensor: 0 to 6000 rpm.

2 Temperature sensors. Air supply: maximum pressure: 7 bar, maximum air flow: 0 to 150 l/min.

Measurement of air pressure, air temperature, air flow, rotational speed and torque.

②HTRC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④HTRC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 800 x 500 x 600 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/HTRC.pdf

PRACTICAL POSSIBILITIES

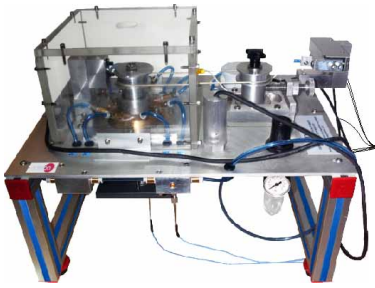
1.- Visual examination of a small reaction turbine.
2.- Production of torque/speed and power/speed curves.
3.- Evaluation of specific air consumption at a range of speeds and pressures.
4.- Application of the First Law to a simple open system undergoing a steady flow pressure.
5.- Determination of the isentropic efficiency of a reaction turbine and plotting the end states on a temperature/entropy diagram.
6.- Construction of retardation curve and the determination of resisting torques due to bearing friction, disc friction and windage, at different speeds.
7.- Obtaining the inlet pressure effect on the outlet power and effectiveness of the turbine, as well as torque, speed and power curves.

Other possible practices:

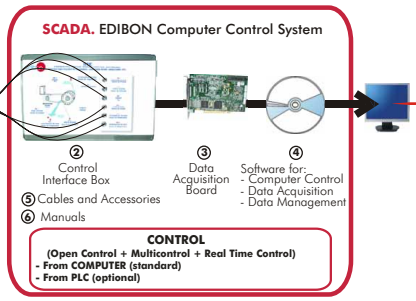
8.- Sensors calibration.

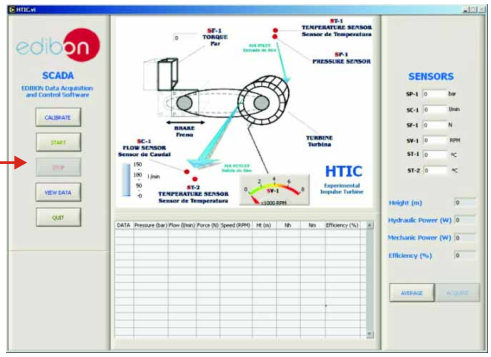
9-27.- Practices with PLC.

HTIC. Computer Controlled **Experimental Impulse Turbine**



① Unit: HTIC. Experimental Impulse Turbine





SPECIFICATIONS SUMMARY

Items supplied as standard

① HTIC. Unit:
Anodized aluminium structure and metallic panels. Diagram in the front panel with similar distribution to the elements in the real unit.
Nozzle: internal dia: 21 mm, external dia: 2.0 mm, inlet angle on blades: 20° and 30°.
Turbine rotor: external dia: 69 mm, internal dia: 40 mm, blades number: 45, blade inlet angle: 40°, blade outlet angle: 40°.
Brake: pulley dia: 60 mm, effective radius: 50 mm.
Sensors: Pressure sensor: 0 to 250 psi. Load cell: 0-20N. Force sensor. Flow sensor: 0 to 150 l/min. Speed sensor. 2 Temperature sensors.
Measurement of air pressure, air temperature, air flow, rotational speed and torque.
Air supply: maximum pressure: 12 bar, maximum air flow: 400 l/min./10 bar.

② HTIC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ HTIC/CCSOF. Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 800 x 500 x 600 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/hydraulicmachinesturbines/HTIC.pdf

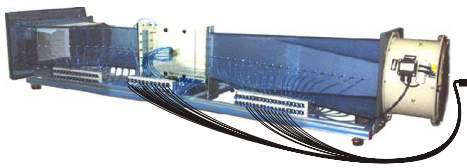
PRACTICAL POSSIBILITIES

1.- Visual examination of a small turbine.
2.- Comparison of turbine performance, including specific consumption, when using:
  Throttle control
  Nozzle control
3.- Production of torque/speed and power/speed curves.
4.- Determination of the isentropic efficiency of a turbine and plotting the end states on a temperature/entropy diagram.
5.- Application of the First Law to a simple open system undergoing a steady flow process.
6.- Construction of retardation curve and the determination of resisting torques due to bearing frictions, disc friction and windage, at different speeds.
7.- Demonstration of cooling by expansion.

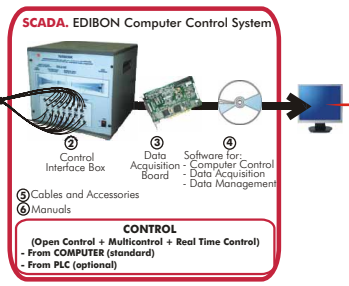
Other possible practices:
8.- Sensors calibration.
9-27.- Practices with PLC.

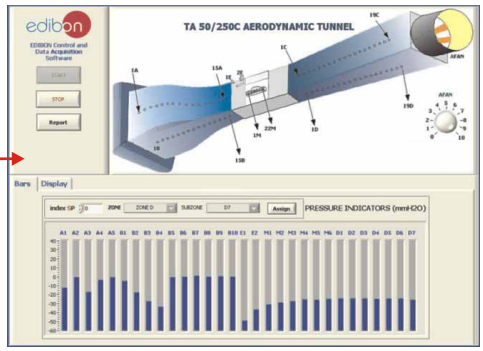
8.7- Aerodynamics (Basic)

TA50/250C. Computer Controlled **Aerodynamic Tunnel, 50 x 250 mm** ✱



① Unit: TA50-250C. Aerodynamic Tunnel, 50 x 250 mm





SPECIFICATIONS SUMMARY

Items supplied as standard

①TA50-250C. Unit:

Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.
Small, benchtop wind tunnel of open circuit and subsonic flux.
Transparent working area for visibility of 50 x 250 mm, including the removable panel to place a wide range of aerodynamics models. 30 pressure sensors for 90 different pressure takings (along the tunnel and in the models).
Pitot's tube.
Variable speed fan, computer controlled.
Models included in the standard supply:

-TA1C. House scale model.
-TA2C. Cylinder model.
-TA3C. Convex semi-cylinder model.

Optional models: (not included in the standard supply)

-TA4C. Car model.
-TA5C. Lorry model.
-TA6C. Lorry with wind deflector model.
-TA7C. Plane model.
-TA8C. Train model.
-TA9C. Projectile model.
-TA11C. Wing of a Plane model.
-TA12C. Concave semi-cylinder.
-TA13C. Blunt Element model.
-TA14C. Bernoulli Apparatus model.
-TA15C. Boundary Layer Plate model.

Optional accessories: (not included in the standard supply)

- TA50/250- SG. Smoke generator.
- TA50/250- BLE. Boundary Layer Experiment Accessory.

②TA50-250C/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TA50-250C /CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 2720 x 820 x 700 mm. Weight: 200 Kg. Control Interface: 490 x 450 x 470 mm. Weight: 20 Kg.

PRACTICAL POSSIBILITIES

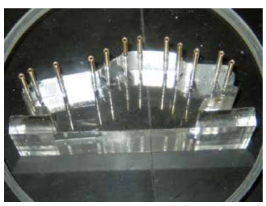
1.- Study of subsonic aerodynamics and air flow studies.
2.- Determine the characteristics of the pressures field in a nozzle.
3.- Flux in an nozzle. To observe the local characteristics, depending on whether the walls have a curvature or not, as well as what happens in the inlet and outlet areas of the contraction.
4.- Flow of an uniform current around a cylinder.
5.- To determine the form of the field of pressures around a cylinder on which a perpendicular to the axis current impacts.
6.- To determine, by the detachment type, if the boundary layer finally becomes turbulent or remains laminar.
7.- To determine the coefficient of resistance of the cylinder, for the described situation of flow.
8.- To relate all the above mentioned with the Reynolds's number.
9.- Flow of an uniform current around a concave and a convex semi-cylinder.
10.- To determine the field or pressures in the two semi-cylinders.
11.- To determine the coefficients of aerodynamic resistance in the two semi-cylinders.
12.- Aerodynamics forces due to the wind on house.
13.- Measurement of pressure distribution around body two dimensional.
14.- Flow visualization studies.
15.- Velocity and pressure distribution measurement using a Pitot's Tube.
16.- Sensors calibration.
17-35.- Practices with PLC.

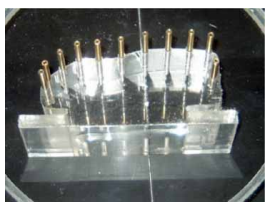
Some available Models:

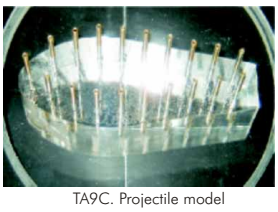

TA1C. House scale model

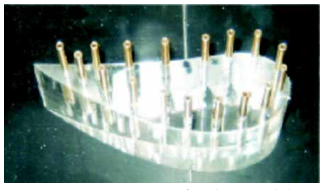

TA2C. Cylinder model


TA3C. Convex semi-cylinder model

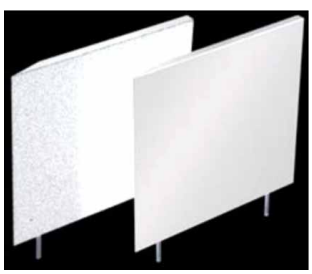

TA4C. Car model


TA8C. Train model


TA9C. Projectile model


TA11C. Wing of a plane model

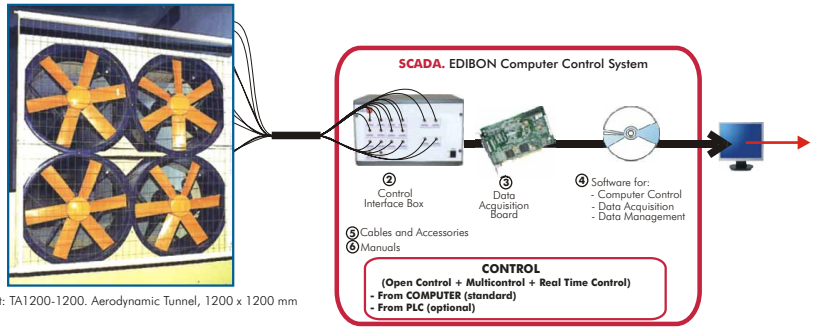

TA14C. Bernoulli Apparatus model


TA15C. Boundary Layer Plate model

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/aerodynamicsbasic/TA50-250C.pdf

✱ Non computer controlled version available too.

TA1200/1200. Computer Controlled **Aerodynamic Tunnel, 1200 x 1200 mm**



① Unit: TA1200-1200. Aerodynamic Tunnel, 1200 x 1200 mm

SPECIFICATIONS SUMMARY

Items supplied as standard

① TA1200/1200. Unit:

Aerodynamic Tunnel of 1200 x 1200 mm, with adequate size for demonstration tests and teaching.
Suitable for three dimensional models.
Test Chamber builts with transparent materials. Low operation and maintenance cost. Suitable for smokes visualization test.
AC motor-ventilator group with frequency variator.
The Aerodynamic Tunnel of 1200 x 1200 mm section for testing, with a longitude of 2000 mm is of the Eiffel type, aspirate and of open circuit, and allows us to carry out tests of measuring forces and aerodynamic field on models of structures, constructions, land vehicles and small planes. Its power plant, formed by 4 ventilators. Great uniformity and low turbulence level, thanks also to the adequate design of the contraction. The tunnel has a steel support structure, and windows for viewing inside the test chamber. A smoke generator can also be connected for flow visualization.

② TA1200/1200/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TA1200/1200/CCSOF. Computer Control+Data Acquisition+Data Management Software:

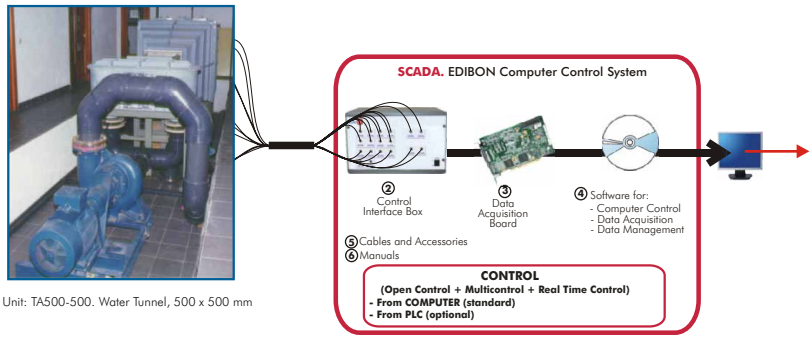
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/aerodynamicsgeneral/TA1200-1200.pdf

TA500/500. Computer Controlled **Water Tunnel, 500 x 500 mm**



① Unit: TA500-500. Water Tunnel, 500 x 500 mm

SPECIFICATIONS SUMMARY

Items supplied as standard

① TA500-500. Unit:

Water tunnel of 500 x 500 mm, principal characteristics with adequate size for flow visualizations on standard models of planes. Useful for teaching and development projects. Top quality vein, uniformity and low turbulence level.
The water tunnel of 500 x 500 mm, of low turbulence level, is specifically designed for carrying out visualization tests on three-dimensional models, though, of course, they can also be used on two-dimensional models.
As it is a closed circuit, it operates continuously and uses the same water, although it may be necessary to renew it once it has lost its transparency due to the use of colorings.
However, if the technique of the hydrogen bubble is used as tracer this problem can also be avoided.

② TA500-500. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TA500-500/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second . It allows the registration of the alarms state and the graphic representation in real time.

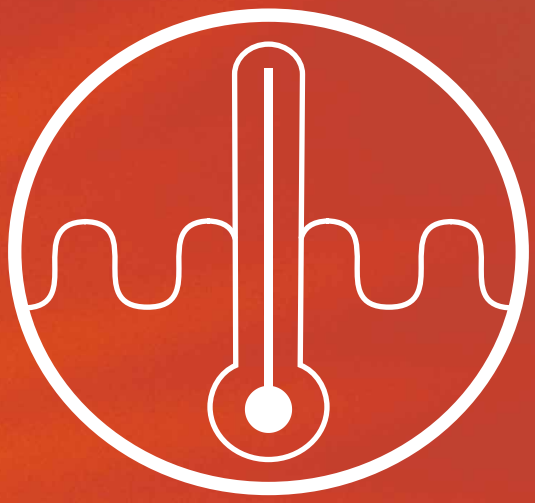
⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/fluidmechanicsaerodynamics/aerodynamicsgeneral/TA500-500.pdf

Summarized
Catalogue

four (4)



9. Thermodynamics & Thermotechnics

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9.- Thermodynamics & Thermotechnics

Equipment list

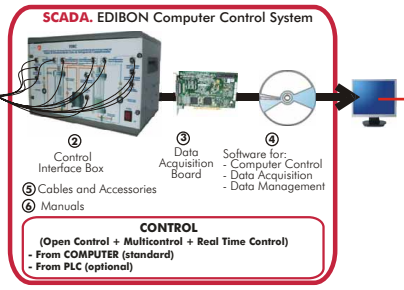
9.- Thermodynamics & Thermotechnics

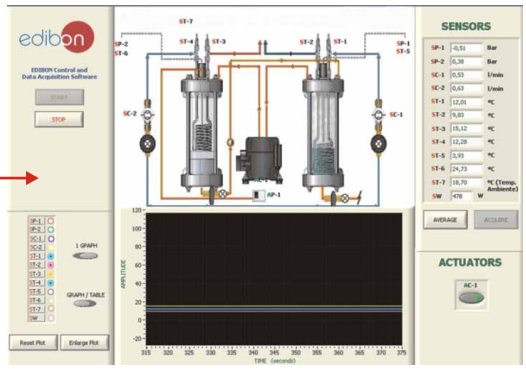
Equipment list

➤Basic Refrigeration

TCRC. Computer Controlled **Refrigeration Cycle Demonstration Unit** ✱

① Unit: TCRC. Refrigeration Cycle Demonstration Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

①TCRC. Unit:
The TCRC unit allows the demonstration of vapour compression refrigeration and heat pump cycle with visual observation of all important processes. It is bench-top unit that is assembled in anodized aluminium structure and panels in painted steel.
Compressor: hermetic compressor of 1/2CV, computer controlled (PC).
Condenser: vertical cylinder, made of glass, through which the coil can be seen where in its inside cooling water circulates. The heat transmission surface is formed by 9 nickel-plated copper spires of 1/4" diameter through which the water flows.
Evaporator: of similar structure to that of the condenser, and with a specially treated copper coil to promote the ebullition.
Expansion valve. Sight glass. 11 Temperature sensors that indicate the water output and input temperatures, both in the condenser and in the evaporator, and the evaporation, condensation, expansion and enviromental temperatures. Maximum working temperature: 100ºC. 2 Flow sensors to measure the water flow (condenser and evaporator). 2 Pressure sensors indicate the refrigerant fluid pressure in the condenser and in the evaporator. Power measurement from computer (PC).
Safety devices: relief valve and high pressure cut-out.
This unit has been designed for the use with the SES36 refrigerant gas, environmental friendly.

②TCRC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TCRC /CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second . It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 700 x 700 x 720 mm. Weight: 70 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TCRC.pdf

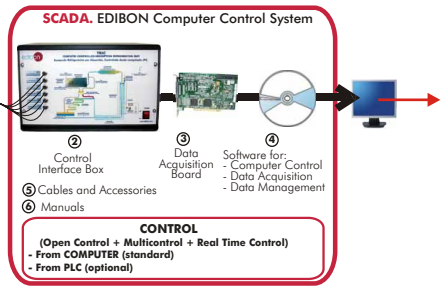
PRACTICAL POSSIBILITIES

1.- Demonstration of the vapour compression refrigeration and heat pump cycle.
2.- Relation between pressure and temperature.
3.- Demonstration of the refrigerant transfer from the evaporator to the condenser.
4.- Charging demonstration.
5.- Demonstration of the air effect in a refrigeration (cooling) system.
6.- Evaporation and condensation temperatures effect in the refrigeration (cooling) rate and in the heat transfer at the condenser.
7.- Analysis of the pressures relation effect in the system behaviour.
8.- Determination of the system operation coefficients.
9.- Measurement of the electrical power.
10.- Estimation of the heat transmission global coefficient between the SES36 refrigerant and the water.

Other possible practices:
11.- Sensors calibration.
12-30.- Practices with PLC.

TRAC. Computer Controlled **Absorption Refrigeration Unit**

① Unit: TRAC. Absorption Refrigeration Unit



SPECIFICATIONS SUMMARY

Items supplied as standard

①TRAC. Unit:
Unit mounted onto a mobile stand that incorporates a work surface. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit and absorption circuit diagram.
A dual power source is provided which includes both electrical and an LPG source:
The LPG source includes the burner and regulator.
For the electrical source, the unit has a step down transformer to convert the main AC into 12 VDC used to power the electric heater.
Self contained absorption system. Refrigeration compartment with temperature sensor. LPG burner with pressure regulator. Electrical heater with 12 VDC transformer. Power measurement from the computer (PC). Volt and amp measurement. Temperature sensors distributed along the unit. Temperature control system. Ammonia/water mixture as working medium. Safety protections.

②TRAC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④TRAC /CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1200 x 700 x 1800 mm. Weight: 110 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TRAC.pdf

PRACTICAL POSSIBILITIES

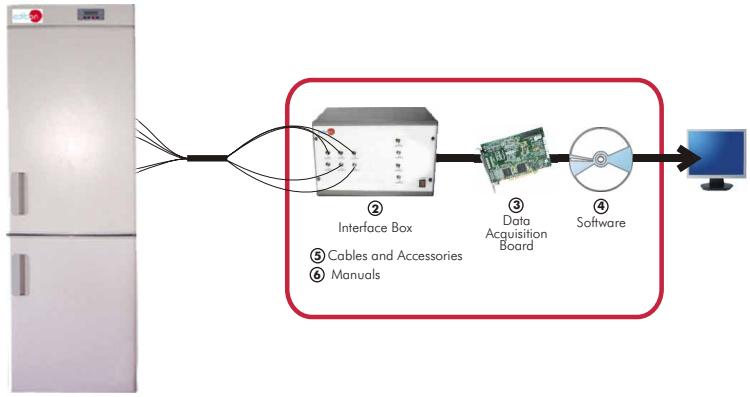
1.- Study of a absorption refrigeration system.
2.- Familiarisation with the individual components of the absorption refrigeration unit.
3.- Operation of a gas absorption refrigeration unit using either electricity or LPG as the heat source.
4.- Demonstration of the refrigeration process.
5.- Measurement of the electrical power.
6.- Measurement of temperature points along the absorption refrigeration process.
7.- Effect of circulating air on the process temperature.

Other possible practices:
8.- Sensors calibration.
9-27.- Practices with PLC.

✱ Non computer controlled version available too.

➤Basic Refrigeration

TRD2PC. **Two Doors Domestic Refrigeration System Trainer**



① Unit: TRD2PC.Two Doors Domestic Refrigeration System Trainer

SPECIFICATIONS SUMMARY

Anodized aluminium structure. Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
PVC covered body.
Capillary tube as expansion device.
Evaporator with fan.
Thermostat.
Resistance heater.
Temperature sensors. Pressures sensors. Flow sensor.
Interface Box.
Data Acquisition Board.
Data Acquisition + Data Management Software.
Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TRD2PC.pdf

PRACTICAL POSSIBILITIES

1.- Connecting of electrical control circuit.

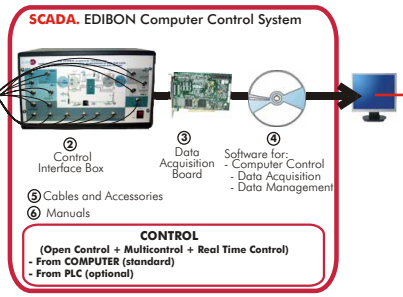
2.- Observation of the household refrigerator.

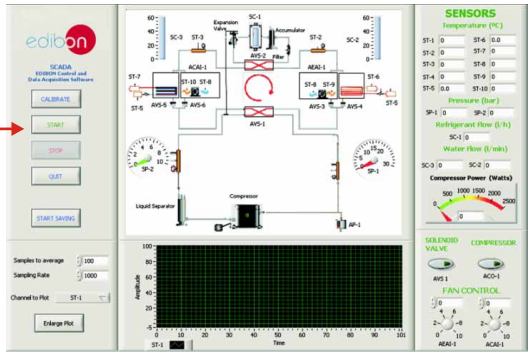
TRCVC. Computer Controlled **Vapour-Compression Refrigeration Unit**

➤General Refrigeration

THIBAR22C. Computer Controlled **Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve** (two condensers (water and air) and two evaporators (water and air))✱

① Unit: THIBAR22C. Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve (two condensers (water and air) and two evaporators (water and air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THIBAR22C. Unit:

Bench-top unit.
Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled.
Air condenser, computer controlled.
Water condenser.
High pressure control.
Coolant accumulation tank.
Cooling filter.
Tank of division of the cooling liquid.
Expansion valve.
Water evaporator.
Air evaporator, computer controlled
4 Manometers.
10 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature, 3 sensors measure the air temperature):
- Temperature sensor, J type (compressor outlet).
- Temperature sensor, J type (condenser outlet/ evaporator inlet).
- Temperature sensor, J type (evaporator inlet/ condenser outlet).
- Temperature sensor, J type (compressor inlet).
- Temperature sensor, J type (water inlet).
- Temperature sensor, J type (condenser outlet/evaporator).
- Temperature sensor, J type (evaporator outlet/ condenser).
- Temperature sensor, J type (room air).
- Temperature sensor, J type (condenser outlet/ evaporator).
- Temperature sensor, J type (evaporator outlet/ condenser).

3 Flow sensors:
- Cooling flow sensor.
- Water flow sensor (water condenser).
- Water flow sensor (water evaporator).

2 Pressure sensors:
- Cooling pressure sensor (compressor outlet).
- Cooling pressure sensor (compressor inlet).

Wattmeter.
Cycle Inversion valve. 4-way valve.
Enthalpy diagram of the refrigerant R134a.

② THIBAR22C/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THIBAR22C/CCSOF. Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 100 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THIBAR22C.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air heat pump).
3.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Air-air heat pump).
4.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air- water heat pump).
5.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Water-water heat pump).
6.- Preparation of performance curves of the heat pump at different inlet and outlet temperatures. Air as a heat source. (Water-air heat pump).
7.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Air-water heat pump).
8.- Preparation of the performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source. (Air-air heat pump).
9.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water heat pump).
10.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air heat pump).
11.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water heat pump).
12.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air heat pump).
13.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water heat pump).
14.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air heat pump).
15.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Air-water heat pump).
16.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air- air heat pump).
17.- Practices with cycle inversion.

Other possible practices:

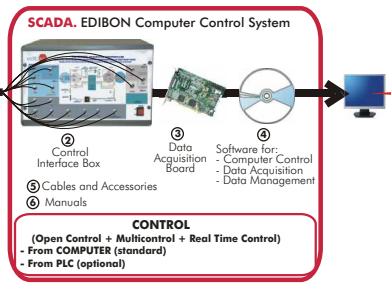
18.- Temperature sensors calibration.
19.- Flow sensors calibration.
20.- Refrigerant flow sensor.
21.- Pressure sensors calibration.
22-40.- Practices with PLC.

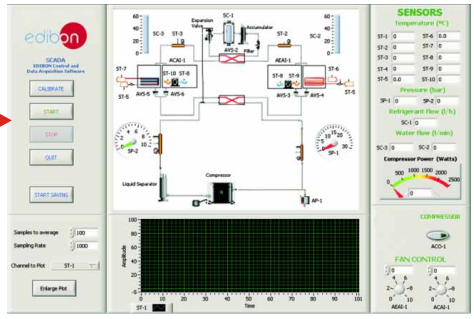
✱ Non computer controlled version available too.

➤General Refrigeration

THAR22C. Computer Controlled **Refrigeration and Air Conditioning Unit** (two condensers (water and air) and two evaporators (water and air))✱

① Unit: THAR22C. Refrigeration and Air Conditioning Unit (two condensers (water and air) and two evaporators (water and air))





SPECIFICATIONS SUMMARY
Items supplied as standard

①THAR22C. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Water evaporator. Air evaporator, computer controlled. Tank of division of the cooling liquid. 4 Manometers.
10 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature, 3 sensors measure the air temperature).
3 Flow sensors: Cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator).
2 Pressure sensors: Cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet).
Wattmeter. Enthalpy diagram of the refrigerant R134a.

②THAR22C/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any time and in a real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THAR22C/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.
⑥ Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 100 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

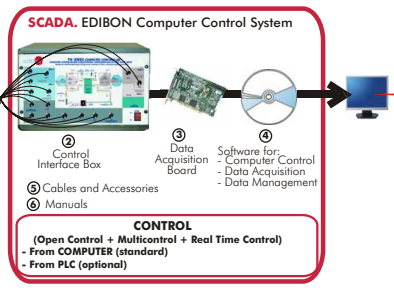
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THAR22C.pdf

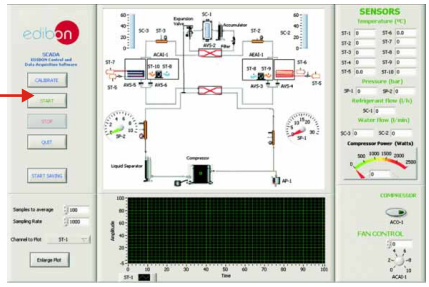
PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air).
3.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Air-air).
4.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air-water).
5.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source. (Water-water).
6.- Preparation of performance curves of the unit at different inlet and outlet temperatures. Air as heat source. (Water-air).
7.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source. (Air-water).
8.- Preparation of the performance curves of the unit with different inlet and outlet temperatures. Air as heat source. (Air-air).
9.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water).
10.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air).
11.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water).
12.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air).
13.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water).
14.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air).
15.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Air-water).
16.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air-air).
Other possible practices:
17.- Temperature sensors calibration.
18.- Water flow sensors calibration.
19.- Refrigerant flow sensor calibration.
20.- Pressure sensors calibration.
21-39.- Practices with PLC.

THAR2LC. Computer Controlled **Refrigeration and Air Conditioning Unit** (two condensers (water and air) and one evaporator (water))✱

① Unit: THAR2LC. Refrigeration and Air Conditioning Unit (two condensers (water and air) and one evaporator (water))





SPECIFICATIONS SUMMARY
Items supplied as standard

① THAR2LC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Water condenser. Air condenser, computer controlled. Water evaporator. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.
9 Temperature sensors (4 sensors measure the cooling temperature, 3 sensor measures the water temperature and 2 sensors measure the air temperature). 3 Flow sensors: coolant flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter. Enthalpy diagram of the refrigerant R134a.

② THAR2LC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THAR2LC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.
⑥ Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

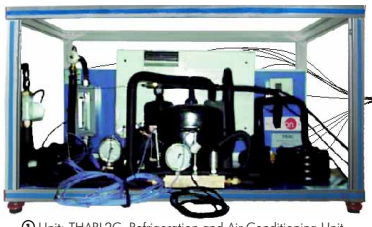
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THAR2LC.pdf

PRACTICAL POSSIBILITIES

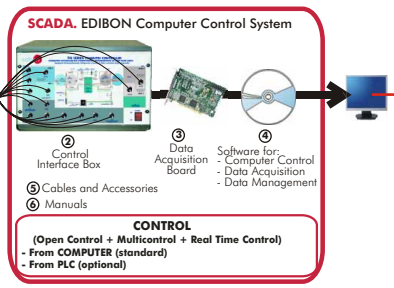
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
4.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.
Other possible practices:
5.- Temperature sensors calibration.
6.- Flow sensors calibration.
7.- Pressure sensors calibration.
8-26.- Practices with PLC.

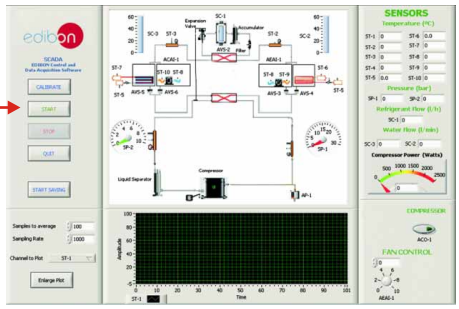
✱ Non computer controlled version available too.

THARL2C. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (water) and two evaporators (water and air))✱



① Unit: THARL2C. Refrigeration and Air Conditioning Unit (one condenser (water) and two evaporators (water and air))





SPECIFICATIONS SUMMARY
Items supplied as standard

① THARL2C. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Water condenser. Air evaporator, computer controlled. Water evaporator. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.
9 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature and 2 sensors measure the air temperature).
3 Flow sensors. Cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter. Enthalpy diagram of the refrigerant R134a.

② THARL2C/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THARL2C/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

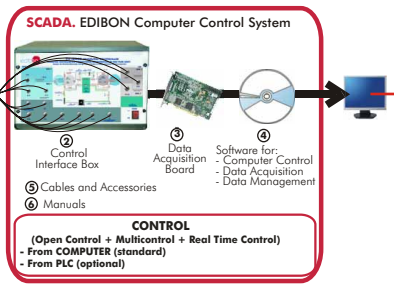
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARL2C.pdf

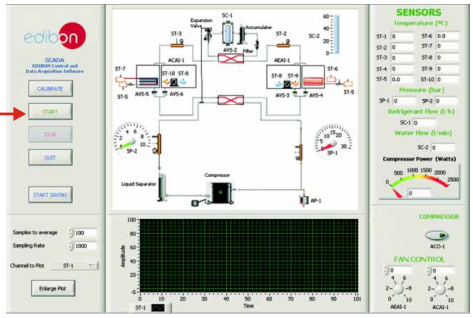
PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
3.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
4.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Air as heat source.
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
7.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.
8.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.
Other possible practices:
9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

THARA2C. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (air) and two evaporators (water and air))✱

① Unit: THARA2C. Refrigeration and Air Conditioning Unit (one condenser (air) and two evaporators (water and air))





SPECIFICATIONS SUMMARY
Items supplied as standard

① THARA2C. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. Water evaporator. Air evaporator, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.
9 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 3 sensors measure the air temperature).
2 Flow sensors: cooling flow sensor and water flow sensor (water evaporator).
2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet).
Wattmeter. Enthalpy diagram of the refrigerant R134a.

② THARA2C/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THARA2C/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARA2C.pdf

PRACTICAL POSSIBILITIES

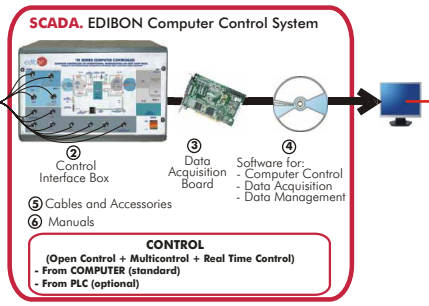
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
3.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
4.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Air as heat source.
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
7.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.
8.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.
Other possible practices:
9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

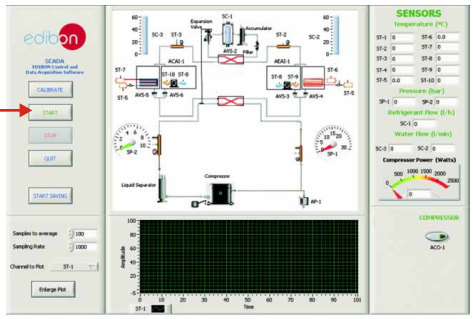
✱ Non computer controlled version available too.

➤General Refrigeration

THARLLC. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (water) and one evaporator (water))✱

① Unit: THARLLC. Refrigeration and Air Conditioning Unit (one condenser (water) and one evaporator (water))





SPECIFICATIONS SUMMARY
Items supplied as standard

①THARLLC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. Water evaporator. 4 Manometers.
7 Temperature sensors (4 sensors measure the cooling temperature and 3 sensors measure the water temperature). 3 Flow sensors: cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THARLLC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THARLLC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARLLC.pdf

PRACTICAL POSSIBILITIES

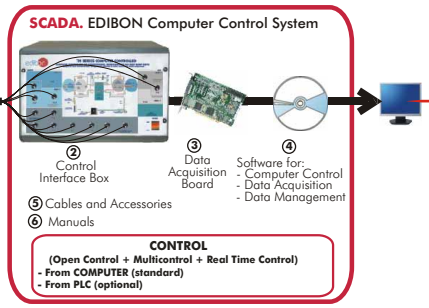
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
4.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.

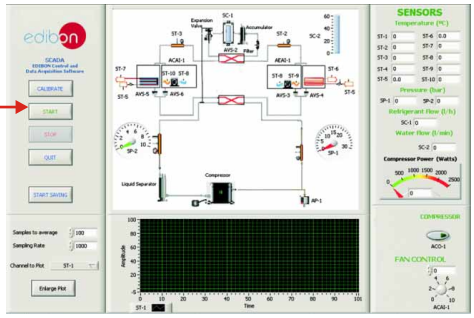
Other possible practices:

5.- Temperature sensors calibration.
6.- Flow sensors calibration.
7.- Pressure sensors calibration.
8-26.- Practices with PLC.

THARALC. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (air) and one evaporator (water))✱

① Unit: THARALC. Refrigeration and Air Conditioning Unit (one condenser (air) and one evaporator (water))





SPECIFICATIONS SUMMARY
Items supplied as standard

①THARALC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Water evaporator. Tank of division of the cooling liquid. 4 Manometers.
8 Temperature sensors (4 sensors for the cooling temperature, 2 sensors for water temperature and 2 sensors for the air temperature). 2 Flow sensors (cooling flow sensor and water flow sensor). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THARALC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THARALC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARALC.pdf

PRACTICAL POSSIBILITIES

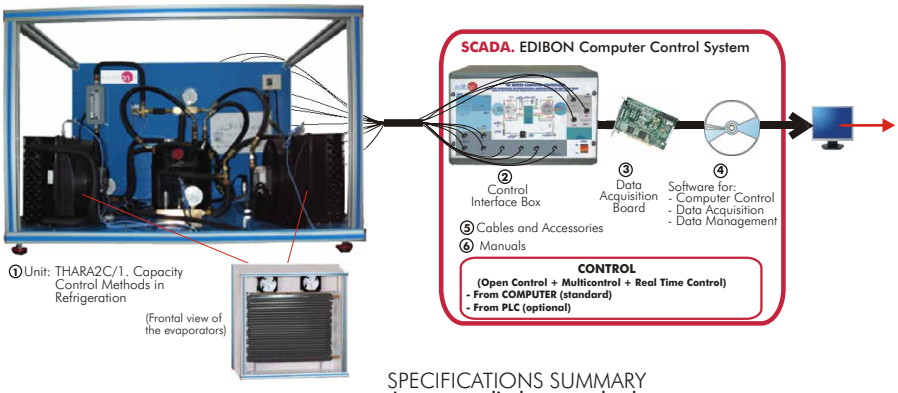
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
4.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.
5.- Energy balances.

Other possible practices:

6.- Temperature sensors calibration.
7.- Flow sensors calibration.
8.- Pressure sensors calibration.
9-27.- Practices with PLC.

✱ Non computer controlled version available too.

THARA2C/1. Computer Controlled **Capacity Control Methods in Refrigeration**



SPECIFICATIONS SUMMARY

Items supplied as standard

① THARA2C/1. Unit:
Computer controlled unit for capacity control in refrigeration engineering. Various types of capacity control can be studied. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Compressor with adjustable speed. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid.
2 Insulated cooling chambers, each one with electric heater and air evaporator with 2 fans, (computer controlled).
One of the evaporators with additional defrosting Heater.
Manometers. Temperature sensors at: compressor outlet/inlet, condenser outlet, evaporators inlet, evaporators outlet.
Temperature sensor (room air). Pressure sensors. Pressure controller. Wattmeter.
Enthalpy diagram of the refrigerant R134a.

② THARA2C/1/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THARA2C/1/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1100 x 700 x 1100 mm. Weight: 100 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

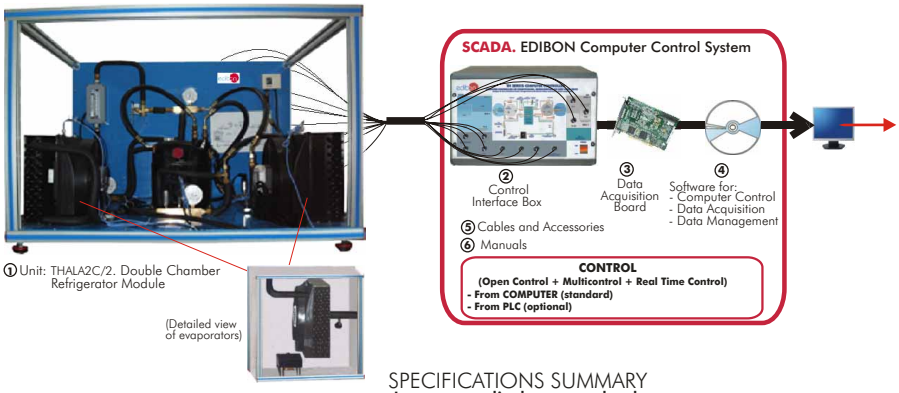
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARA2C-1.pdf

PRACTICAL POSSIBILITIES

1.- Study of refrigerant circuit with two evaporators.
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source.
3.- Effect of the compressor speed on the system cooling capacity.
4.- Preparation of performances curves of the unit at different inlet and outlet temperatures. Air as a heat source.
5.- Study of various types of capacity regulation via temperature.
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
7.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

Other possible practices:
8.- Temperature sensors calibration.
9.- Pressure sensors calibration.
10-28.- Practices with PLC.

THARA2C/2. Computer Controlled **Double Chamber Refrigerator Module**



SPECIFICATIONS SUMMARY

Items supplied as standard

① THARA2C/2. Unit:
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Compressor, computer controlled. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid.
2 Closed cooling chambers, each one with electric heater and air evaporator (computer controlled). Manometers. 3 expansion elements: 2 expansion valves and capillary tube.
Temperature sensors. Pressure sensors. Pressure controller. Wattmeter.
Enthalpy diagram of the refrigerant R134a.

② THARA2C/2/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THARA2C/2/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1000 x 600 x 1000 mm. Weight: 70 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARA2C-2.pdf

PRACTICAL POSSIBILITIES

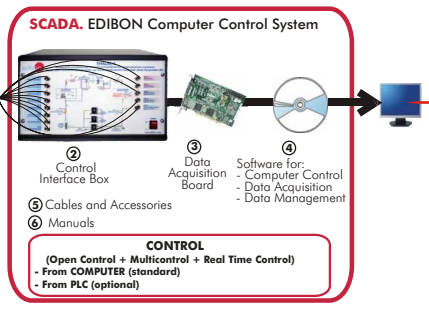
1.- Familiarisation with a cooling system and its main components.
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source.
3.- Series and parallel operation of an evaporator.
4.- Cyclic process on the p-h state diagram.
5.- Preparation of performances curves of the unit at different inlet and outlet temperatures. Air as a heat source.
6.- Fault finding and simulation.
7.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
8.- Familiarisation with various expansion elements:
Capillary tube. Expansion valve.
9.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.
10.- Effects of a cooling load.

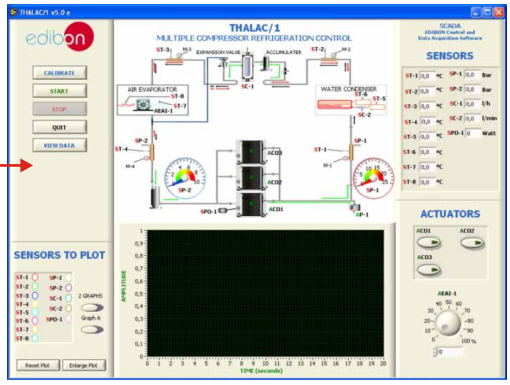
Other possible practices:
11.- Temperature sensors calibration.
12.- Pressure sensors calibration.
13-31.- Practices with PLC.

➤General Refrigeration

THALAC/1. Computer Controlled **Multiple Compressor Refrigeration Control**

① Unit: THALAC/1. Multiple Compressor Refrigeration Control





SPECIFICATIONS SUMMARY
Items supplied as standard

①THALAC/1. Unit:
Refrigeration unit for the demonstration of the combined operation of compressors. The multiple compressor refrigeration control unit has the goal of introducing the student into the complex world of installing heat pumps, as well as the study and calculation of the characteristic operating parameters of the unit in relation to the environmental demands (heat, temperature, refrigeration, etc.).
Anodized aluminium structure and panels in painted steel. Diagram in the front panel.
3 Cooling compressors, computer controlled. This compound system is controlled so that individual compressor can be switched depending on the performance. Water condenser. Coolant accumulation tank. Cooling filter. Expansion valve.
Air evaporator, computer controlled. Tank of division of the cooling liquid. 2 Low and 2 High pressure manometers.
High pressure control: Pressure switch.
8 Temperature sensors type in different points in the unit. 2 Flow sensors: cooling flow sensor and water flow sensor (condenser). 2 Pressure sensors: high pressure sensor and low pressure sensor.
Power measurement form the computer (PC). Enthalpy diagram of the refrigerant R134a.

②THALAC/1/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THALAC/1/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1000 x 600 x 600 mm. Weight: 100 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

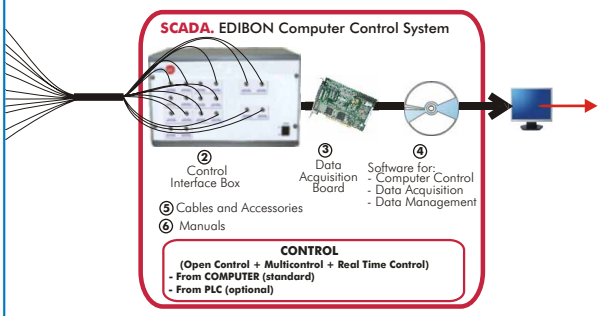
PRACTICAL POSSIBILITIES

1.- Combined operation of compressors: Power measurement. Comparison of the energy for operating individual compressor and multiple compressors.
2.- Cyclic process on the p-h state diagram.
3.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
4.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Air as heat source.
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
6.- Effect of refrigerant supercooling.
7.- Effect of the airflow rate on the condenser performance.
8.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.
9.- Energy balances.
Other possible practices:
10.- Temperature sensors calibration.
11.- Flow sensors calibration.
12.- Pressure sensors calibration.
13-31.- Practices with PLC.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THALAC-1.pdf

TCPISC. Computer Controlled **Cooling Plant with Ice Store**

① Unit: TCPISC. Cooling Plant with Ice Store



SPECIFICATIONS SUMMARY
Items supplied as standard

①TCPISC. Unit:
Cooling plant at teaching and industrial level, with modular design, and computer controlled. Plant with ice store, wet cooling tower and dry cooler.
Anodized aluminium and steel structures. Main metallic elements in stainless steel. Diagram in the front panel.
The different units (modules) connected with hoses. Refrigeration circuit (condenser, evaporator, compressor) and pumps. Wet cooling tower. Dry cooler. Using valves different operating modes can be configured. Ice tank. Liquid tank. High pressure control. Manometers. Temperature sensors. Flow sensors. Pressure sensors. Wattmeter. Refrigerant R134a. Connecting hoses.

②TCPISC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TCPISC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

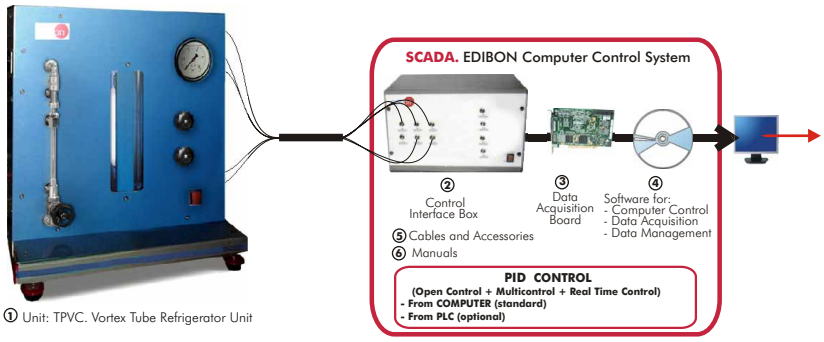
PRACTICAL POSSIBILITIES

1.- Thermodynamics investigation of a refrigeration process on a p-h state diagram.
2.- Energy balances.
3.- Determination of the refrigerating capacity.
4.- Determination of the coefficient of performance.
5.- Determination of the process parameters.
6.- Function of the elements in a cyclic process.
7.- Function of an ice store.
8.- Performance of an ice store.
9.- Function and performance of a cooling tower.
10.- Demonstration of a batch cooling and batch heating process.
11.- Mass balance. Use of psychrometric charts.
12.- Comparison of dry cooling performance with evaporative cooling under the same load conditions.
13.- Investigation flow and batch processes.
14.- Performance curves.
15.- Investigation of cooling processes.
Other possible practices:
16.- Temperature sensors calibration.
17.- Flow sensors calibration.
18.- Pressure sensors calibration.
19-37.- Practices with PLC.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TCPISC.pdf

➤Special Refrigeration

TPVC. Computer Controlled **Vortex Tube Refrigerator Unit**



① Unit: TPVC. Vortex Tube Refrigerator Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① TPVC. Unit:

Unit for use with compressed air or other suitable gas. Bench top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Vortex tube, rated at 300 l./min. at 700kN m^{-2} approx. Pressure regulator and filter, to supply clean and pressure stable air. Heat exchanger: concentric tube, contra flow. 2 valves for isolation and balance. Flow sensors, for cold air and hot air. Temperature sensors. Pressure sensor. Control valves.

②TPVC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TPVC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

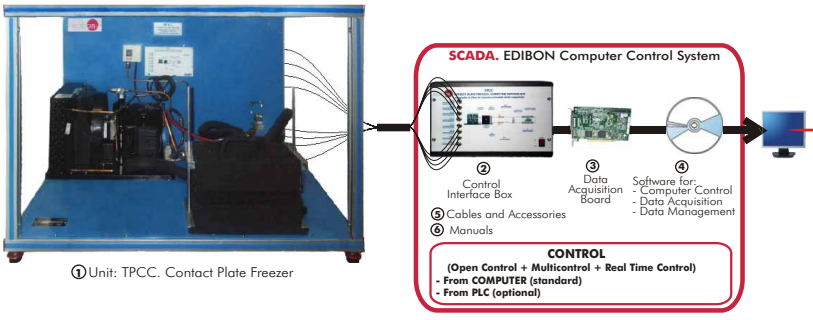
Dimensions (approx.) = Unit: 700 x 400 x 800 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TPVC.pdf

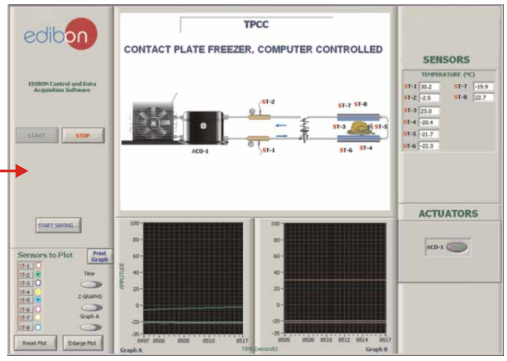
PRACTICAL POSSIBILITIES

1.- Demonstration of the ability to produce hot and cold air from a device with no moving parts.
2.- Production of performance curves for a vortex tube with variation of inlet pressure.
3.- Production of performance curves for a vortex tube with variation of hot and cold gas ratios.
4.- Production of performance curves for a vortex tube with variation of gas (if available).
5.- Determination of refrigerating effect and comparison of this with the estimated power needed to drive the compressor.
6.- Sensors calibration.
7-25.- Practices with PLC.

TPCC. Computer Controlled **Contact Plate Freezer**



① Unit: TPCC. Contact Plate Freezer



SPECIFICATIONS SUMMARY

Items supplied as standard

① TPCC. Unit:

The TPCC unit has as aim to introduce the students to quick freezing processes, to their advantages compared with conventional freezing processes, as well as to proceed to the study of the thermodynamic process, through which such freezing is obtained. Basically, this unit is made up of a refrigeration circuit. The unit has been designed to observe the thermodynamic changes occured during the process, for a given coolant, allowing the study of the refrigeration cycle.

Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit. Coolant compressor. Air condenser. High pressure control. Coolant accumulation tank. Expansion valve. Four-way valve. Evaporator-freezer, with two freezing plates of 180 mm x 280 mm. Plate temperature (both plates): <-35ºC.

8 Temperature sensors: 2 temperature sensors (temperature measurement of the coolant) and 6 temperature sensors (temperature measurement of the food). 2 Manometers. Enthalpy diagram of the coolant R404a.

② TPCC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TPCC /CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 90 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TPCC.pdf

PRACTICAL POSSIBILITIES

1.- Study of industrial freezing process.
2.- Study of food preservation.
3.- Study the effect of freezing on food.
4.- Investigate the effect on the freezing process of parameters such as the shape of the product, portion size, the packaging, etc.
5.- To evaluate the difference between fast freezing and domestic freezing.
6.- Freezing rates.
7.- Study of fast freezing vs slow freezing.
8.- Temperature sensing.
9.- Taste and texture assessments.
10.- Study of the deep-freezing process effect: structural.
11.- Study of the deep-freezing process effect: compositional.
12.- Study of the deep-freezing process effect: sensorial.
13.- Study of the thermal process.
14.- Study the effect of the temperature on bacteria.
15.- Quality control.
16.- Quality assurance.
17.- Freezing curves analysis.
18.- Links with Physics (refrigeration) and with Biology (food structure).

Other possible practices:

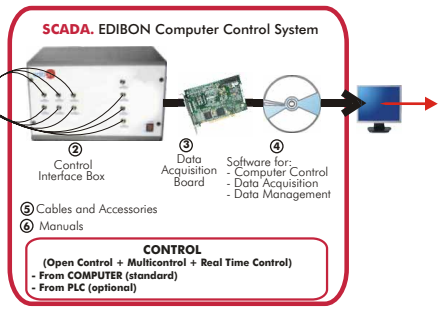
19.- Sensors calibration.
20-38.- Practices with PLC.

9.1- Refrigeration

➤Special Refrigeration

TEVC. Computer Controlled **Ventilation Trainer**

① Unit:TEVC. Ventilation Trainer



SPECIFICATIONS SUMMARY

Items supplied as standard

① TEVC. Unit:
This ventilation training unit enables students to study basic airflow and fluid mechanics as well as process of commissioning and balancing a multiducted air distribution system.
Metallic structure. Diagram in the front panel with similar distribution to the elements in the real unit.
Variable speed centrifugal fan, computer controlled. Rectangular air intake and filter holder.
The fan discharges into a 200 mm diameter steel duct and this connects to distribution ductwork. Connections and ductwork are manufactured in steel and may be connected in different forms. The ductwork is supported from air distribution isolation mounts hung on steel pedestals linked towether.
Necessary components are supplied with the unit to enable parallel branch and line balancing experiments to be undertaken.
Air power supply points are provide that may be balanced on the assembled unit to supply a range of airflows. Pressure sensors. Flow sensors. Pitot static tube.

② TEVC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TEVC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 10000 x 3000 x 2000 mm. Weight: 300 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TEVC.pdf

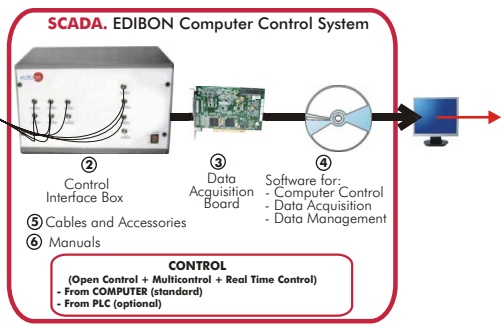
PRACTICAL POSSIBILITIES

1.- Examination of typical components, fabrication, installation and assembly techniques used in air handling systems.
2.- Investigation of pressure losses in beds, branches, changes of section and over straight lengths of duct, together with the variation in pressure drop with velocity.
3.- Measurement of air flow rate using pitot-static traverse, orifice pressure differential and anemometer methods.
4.- Examination of standard types of panel an bag filters and their pressure drop against face velocity.
5.- Determination of the "k" factor for the pressure loss of the above components in each particular configuration.
6.- Investigation of the fan pressure and volume flow characteristics at various supply voltages.
7.- Balancing of air flow distribution in a series or two branch parallel distribution system using either main damper or fan speed flow control.
8.- Allows an additional parallel branch and two diffusers to be investigated.
9.- Addition of the ductwork leakage test set allows students to carry out commissioning leak testing on the above components.
10.- Allows an additional tee branch and two diffusers to be investigated.
11.- Sensors calibration.
12-30.- Practices with PLC.

9.3- Heating

EACC. Computer Controlled **Hot Water Production and Heating Teaching Unit**

①Unit: EACC. Hot Water Production and Heating Teaching Unit



SPECIFICATIONS SUMMARY

Items supplied as standard

① EACC. Unit:
This unit has as objectives: to produce hot water heating and similar uses; hot water production for a sanitary use, industrial use, etc.
Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.
In order to make it easier, and being given that the process can be exhaustively analysed, we will just produce hot water maximum up to 95°C. The unit has a fuel portable deposit, burner, boiler with exchanger, accumulator and hot water exit. The whole system is computer controlled through a control interface, which controls the following parameters: fuel control (consumption), smokes temperature, boiler temperature, sanitary water temperature, heating water temperature, net water temperature, burner aspiration pressure, quantity of CO_2 and CO.
Automatic burner for 25,000 Kcal/h. Acceleration pump. Stainless steel accumulator of 140 l. Three ways engine motorized valve. Sheet chimney. Closed expansion deposit. Sensors of temperature, pressure and flow.

② EACC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EACC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heating/EACC.pdf

PRACTICAL POSSIBILITIES

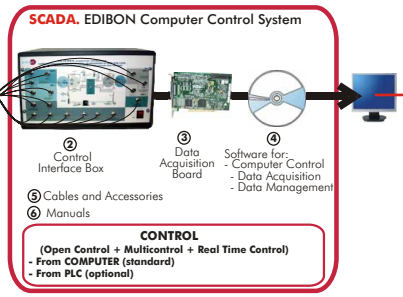
1.- Determination of the flow and fuel consumption.
2.- Determination of the boiler's temperature.
3.- Determination of the heating water exit temperature.
4.- Determination of the sanitary water exit temperature.
5.- Determination of the net water exit temperature.
6.- Determination of the burner aspiration pressure.
7.- Energy balance of the heating circuit.
8.- Energy balance of the sanitary water circuit.
9.- Influence of the aspiration pressure in the efficiency.
10.- Variation of the exhaust gases, in function of the combustion quality.

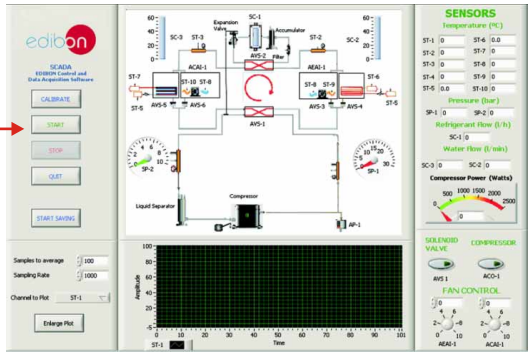
Other possible practices:
11.- Sensors calibration.
12-30.- Practices with PLC.

➤General Heat Pumps

THIBAR22C. Computer Controlled **Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve** (two condensers (water and air) and two evaporators (water and air))✱

① Unit: THIBAR22C. Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve (two condensers (water and air) and two evaporators (water and air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THIBAR22C. Unit:

Bench-top unit.
Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled.
Air condenser, computer controlled.
Water condenser.
High pressure control.
Coolant accumulation tank.
Cooling filter.
Tank of division of the cooling liquid.
Expansion valve.
Water evaporator.
Air evaporator, computer controlled
4 Manometers.
10 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature, 3 sensors measure the air temperature):
- Temperature sensor, J type (compressor outlet).
- Temperature sensor, J type (condenser outlet/ evaporator inlet).
- Temperature sensor, J type (evaporator inlet/ condenser outlet).
- Temperature sensor, J type (compressor inlet).
- Temperature sensor, J type (water inlet).
- Temperature sensor, J type (condenser outlet/evaporator).
- Temperature sensor, J type (evaporator outlet/ condenser).
- Temperature sensor, J type (room air).
- Temperature sensor, J type (condenser outlet/ evaporator).
- Temperature sensor, J type (evaporator outlet/ condenser).

3 Flow sensors:
- Cooling flow sensor.
- Water flow sensor (water condenser).
- Water flow sensor (water evaporator).

2 Pressure sensors:
- Cooling pressure sensor (compressor outlet).
- Cooling pressure sensor (compressor inlet).

Wattmeter.
Cycle Inversion valve. 4-way valve.
Enthalpy diagram of the refrigerant R134a.

② THIBAR22C/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s . 2 Analog outputs. 24 Digital Inputs/Outputs.

④ THIBAR22C/CCSOF. Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 100 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THIBAR22C.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air heat pump).
3.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Air-air heat pump).
4.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air- water heat pump).
5.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Water-water heat pump).
6.- Preparation of performance curves of the heat pump at different inlet and outlet temperatures. Air as a heat source. (Water-air heat pump).
7.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Air-water heat pump).
8.- Preparation of the performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source. (Air-air heat pump).
9.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water heat pump).
10.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air heat pump).
11.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water heat pump).
12.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air heat pump).
13.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water heat pump).
14.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air heat pump).
15.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Air-water heat pump).
16.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air- air heat pump).
17.- Practices with cycle inversion.

Other possible practices:

18.- Temperature sensors calibration.
19.- Flow sensors calibration.
20.- Refrigerant flow sensor.
21.- Pressure sensors calibration.
22-40.- Practices with PLC.

Other available Unit:

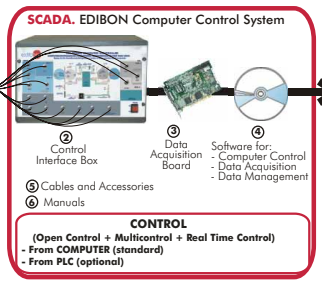
THIBAR44C. Computer Controlled **Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve** (four condensers (two of water and two of air) and four evaporators (two of water and two of air))✱

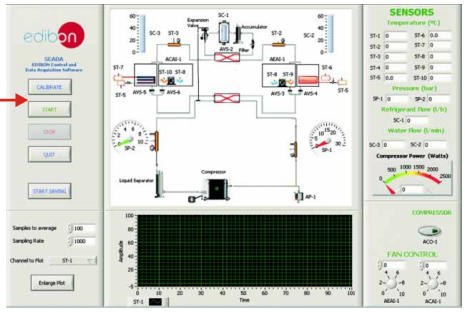
✱ Non computer controlled version available too.

➤General Heat Pumps

THB22C. Computer Controlled **Heat Pump Unit** (two condensers (water and air) and two evaporators (water and air)) ✱

① Unit: THB22C. Heat Pump Unit (two condensers (water and air) and two evaporators (water and air))





PRACTICAL POSSIBILITIES

SPECIFICATIONS SUMMARY

Items supplied as standard

①THB22C. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Water evaporator. Air evaporator, computer controlled. Tank of division of the cooling liquid. 4 Manometers.
10 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature and 3 sensors measure the air temperature). 3 Flow sensors: cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THB22C/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THB22C/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

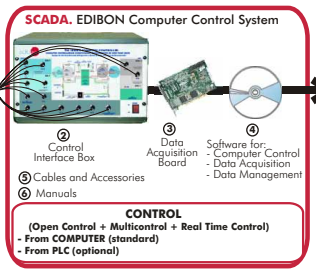
Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 100 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

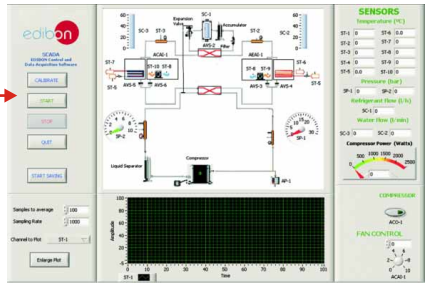
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THB22C.pdf

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air heat pump).
3.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Air-air heat pump).
4.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air- water heat pump).
5.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Water-water heat pump).
6.- Preparation of performance curves of the heat pump at different inlet and outlet temperatures. Air as a heat pump. (Water-air heat pump).
7.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Air-water heat pump).
8.- Preparation of the performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source. (Air-air heat pump).
9.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water heat pump).
10.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air heat pump).
11.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water heat pump).
12.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air heat pump).
13.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water heat pump).
14.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air heat pump).
15.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Air-water heat pump).
16.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air- air heat pump).
Other possible practices:
17.- Temperature sensors calibration.
18.- Water flow sensors calibration.
19.- Refrigerant flow sensor.
20.- Pressure sensors calibration.
21-39.- Practices with PLC.

THB2LC. Computer Controlled **Heat Pump Unit** (two condensers (water and air) and one evaporator (water)) ✱

① Unit: THB2LC. Heat Pump Unit (two condensers (water and air) and one evaporator (water))





PRACTICAL POSSIBILITIES

SPECIFICATIONS SUMMARY

Items supplied as standard

①THB2LC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel.
Cooling compressor, computer controlled. Water condenser. Air condenser, computer controlled. Water evaporator. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.
9 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperatures and 2 sensors measure the air temperature). 3 Flow sensors: cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THB2LC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THB2LC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

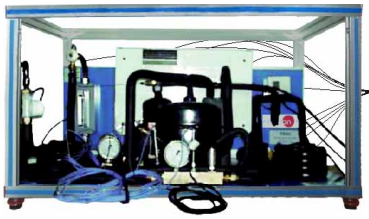
Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 85 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THB2LC.pdf

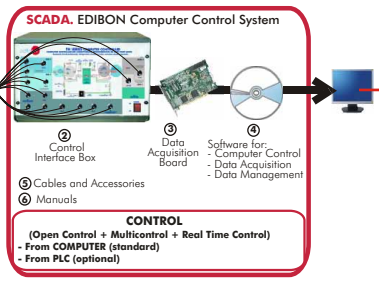
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air-water heat pump).
3.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Water-water heat pump).
4.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Air-water heat pump).
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water heat pump).
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water heat pump).
7.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water heat pump).
8.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air-water heat pump).
Other possible practices:
9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

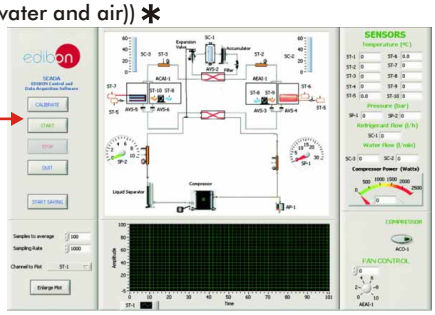
✱ Non computer controlled version available too.

THBL2C. Computer Controlled **Heat Pump Unit** (one condenser (water) and two evaporators (water and air)) ✱



① Unit: THBL2C. Heat Pump Unit (one condenser (water) and two evaporators (water and air))





PRACTICAL POSSIBILITIES

SPECIFICATIONS SUMMARY
Items supplied as standard

①THBL2C. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Water condenser. Air evaporator, computer controlled. Water evaporator. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.

9 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature and 2 sensors measure the air temperature).

3 Flow sensors: cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet).

Wattmeter. Enthalpy diagram of the refrigerant R134a.

②THBL2C/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THBL2C/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

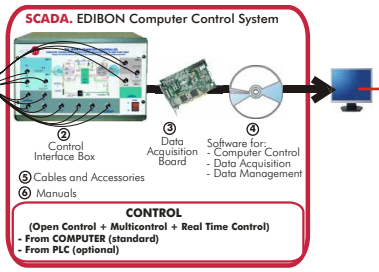
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBL2C.pdf

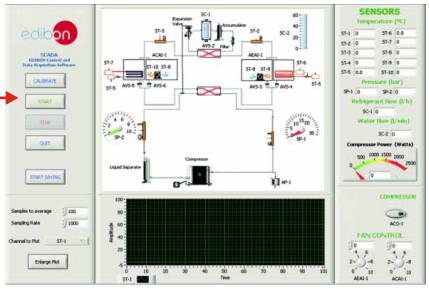
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
3.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source.
4.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source.
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
7.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.
8.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

Other possible practices:
9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

THBA2C. Computer Controlled **Heat Pump Unit** (one condenser (air) and two evaporators (water and air)) ✱

① Unit: THBA2C. Heat Pump Unit (one condenser (air) and two evaporators (water and air))





PRACTICAL POSSIBILITIES

SPECIFICATIONS SUMMARY
Items supplied as standard

①THBA2C. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Water evaporator. Air evaporator, computer controlled. Tank of division of the cooling liquid. 4 Manometers.

9 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 3 sensors measure the air temperature). 2 Flow sensors: cooling flow sensor and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.

Enthalpy diagram of the refrigerant R134a.

②THBA2C/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THBA2C/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBA2C.pdf

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
3.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source.
4.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source.
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
7.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.
8.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

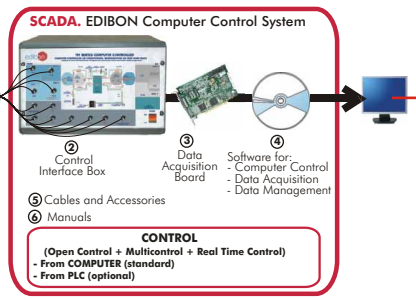
Other possible practices:
9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

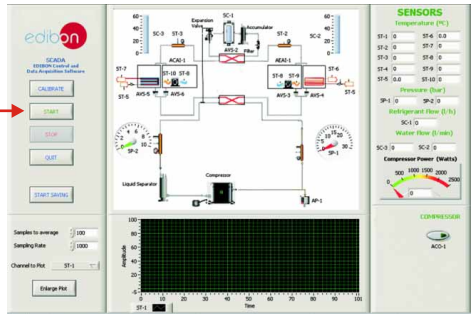
✱ Non computer controlled version available too.

➤General Heat Pumps

THBLLC. Computer Controlled **Heat Pump Unit** (one condenser (water) and one evaporator (water)) ✱

①Unit: THBLLC. Heat Pump Unit (one condenser (water) and one evaporator (water))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THBLLC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Water evaporator. Tank of division of the cooling liquid. 4 Manometers.
7 Temperature sensors (4 sensors measure the cooling temperature and 3 sensors measure the water temperature).
3 Flow sensors: cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THBLLC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THBLLC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBLLC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.

2.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source.

3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.

4.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.

Other possible practices:

5.- Temperature sensors calibration.

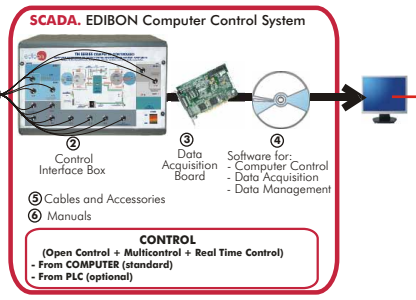
6.- Flow sensors calibration.

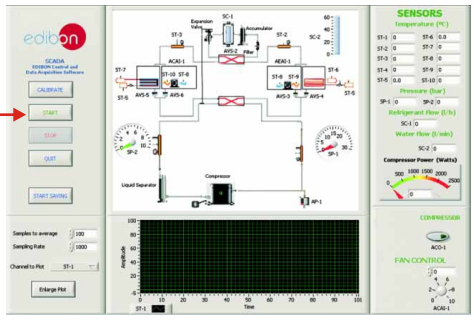
7.- Pressure sensors calibration.

8-26.- Practices with PLC.

THBALC. Computer Controlled **Heat Pump Unit** (one condenser (air) and one evaporator (water)) ✱

①Unit: THBALC. Heat Pump Unit (one condenser (air) and one evaporator (water))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THBALC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Water evaporator. Tank of division of the cooling liquid. 4 Manometers.
8 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 2 sensors measure the air temperature).
2 Flow sensors: cooling flow sensor and water flow sensor. 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THBALC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THBALC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBALC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.

2.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source.

3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source.

4.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source.

5.- Energy balances.

Other possible practices:

6.- Temperature sensors calibration.

7.- Flow sensors calibration.

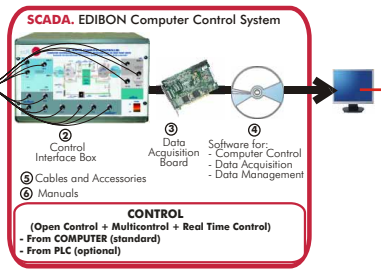
8.- Pressure sensors calibration.

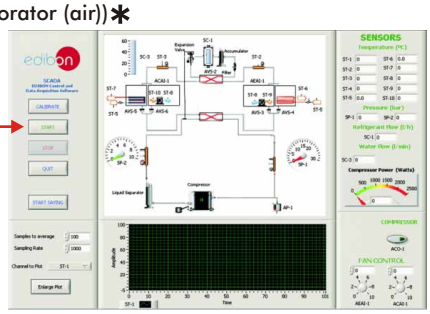
9-27.- Practices with PLC.

✱ Non computer controlled version available too.

THB2AC. Computer Controlled **Heat Pump Unit** (two condensers (water and air) and one evaporator (air))*

①Unit: THB2AC. Heat Pump Unit (two condensers (water and air) and one evaporator (air))





PRACTICAL POSSIBILITIES

SPECIFICATIONS SUMMARY

Items supplied as standard

①THB2AC. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Air condenser, computer controlled. Water condenser. Air evaporator, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.

9 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 3 sensors measure the air temperature).

2 Flow sensors: cooling flow sensor and water flow sensor (water condenser). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet).

Wattmeter.

Enthalpy diagram of the refrigerant R134a.

②THB2AC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THB2AC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THB2AC.pdf

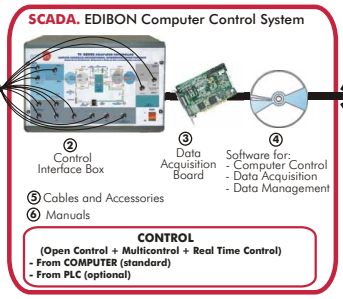
1.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source. (Water-air heat pump).
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source. (Air-air heat pump).
3.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source. (Water-air heat pump).
4.- Preparation of performance curves of the heat pump at different inlet and outlet temperatures. Air as heat source. (Air-air heat pump).
5.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air heat pump).
6.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air heat pump).
7.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air heat pump).
8.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air- air heat pump).

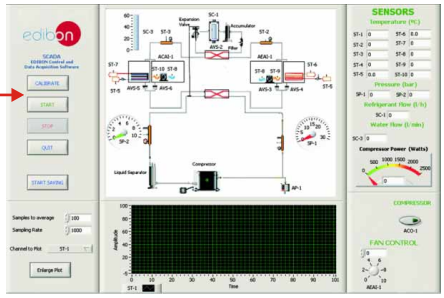
Other possible practices:

9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

THBLAC. Computer Controlled **Heat Pump Unit** (one condenser (water) and one evaporator (air))*

①Unit: THBLAC. Heat Pump Unit (one condenser (water) and one evaporator (air))





PRACTICAL POSSIBILITIES

SPECIFICATIONS SUMMARY

Items supplied as standard

①THBLAC. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Air evaporator, computer controlled. Tank of division of the cooling liquid. 4 Manometers.

8 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 2 sensors measure the air temperature).

2 Flow sensors: cooling flow sensor and water flow sensor (water condenser). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.

Enthalpy diagram of the refrigerant R134a.

②THBLAC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THBLAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBLAC.pdf

1.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
2.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
4.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.
5.- Energy balances.

Other possible practices:

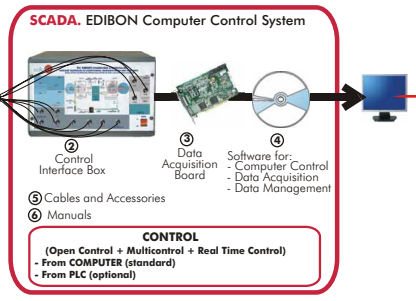
6.- Temperature sensors calibration.
7.- Flow sensors calibration.
8.- Pressure sensors calibration.
9-27.- Practices with PLC.

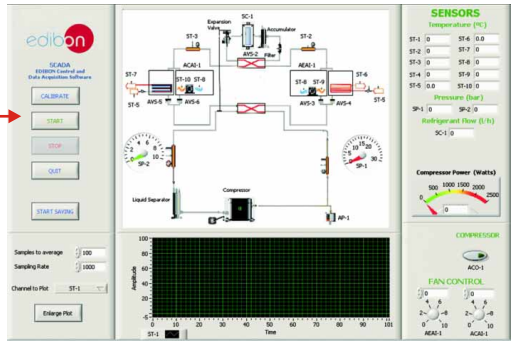
* Non computer controlled version available too.

➤General Heat Pumps

THBAAC. Computer Controlled **Heat Pump Unit** (one condenser (air) and one evaporator (air)) ✱

① Unit: THBAAC. Heat Pump Unit (one condenser (air) and one evaporator (air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THBAAC. Unit:
Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. Air evaporator, computer controlled. 4 Manometers.
7 Temperature sensors (4 sensors measure the cooling temperature and 3 sensors measure the air temperature). Flow sensor. 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter. Enthalpy diagram of the refrigerant R134a.

②THBAAC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and th the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THBAAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBAAC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source.
2.- Preparation of performances curves of the heat pump at different inlet and outlet temperatures. Air as a heat pump.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.
4.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

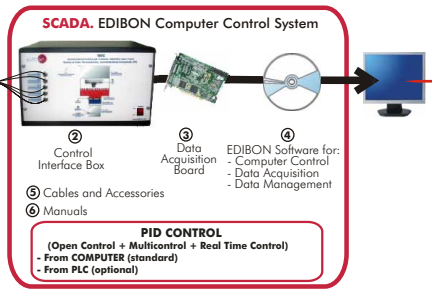
Other possible practices:

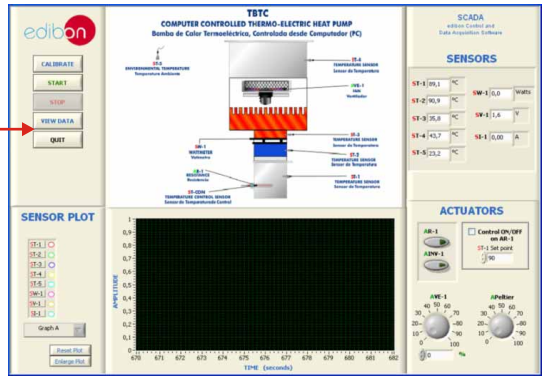
5.- Temperature sensors calibration.
6.- Flow sensor calibration.
7.- Pressure sensors calibration.
8-26.- Practices with PLC.

➤Special Heat Pumps

TBTC. Computer Controlled **Thermo-Electric Heat Pump**

① Unit: TBTC. Thermo-Electric Heat Pump





SPECIFICATIONS SUMMARY

Items supplied as standard

① TBTC. Unit:
The Thermo-Electric Heat Pump (TBTC) allows the study of different phenomena in which heat and electricity take place (Thermoelectricity). Some of them are the Peltier effect, the Thomson or Lenz effect and the Seebeck effect. The application of the Peltier effect as a refrigeration method can also be studied. We will be able to carry out with this unit the study and use of a Peltier element as a heat pump and for the refrigeration.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel.
Thermoelectric module-Peltier device mounted over two sides.
Electric heating resistance on the cold side of the module, covered by a thermally insulated conductor made of stainless steel.
Heatsink and a fan on the hot side of the module. They are placed inside an insulated box.
Heat transfer rate up to 89W.
Heating resistance (100W, 230V), computer controlled. Fan, computer controlled. Air flow regulation. Heatsink.
Energy/power supply to the thermoelectric module, computer controlled, mounted internally. (Power supply of 12V). Polarity reverser.
5 Temperature sensors at different points, to measure the temperature in the hot side, in the cold side and the environment temperature. Sensors to measure voltage, current and power related to the power supply to the thermoelectric module.
Measurement of the voltage generated by the thermoelectric module.

② TBTC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TBTC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 500 x 400 x 550 mm. Weight: 20 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/TBTC.pdf

PRACTICAL POSSIBILITIES

1.- Investigation of the effects upon the surface temperature of either face of the module with increasing power supply (Peltier Effect).
2.- Investigation of the effect upon heat transfer of reversing the polarity of the power supply (Thomson or Lenz Effect).
3.- Investigation of the variation in open circuit voltage across the module due to the variation in surface temperature difference (Seebeck Effect).
4.- Estimation of the module's efficiency coefficient acting as refrigerator (Cop).
5.- Energy balance.

Other possible practices:

6.- Sensors calibration.
7-25.- Practices with PLC.

✱ Non computer controlled version available too.

➤Special Heat Pumps

TBCF. **Bomb Calorimeter Set for Testing Calorific Value of Fuels**

SPECIFICATIONS SUMMARY

The TBCF has been designed for the accurate determination of the calorific value of liquid and solid hydrocarbons and other fuels. The unit is self contained with the control unit housed in an instrument case.

Calorimeter for testing calorific value of fuels, including:

- Main metallic elements in stainless steel.
- Diagram in the front panel with similar distribution to the elements in the real unit.
- Bomb.
- Calorimeter vessel.
- Double walled outer vessel.
- Electric stirrer gear.
- Combined motor control and ignition unit.
- Beckman thermometer.
- Charging unit with pressure gauges.
- Two Vitreosil and one nickel crucibles.
- Reel of Nichrome wire.
- Charging unit furnised with pressure gauges.

Cables and accessories, for normal operation.

Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 500 x 400 x 1000 mm. Weight: 40 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/TBCF.pdf

PRACTICAL POSSIBILITIES

1.- To calculate amount of electric energy for heat capacity measurement.

2.- Perform experiments to measure heats of reactions.

3.- To calculate the heats of reactions from experimental results.

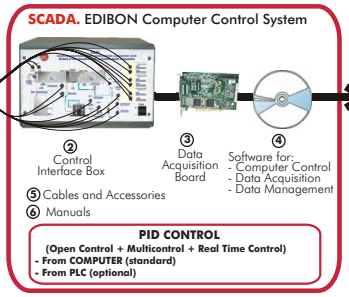
4.- To calculate internal energies of reactions from bomb calorimeter experiments.

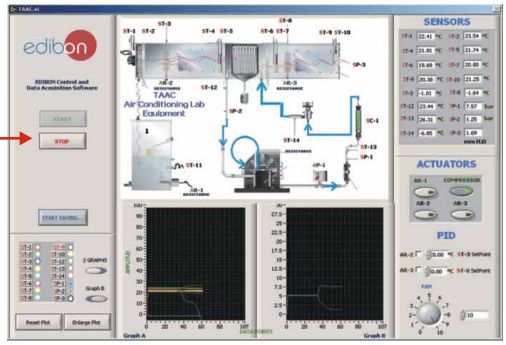
5.- To calculate enthalpies of reactions from bomb calorimetry experiments.

➤General Air Conditioning

TAAC. Computer Controlled **Air Conditioning Laboratory Unit** ✱

① Unit: TAAC. Air Conditioning Laboratory Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

①TAAC. Unit:
This unit has as objective to introduce the student in the world of the air conditioning installations, as well as to study and determine the good parameters for the unit operation in function of the environmental demands (humidity, heat, temperature and refrigeration, etc).
Diagram in the front panel with similar distribution to the elements in the real unit. Tunnel of 300 x 300 x 1600 mm., made in stainless steel with 2 windows of 200 x 300 mm. to visualize the tunnel inside. 2 Electrical heating resistances (computer controlled): one of 2000W (pre-heater) to the inlet of the evaporator and other of 1000 W (re-heater) to the outlet of the evaporator. 4 Hygrometers placed along the tunnel, formed each one by 2 temperature sensors (wet and dry bulb). Fan, with speed control from computer. Evaporator. Compressor. Condenser unit. High-pressure cut-out. Filter dryer.
Sensors included:
Flow meter and refrigerant flow sensor. Temperature (11): 4 dry bulb, 4 wet bulb, 1 inlet of the evaporator, 1 outlet of the evaporator, 1 outlet of the condenser. Pressure (3): 1 sensor (outlet of the condenser), 1 sensor (inlet of the condenser), 1 differential sensor (measure of flow). 1 bourdon manometer (outlet of the condenser), 1 bourdon manometer (inlet of the evaporator), 1 bourdon manometer (outlet of the evaporator).
Psychometric chart and Enthalpy diagram of R134a.

②TAAC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TAAC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1600 x 570 x 1500 mm. Weight: 200 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/TAAC.pdf

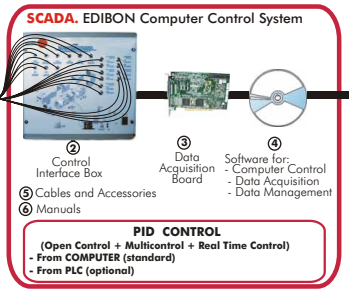
PRACTICAL POSSIBILITIES

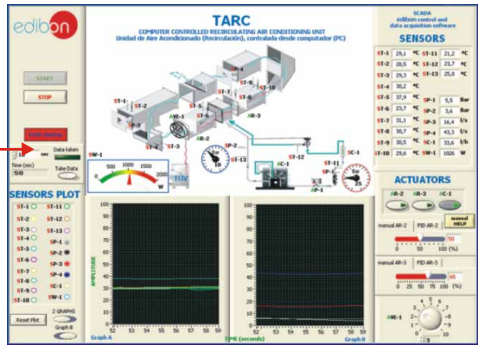
1.- Demonstration of the processes and components used in heating, cooling, humidification, de-humidification of an airstream.
2.- Obtaining of the steam generator efficiency curve.
3.- Energy balance in the steam generator.
4.- Efficiency determination of the preheating resistance.
5.- Preheating effect in an air conditioning installation.
6.- Dehumidification process study.
7.- Material balance in the evaporator.
8.- Energy balance in the evaporator.
9.- Re-heat effect.
10.- Experimental determination of the air specific heating capacity.

Other possible practices:
11.- Psychrometric chart.
12.- Example of the air properties determination.
13.- Usage of psychrometric chart.
14.- Determination of the airflow.
15.- Temperature sensors calibration.
16.- Pressure sensors calibration.
17.- Determination of a PWM controller adjustment parameters.
18.- Properties of the Refrigerant R134a.
19.- Enthalpy-Pressure diagram for the refrigerant R134a.
20-38.- Practice with PLC.

TARC. Computer Controlled **Recirculating Air Conditioning Unit** ✱

① Unit: TARC. Recirculating Air Conditioning Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

①TARC. Unit:
This unit has as objective to introduce the student in the world of the air conditioning installations, as well as to study and determine the good parameters for the unit operation in function of the environmental demands (humidity, heat, temperature and refrigeration, etc). It allows to work with recirculaing air and fresh air modes.
Diagram in the front panel with similar distribution to the elements in the real unit.
Tunnel made in stainless steel of 300 x 300 x 4000 mm., in which there has been installed 4 windows of 200 x 300 mm. to visualize the tunnel inside. 2 Electrical heating resistances, computer controlled: one of 2000W (pre-heater) at the inlet of the evaporator and other of 1000W (re-heater) at the outlet of the evaporator. Axial fan, with speed control from computer. Evaporator. Condenser unit, composed by: compressor, computer controlled, condenser. High-pressure cut-out. Filter dryer.
Sensors included:
Flow meter and refrigerant flow sensor. 5 Hygrometers, placed along the tunnel, formed each one by 2 temperature sensors (wet and dry bulb). 3 of Temperature in the refrigeration circuit: 1 temperature sensor (evaporator inlet), 1 temperature sensor (evaporator outlet) and 1 temperature sensor (condenser outlet). 4 of Pressure: high pressure sensor (condenser outlet), low pressure sensor (condenser inlet), very low pressure sensor 0-1 water inch., very low pressure sensor 0-1 water inch. 3 Bourdon manometers: two of 10 bar and one of 25 bar.
With the trapdoor we can adjust the percentage of recirculating air.
Psychrometric chart and Enthalpy diagram of R134a.

②TARC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TARC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 2100 x 1100 x 1700 mm. Weight: 250 Kg. Control Interface: 490 x 450 x 470 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/TARC.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of the processes of air heating, cooling, humidification, de-humidification, recirculating and mixing.
2.- Efficiency determination of the preheating resistance.
3.- Preheating effect in an air conditioning installation.
4.- De-humidification process study.
5.- Material balance in the evaporator.
6.- Energy balance in the evaporator.
7.- Re-heat effect.
8.- Dehumidification process study recirculating air.
9.- Experimental determination of the air specific heating capacity.
10.- Demonstration of recirculating and the "adiabatic" mixing of two air streams at different states.
11.- It enables the condensate formed during de-humidification to be compared with that expected from the change of air properties across the evaporator.
12.- Comparison of the heat transfer at the boiler with the enthalpy increase of the air during steam injection.
13.- Obtaining of the steam generator efficiency curve.
14.- Energy balance in the steam generator.

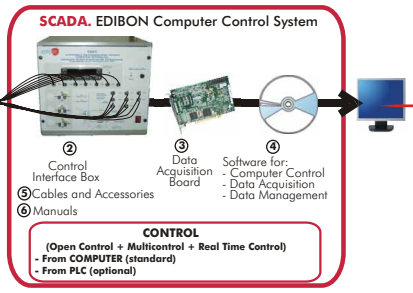
Other possible practices:
15.- Sensors calibration.
16.- Psychrometric chart.
17.- Determingtion of the airflow.
18.- Example of the air properties determination.
19.- Usage of psychrometric chart.
20.- Properties of the Refrigerant R134a.
21.- Enthalpy-Pressure diagram for the refrigerant R134a.
22-40.- Practice with PLC.

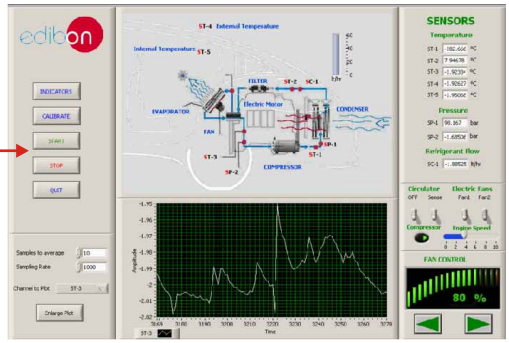
✱ Non computer controlled version available too.

➤General Air Conditioning

TAAUC. Computer Controlled **Automobile Air Conditioning Trainer** ✱

① Unit: TAAUC. Automobile Air Conditioning Trainer





SPECIFICATIONS SUMMARY

Items supplied as standard

①TAAUC. Unit:

The automobile air conditioning unit (TAAUC) introduces the student into the world of the air conditioning installations, as well as allows studying and determining the optimum parameters for the unit functioning with regards to the basic functions of an automobile. Anodized aluminium structure and panels in painted steel. Diagram in the front panel.
2 Fans with speed control by computer. Condenser. Compressor, computer controlled. Filter. Electrical engine with speed control by computer. Evaporator. Expansion valve. Refrigerant tank. Sensors: 5 temperature sensors, 2 absolute pressure sensors and flow sensor(refrigerant). Automobile control panel (including in the control interface box). Ventilation motors visualization (including in the control interface box). Enthalpy diagram R134a.

②TAAUC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TAAUC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1560 x 860 x 760 mm. Weight: 100 Kg. Control Interface: 490 x 450 x 470 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/TAAUC.pdf

PRACTICAL POSSIBILITIES

1.- General use of the air conditioning: Manual/Auto modes.
2.- Cooling with and without internal circulation.
3.- Speed of the automobile engine.
4.- Cooling in function of the radiator fans.
5.- Cooling in function of the automobile inlet fan.
6.- Energy balance in the evaporator.
7.- Matter balance in the evaporator.
8.- Experimental determination of the specific calorific capacity of the air.
9.- Optimum determination of the parameters involved in an air conditioning process.
10.- Temperature sensors calibration.
11.- Absolute pressure sensors calibration.

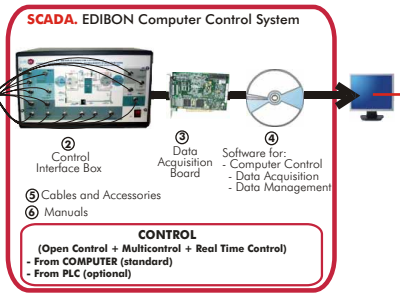
Other possible practices:

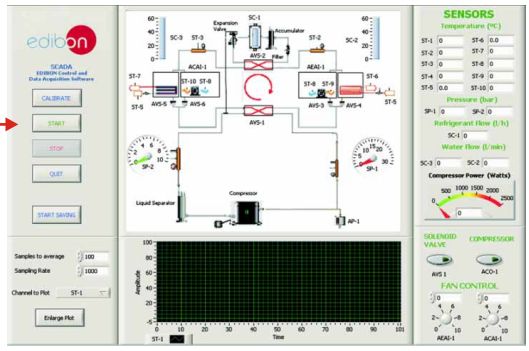
12.- Use of a psychometric map.
13.- Properties of the coolant R134a.
14.- Enthalpy diagram-pressure of the R134a.
15-33.- Practices with PLC.

➤Applied Air Conditioning

THIBAR22C. Computer Controlled **Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve** (two condensers (water and air) and two evaporators (water and air))✱

① Unit: THIBAR22C. Heat Pump + Air Conditioning +Refrigeration Unit, with Cycle Inversion Valve (two condensers (water and air) and two evaporators (water and air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THIBAR22C. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Air condenser, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Tank of division of the cooling liquid. Expansion valve. Water evaporator. Air evaporator, computer controlled. 4 Manometers.
10 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature and 3 sensors measure the air temperature). 3 Flow sensors: cooling flow sensor, water flow sensor (water condenser) and water flow sensor (water evaporator). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter.
Cycle Inversion valve. 4-way valve. Enthalpy diagram of the refrigerant R134a.

② THIBAR22C/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THIBAR22C/CCSOF. Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 100 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THIBAR22C.pdf

✱ Non computer controlled version available too.

PRACTICAL POSSIBILITIES

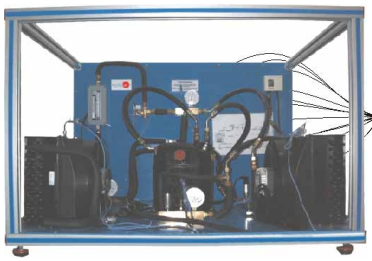
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air heat pump).
3.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Air-air heat pump).
4.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air-water heat pump).
5.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Water-water heat pump).
6.- Preparation of performance curves of the heat pump at different inlet and outlet temperatures. Air as a heat source. (Water-air heat pump).
7.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. Water as heat source. (Air-water heat pump).
8.- Preparation of the performance curves of the heat pump with different inlet and outlet temperatures. Air as heat source. (Air-air heat pump).
9.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water heat pump).
10.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air heat pump).
11.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water heat pump).
12.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air heat pump).
13.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water heat pump).
14.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air heat pump).
15.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Air-water heat pump).
16.- Preparation of the performance curves of the heat pump based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air- air heat pump).
17.- Practices with cycle inversion.

Other possible practices:

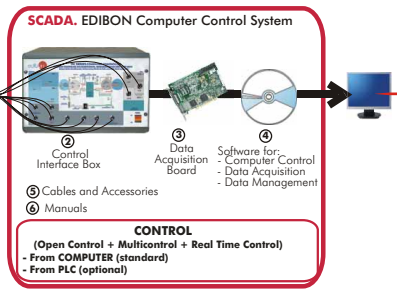
18.- Temperature sensors calibration.
19.- Flow sensors calibration.
20.- Refrigerant flow sensor.
21.- Pressure sensors calibration.
22-40.- Practices with PLC.

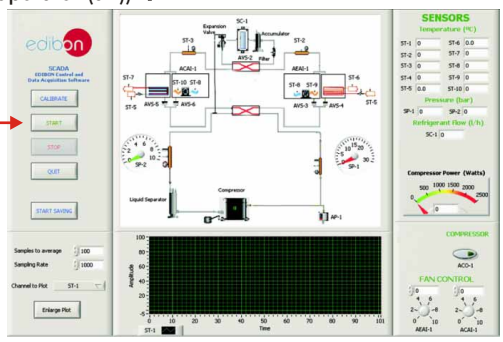
➤Applied Air Conditioning

THAAAC. Computer Controlled **Air Conditioning Unit** (one condenser (air) and one evaporator (air)) ✱



① Unit: THAAAC. Air Conditioning Unit (one condenser (air) and one evaporator (air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THAAAC. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Air condenser, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. Air evaporator, computer controlled. 4 Manometers.

7 Temperature sensors (4 sensors measure the cooling temperature and 3 sensors measure the air temperature).

Flow sensor. 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet).

Wattmeter. Enthalpy diagram of the refrigerant R134a.

②THAAAC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THAAAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THAAAC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source.

2.- Preparation of performances curves of the unit at different inlet and outlet temperatures. Air as a heat source.

3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.

4.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

Other possible practices:

5.- Temperature sensors calibration.

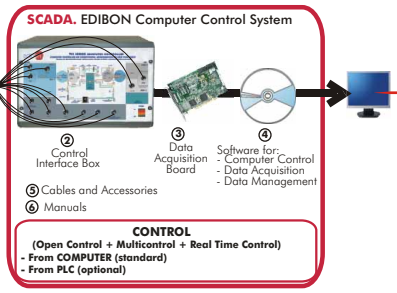
6.- Flow sensor calibration.

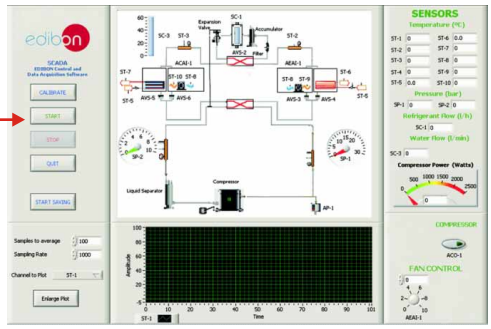
7.- Pressure sensors calibration.

8-26.- Practices with PLC.

THALAC. Computer Controlled **Air Conditioning Unit** (one condenser (water) and one evaporator (air)) ✱

① Unit: THALAC. Air Conditioning Unit (one condenser (water) and one evaporator (air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THALAC. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Cooling compressor, computer controlled. Water condenser. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Air evaporator, computer controlled. Tank of division of the cooling liquid. 4 Manometers.

8 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 2 sensors measure the air temperature).

2 Flow sensors: cooling flow sensor and water flow sensor (water condenser). 2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet). Wattmeter. Enthalpy diagram of the refrigerant R134a.

②THALAC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THALAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 75 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THALAC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.

2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Air as heat source.

3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.

4.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

5.- Energy balances.

Other possible practices:

6.- Temperature sensors calibration.

7.- Flow sensors calibration.

8.- Pressure sensors calibration.

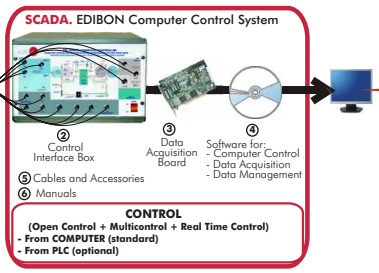
9-27.- Practices with PLC.

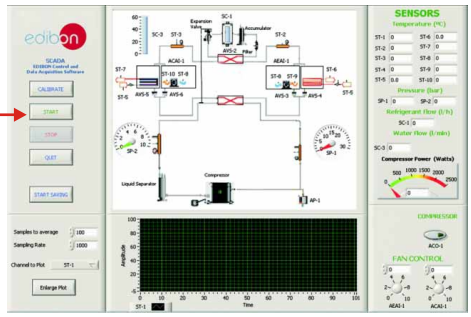
✱ Non computer controlled version available too.

➤Applied Air Conditioning

THA2AC. Computer Controlled **Air Conditioning Unit** (two condensers (water and air) and one evaporator (air))✱

①Unit: THA2AC. Air Conditioning Unit (two condensers (water and air) and one evaporator (air))





SPECIFICATIONS SUMMARY

Items supplied as standard

①THA2AC. Unit:

Bench-top unit. Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Cooling compressor, computer controlled. Air condenser, computer controlled. Water condenser. Air evaporator, computer controlled. High pressure control. Coolant accumulation tank. Cooling filter. Expansion valve. Tank of division of the cooling liquid. 4 Manometers.
9 Temperature sensors (4 sensors measure the cooling temperature, 2 sensors measure the water temperature and 3 sensors measure the air temperature).
2 Flow sensors: cooling flow sensor and water flow sensor (water condenser).
2 Pressure sensors: cooling pressure sensor (compressor outlet) and cooling pressure sensor (compressor inlet).
Wattmeter.
Enthalpy diagram of the refrigerant R134a.

②THA2AC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④THA2AC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THA2AC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.

2.- Preparation of performances curves of the unit whit different inlet and outlet temperatures. Air as a heat source.

3.- Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source.

4.- Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source.

5.- Energy balances.

Other possible practices:

6.- Temperature sensors calibration.

7.- Flow sensors calibration.

8.- Pressure sensors calibration.

9-27.- Practices with PLC.

THAR22C. Computer Controlled **Refrigeration and Air Conditioning Unit** (two condensers (water and air) and two evaporators (water and air))✱

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THAR22C.pdf

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THAR2LC. Computer Controlled **Refrigeration and Air Conditioning Unit** (two condensers (water and air) and one evaporator (water))✱

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THAR2LC.pdf

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THARL2C. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (water) and two evaporators (water and air))✱

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THARL2C.pdf

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THARA2C. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (air) and two evaporators (water and air))✱

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THARA2C.pdf

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THARLLC. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (water) and one evaporator (water))✱

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THARLLC.pdf

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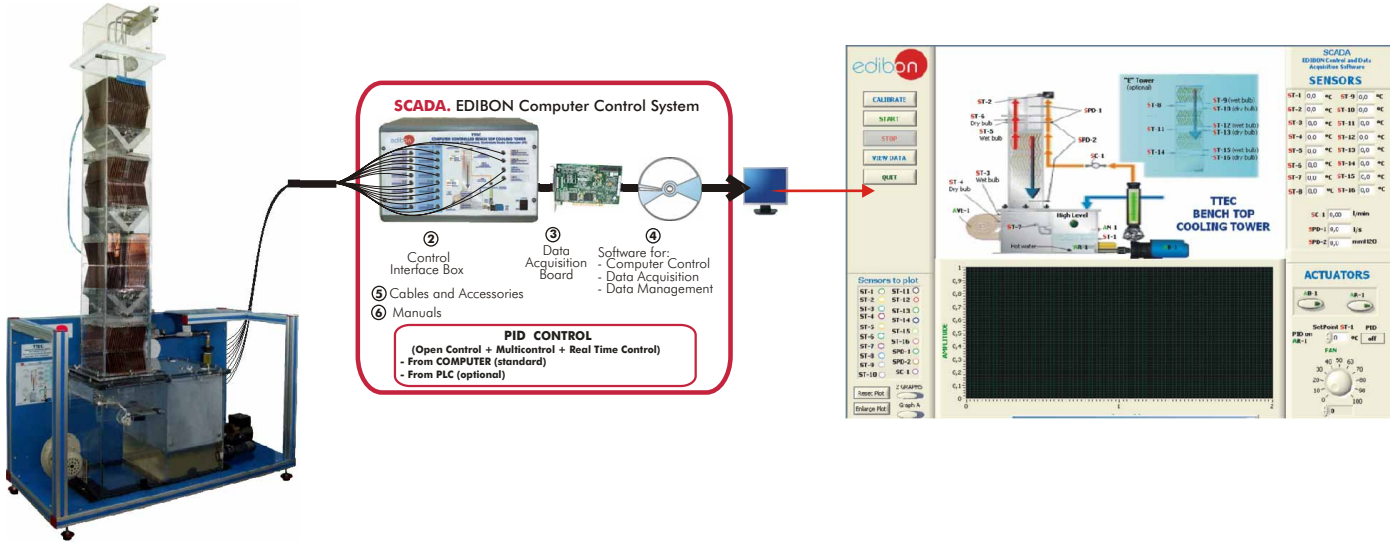
THARALC. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (air) and one evaporator (water))✱

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THARALC.pdf

✱ Non computer controlled version available too.

TTEC. Computer Controlled **Bench Top Cooling Tower** ✱



① Unit: TTEC. Bench Top Cooling Tower

SPECIFICATIONS SUMMARY

Items supplied as standard

① TTEC. Unit:

The Bench Top Cooling Tower (TTEC) has been perfectly developed to offer to the students the opportunity of appreciate the construction, design and operative characteristics of a modern cooling system by evaporating water. The unit is a good example of "open system" through which two currents of fluids (water and air) flow and where a transfer of matter from one current to the other occurs.

With this unit, the performance of the cooling system will be studied, as well as balances of matter and energy, and the effects of: Volume of air flowing. Volume of water flowing. Water temperature. Cooling load. Packing density.

Anodized aluminium structure and panels in painted steel. Main metallic elements in stainless steel.

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

Water propeller pump, computer controlled, maximum flow of water of 120 l./h.

Air propeller with a fan with speed control (145 m^3/h max., 3000 rpm).

Heating resistance, computer controlled (60° C. max).

Water tank (14l.), with water level gauge.

On/Off level switch for filling the tank.

Solenoid valves.

Flow sensor.

2 Differential pressure sensors, range: 0 - 1" H_20.

Up to 16 Temperature sensors type "J" (of wet bulb, dry bulb and water temperature), according to the column supplied.

Column included:

Column type B: N° of levels: 8. N° of sheets by level: 10. Total surface: 1.013 m^2. Height of packaging: 650mm. Density Area/volume: 58 m^2/m^3.

-Optional Columns: (NOT included in the standard supply)

Column type A: N° of levels: 8. N° of sheets by level: 19. Total surface: 1.915 m^2.
Height of packaging: 650 mm. Density Area/volume: 112.64 m^2/m^3.

Column type C: N° of levels: 8. N° of sheets by level: 7. Total surface: 0.680 m^2.
Height of packaging: 650 mm. Density Area/volume: 40.02 m^2/m^3.

Column type D: No packaging.

Column type E: (Packing characteristics column): with packing arranged to allow measurement of air and water properties within column. Fitted with temperature sensors in 3 points.
Sensors: Temperature sensors of dry bulb, wet bulb and water temperature sensors.
N° of levels: 8. N° of sheets by level: 19. Height of column: 1100mm. Height of packaging: 650 mm. Density Area/volume: 112.64 m^2/m^3.

② TTEC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TTEC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1000 x 450 x 1400 mm. Weight: 100 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/coolingtowers/TTEC.pdf

PRACTICAL POSSIBILITIES

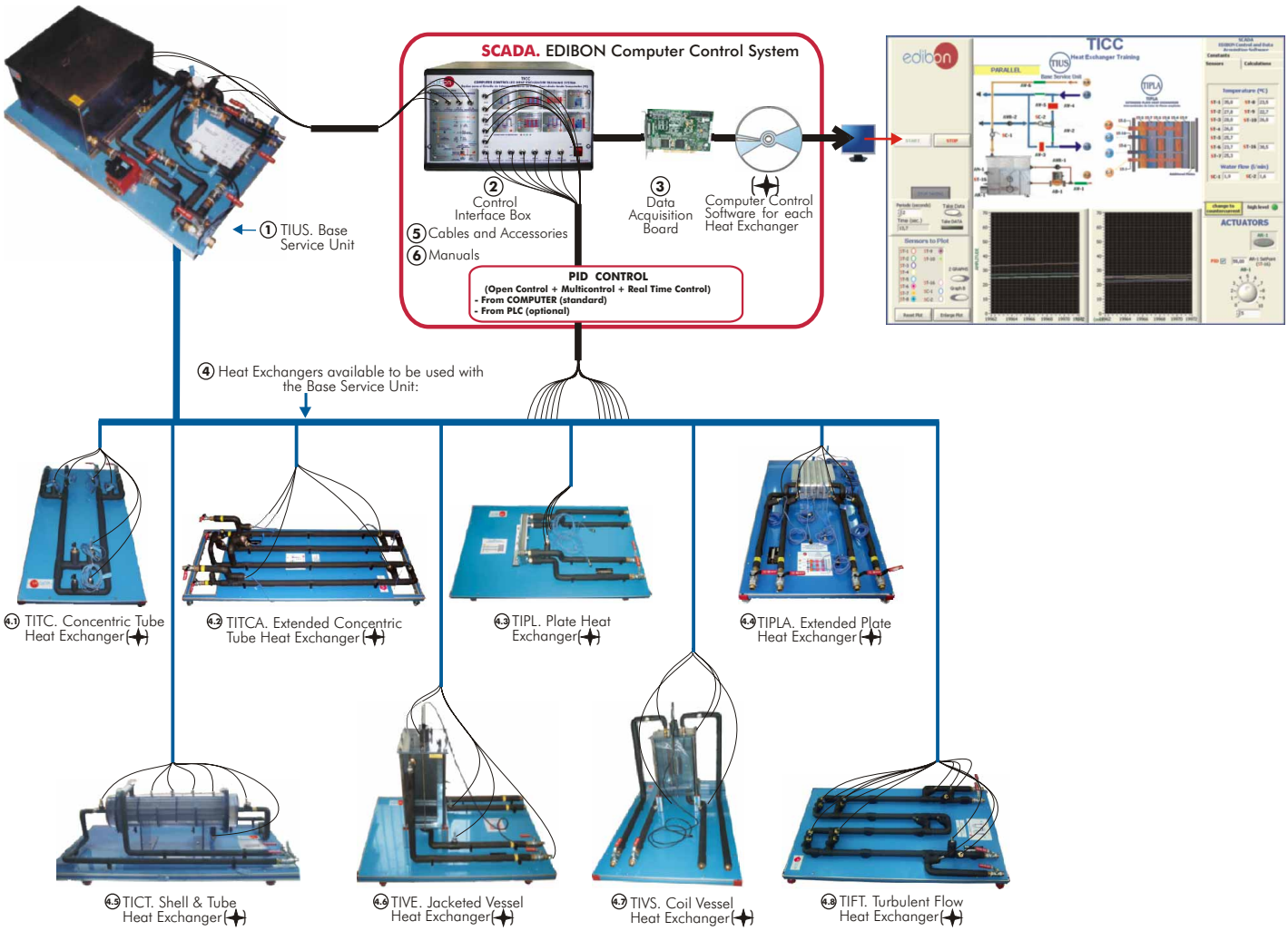
1.- Process observation inside a bench top cooling tower.
2.- Determination of evaporation velocity.
3.- Mass balance. Use of psychrometric charts.
4.- Energy balance.
5.- Effect of cooling load against "Wet bulb approach".
6.- Relation between air velocity, wet bulb approach and head loss.
7.- Determination of the cooling capacity.
8.- Determination of the cooling capacity for different cooling towers.
9.- Thermodynamic properties.
10.- Evaporation from a wet bed.
11.- Observation of water flow pattern and distribution.
12.- Control system: Temperature sensors calibration.
13.- Control system: PID temperature control.
14.- Control system: Flow sensors calibration.
15.- Study of flow sensor hysteresis.
16.- Control system: Determination of adjustment parameters of a PWM controller.
17.- Differential pressure sensors calibration.

Other possible practices:

18.- Variation of specific enthalpy with pressure.
19.- Properties of air.
20.- Use of a psychometric map.
21.- Determination of water flow.
22-40.- Practices with PLC.

✱ Non computer controlled version available too.

TICC. Computer Controlled **Heat Exchangers Training System:**✱



SPECIFICATIONS SUMMARY

Common items for Heat Exchangers type"TI"

①TIUS. Base Service Unit:

This unit is common for Heat Exchangers type "TI" and can work with one or several exchangers.

This unit performs the following tasks:

- Heating the water.
- Pumping of hot water.
- Change in the direction of cold water flows.
- Cold and hot water measures.

Anodized aluminium structure and panels in steel.

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

Stainless steel tank (30 l.) equipped with:

Electric resistance (3000 W), computer controlled. Temperature sensor to measure the water temperature. Level switch to control the water level of the tank. Stainless steel cover to avoid the contact with the hot water; in this cover exists an hole to allows us to visualize the water level and even to stuff the tank. Draining water valve.

Centrifugal pump with speed control from the computer.

2 Flow sensors, one to control hot water and the other for cold water.

Control valve for the cold water. 4 Ball valves that, depending on how do we manipulate them, they give us parallel or crosscurrent flux in the exchanger. Regulation pressure valve.

Flexible tubes to connect with the different exchangers.

Cables and Accessories, for normal operation.

This unit is supplied with 8 manuals.

Dimensions (approx.) = 1100 x 630 x 500 mm. Weight: 50 Kg.

②TICC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

Dimensions (approx.) = 490 x 330 x 310 mm. Weight: 10 Kg.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

Continue...

✱ Non computer controlled version available too.

TICC. Computer Controlled **Heat Exchangers Training System:** ✱

SPECIFICATIONS SUMMARY

④ **Heat Exchangers** available to be used with the Base Service Unit:

PRACTICAL POSSIBILITIES

④.1 TITC. Concentric Tube Heat Exchanger:

This Concentric Tube Heat Exchanger allows the study of heat transfer between hot water flowing through an internal tube and cold water flowing in the ring area lying between the internal and external tubes. This exchanger allows measuring hot and cold water temperatures in different points of the exchanger.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
The exchanger is formed by two concentric copper tubes with hot water circulating through the interior tube and cold water circulating in the ring space.
This exchanger has 2 equal sections of 500 mm each one, where heat transfer takes place.
Exchange length: L = 2 x 0.5 = 1 m.
Internal tube: Internal diameter: $D_{int} = 16 \bullet 10^{-3}$ m. External diameter: $D_{ext} = 18 \bullet 10^{-3}$ m. Thickness = 10^{-3}m. Heat transfer internal area: $A_h = 0.0503\ m^2$. Heat transfer external area: $A_c = 0.0565\ m^2$.
External tube: Internal diameter: $D_{int} = 26 \bullet 10^{-3}$ m. External diameter: $D_{ext} = 28 \bullet 10^{-3}$ m. Thickness = 10^{-3} m.
6 Temperature sensors: 3 temperature sensors for measuring cold water temperature and 3 temperature sensors for measuring hot water temperature.
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Concentric Tube Heat Exchanger (TITC).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1100 x 630 x 320 mm. Weight: 20 Kg.

Practices to be done with the Concentric Tube Heat Exchanger (TITC):

1.- Global energy balance in the exchanger and the study of losses.
2.- Exchanger effectiveness determination. NTU Method.
3.- Study of the heat transfer under of countercurrent and parallel flow conditions.
4.- Flow influence in the heat transfer. Reynolds number calculation.
5.- Control system: Temperature sensors calibration.
6.- Control system: Flow sensors calibration.
7.- Study of the hysteresis of the flow sensor.
8-26.- Practices with PLC.

④.2 TITCA. Extended Concentric Tube Heat Exchanger:

This Extended Concentric Tube Heat Exchanger allows the study of heat transfer between hot water flowing through an internal tube and cold water flowing in the ring area lying between the internal and external tubes. This exchanger allows measuring hot and cold water temperatures in different points of the exchanger.
TITCA is a more sophisticated unit than TITC, with four longer tube sections, giving four times the overall heat transfer area and three interim temperature measurement points (temperature sensors) in each fluid stream.
This exchanger has sufficient heat transfer area for demonstrating the typical counter current flow conditions where the outlet of the heated stream is hotter than the outlet of the cooled stream.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
The exchanger is formed by two concentric copper tubes with hot water circulating through the interior tube and cold water circulating in the ring space.
This exchanger has 4 sections of 1000 mm each one, where heat transfer takes place.
Exchange length: L=4x1=4 m.
Internal tube: Internal diameter: $D_{int} = 16 \bullet 10^{-3}$ m. External diameter: $D_{ext} = 18 \bullet 10^{-3}$ m. Thickness = 10^{-3}m. Heat transfer internal area: $A_h = 0.0503\ m^2$. Heat transfer external area: $A_c = 0.0565\ m^2$.
External tube: Internal diameter: $D_{int} = 26 \bullet 10^{-3}$ m. External diameter: $D_{ext} = 28 \bullet 10^{-3}$ m. Thickness = 10^{-3} m.
10 Temperature sensors: 5 temperature sensors for measuring cold water temperature and 5 temperature sensors for measuring hot water temperature.
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Extended Concentric Tube Heat Exchanger (TITCA).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1500 x 700 x 320 mm. Weight: 30 Kg.

Practices to be done with the Extended Concentric Tube Heat Exchanger (TITCA):

27.- Global energy balance in the exchanger and the study of losses.
28.- Exchanger effectiveness determination. NTU Method.
29.- Study of the heat transfer under of countercurrent and parallel flow conditions.
30.- Flow influence in the heat transfer. Reynolds number calculation.
31.- Control system: Temperature sensors calibration.
32.- Control system: Flow sensors calibration.
33.- Study of the hysteresis of the flow sensor.
34-52.- Practices with PLC.

④.3 TIPL. Plate Heat Exchanger:

This Plate Heat Exchanger allows the study of heat transfer between hot and cold water through alternate channels formed between parallel plates. The exchanger allows measuring cold and hot temperatures at the inlet and outlet of the exchanger.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Formed by corrugated stainless steel plates. This can be dismantled to observe its structure.
4 ports or connections of input and output of hot and cold water.
Max. flow: 12m^3/h. Max. work pressure: 10 bar. Max. work temperature: 100° C. Minimum work temperature: 0° C. Max. number of plates: 20. Internal circuit capacity: 0.176 l. External circuit capacity: 0.22 l. Area: 0.32m^2.
4 Temperature sensors: 2 temperature sensors for measuring cold water temperature (inlet and outlet) and 2 temperature sensors for measuring hot water temperature (inlet and outlet).
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Plate Heat Exchanger (TIPL).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1100 x 630 x 320 mm. Weight: 20 Kg.

Practices to be done with the Plate Heat Exchanger (TIPL):

53.- Global energy balance in the exchanger and the study of losses.
54.- Exchanger effectiveness determination. NTU Method.
55.- Study of the heat transfer under of countercurrent and parallel flow conditions.
56.- Flow influence in the heat transfer. Reynolds number calculation.
57.- Control system: Temperature sensors calibration.
58.- Control system: Flow sensors calibration.
59.- Study of the hysteresis of the flow sensor.
60-78 .- Practices with PLC.

④.4 TIPLA. Extended Plate Heat Exchanger:

This Extended Plate Heat Exchanger allows the study of heat transfer between hot and cold water through alternate canals formed between parallel plates. The exchanger allows measuring cold and hot temperatures in different points of the exchanger.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Formed by corrugated stainless steel plates. This can be dismantled to observe its structure.
4 ports or connections of input and output of hot and cold water.
Max. flow: 12m^3/h. Max. work pressure: 10 bar. Max. work temperature: 100° C. Minimum work temperature: 0° C. Max. number of plates: 20. Internal circuit capacity: 0.176 l. External circuit capacity: 0.22 l. Area: 0.32m^2.
10 Temperature sensors: 5 temperature sensors for measuring cold water temperature (inlet, outlet and interim positions) and 5 temperature sensors for measuring hot water temperature (inlet, outlet and interim positions).
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Extended Plate Heat Exchanger (TIPLA).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1200 x 700 x 320 mm. Weight: 25 Kg.

Practices to be done with the Extended Plate Heat Exchanger (TIPLA):

79.- Global energy balance in the exchanger and the study of losses.
80.- Exchanger effectiveness determination. NTU Method.
81.- Study of the heat transfer under of countercurrent and parallel flow conditions.
82.- Flow influence in the heat transfer. Reynolds number calculation.
83.- Control system: Temperature sensors calibration.
84.- Control system: Flow sensors calibration.
85.- Study of the hysteresis of the flow sensor.
86-104.- Practices with PLC.

Continue...

✱ Non computer controlled version available too.

TICC. Computer Controlled **Heat Exchangers Training System:** ✱

SPECIFICATIONS SUMMARY

④ **Heat Exchangers** available to be used with the Base Service Unit:

4.5 TICT. Shell & Tube Heat Exchanger:

It consists of a group of tubes inside the heat exchanger. The hot water flows through the internal tubes and cooling water circulates through the space between the internal tubes and the shell. There are traverse baffles placed in the shell to guide the cold water maximize the heat transfer.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Formed by tubes of stainless steel with hot water circulating in the interior.
4 segmented baffles located transversal in the shell.
Exchange length of the shell and each tube: L = 0.5m.
Internal tube (21 tubes): Internal diameter: $D_{int} = 8 \bullet 10^{-3}$ m. External diameter: $D_{ext} = 10 \bullet 10^{-3}$ m. Thickness = 10^{-3} m.
Internal heat transfer area: $A_h = 0.0126\ m^2$. External heat transfer area : $A_c = 0.0157 m^2$.
Shell: Internal diameter: $D_{int,c} = 0.148$ m. External diameter: $D_{ext,c} = 0.160$ m. Thickness = $6 \bullet 10^{-3}$ m.
7 Temperature sensors for measuring cold and hot water temperatures in different points of the exchanger.
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Shell & Tube Heat Exchanger (TICT).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1100 x 630 x 400 mm. Weight: 30 Kg.

4.6 TIVE. Jacketed Vessel Heat Exchanger:

This Jacketed Vessel Heat Exchanger allows the study of heat transfer between hot water flowing through a jacket and the cold water contained in a vessel. It can work in continuous supply or in a batch process (heating of a constant mass of water containing in a vessel). The exchanger allows measuring temperatures at the inlet and outlet of the exchanger in cold as well as in hot water.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Constituted of a vessel. Vessel total volume: 14 l. Interior vessel volume: 7 l. approx. Jacket volume: 7 l. approx.
An overflow or a pipe that allows the exit of the water in the vessel through its upper part to maintain a constant flow during the process with continuous supply.
A jacket that surrounds the vessel through where hot water flows.
An electric stirrer, range between 50 and 300 rpm.
5 Temperature sensors: 3 temperature sensors for measuring cold water temperature and 2 temperature sensors for measuring hot water temperature.
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Jacketed Vessel Heat Exchanger (TIVE).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1100 x 630 x 700 mm. Weight: 35 Kg.

4.7 TIVS. Coil Vessel Heat Exchanger:

This heat exchanger allows the study of heat transfer between hot water flowing through a coil and cold water contained in the vessel. It can work in continuous supply or in a batch process.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Formed by a pvc-glass vessel, volume: 14 l.
An overflow or pvc-glass tube lets the output of water from the vessel in the upper part in order to maintain the flow constant for continue supply process.
A copper coil where the water circulates: $D_{int} = 4.35$ mm. $D_{ext} = 6.35$ mm.
An electric stirrer, range between 50 and 300 rpm.
5 Temperature sensors: 3 temperature sensors for measuring cold water temperature and 2 temperature sensors for measuring hot water temperature.
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Coil Vessel Heat Exchanger (TIVS).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1100 x 630 x 700 mm. Weight: 30 Kg.

4.8 TIFT. Turbulent Flow Heat Exchanger:

This Turbulent Flow Heat Exchanger let us the heat transfer study between hot water that circulates through an internal tube and cold water that flows through the annular zone between the internal and the external tubes. This exchanger let us to measure cold water and hot water temperatures in different points of the exchanger.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Formed by two copper concentric tubes with hot water circulating through the internal tube and cold water circulating through the annular space.
The exchanger has 4 equal sections of 500 mm each one, where the heat transfer takes place.
Exchange length: L = 4 x 0.5 = 2 m.
Internal tube: Internal diameter: $D_{int} = 8 \bullet 10^{-3}$ m. External diameter: $D_{ext} = 10 \bullet 10^{-3}$ m. Thickness = 10^{-3} m. Internal heat transfer area: $A_h = 0.0377\ m^2$. External heat transfer area: $A_c = 0.0471\ m^2$.
External tube: Internal diameter: $D_{int,c}$ 13 • 10^{-3} m. External diameter: $D_{ext,c}$ 15 • 10^{-3} m. Thickness = 10^{-3} m.
12 Temperature sensors.
Easy connection with the Base Service Unit.
Computer Control Software:
Computer Control+Data Acquisition+Data Management Software for Turbulent Flow Heat Exchanger (TIFT).
Flexible, open and multicontrol software. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. It allows the registration of the alarms state and the graphic representation in real time.
This unit is supplied with 8 manuals.
Dimensions (approx.) = 1100 x 630 x 350 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatexchange/TICC.pdf

✱ Non computer controlled version available too.

PRACTICAL POSSIBILITIES

Practices to be done with the Shell & Tube Heat Exchanger (TICT):

105.- Global energy balance in the exchanger and the study of losses.
106.- Exchanger effectiveness determination. NTU Method.
107.- Study of the heat transfer under of countercurrent and parallel flow conditions.
108.- Flow influence in the heat transfer. Reynolds number calculation.
109.- Control system: Temperature sensors calibration.
110.- Control system: Flow sensors calibration.
111.- Study of the hysteresis of the flow sensor.
112-130.- Practices with PLC.

Practices to be done with the Jacketed Vessel Heat Exchanger (TIVE):

131.- Global balance of energy in the exchanger and losses study.
132.- Determination of the exchanger effectiveness. NTU Method.
133.- Influence of the flow in the heat transfer. Calculation of the number of Reynolds.
134.- Influence of the stirring of the vessel on the heat transfer when operating in batches.
135.- Influence of the vessel's water volume on the heat transfer when operating in batches.
136.- Control system: Temperature sensors calibration.
137.- Control system: Flow sensors calibration.
138.- Study of the hysteresis of the flow sensor.
139-157.- Practices with PLC.

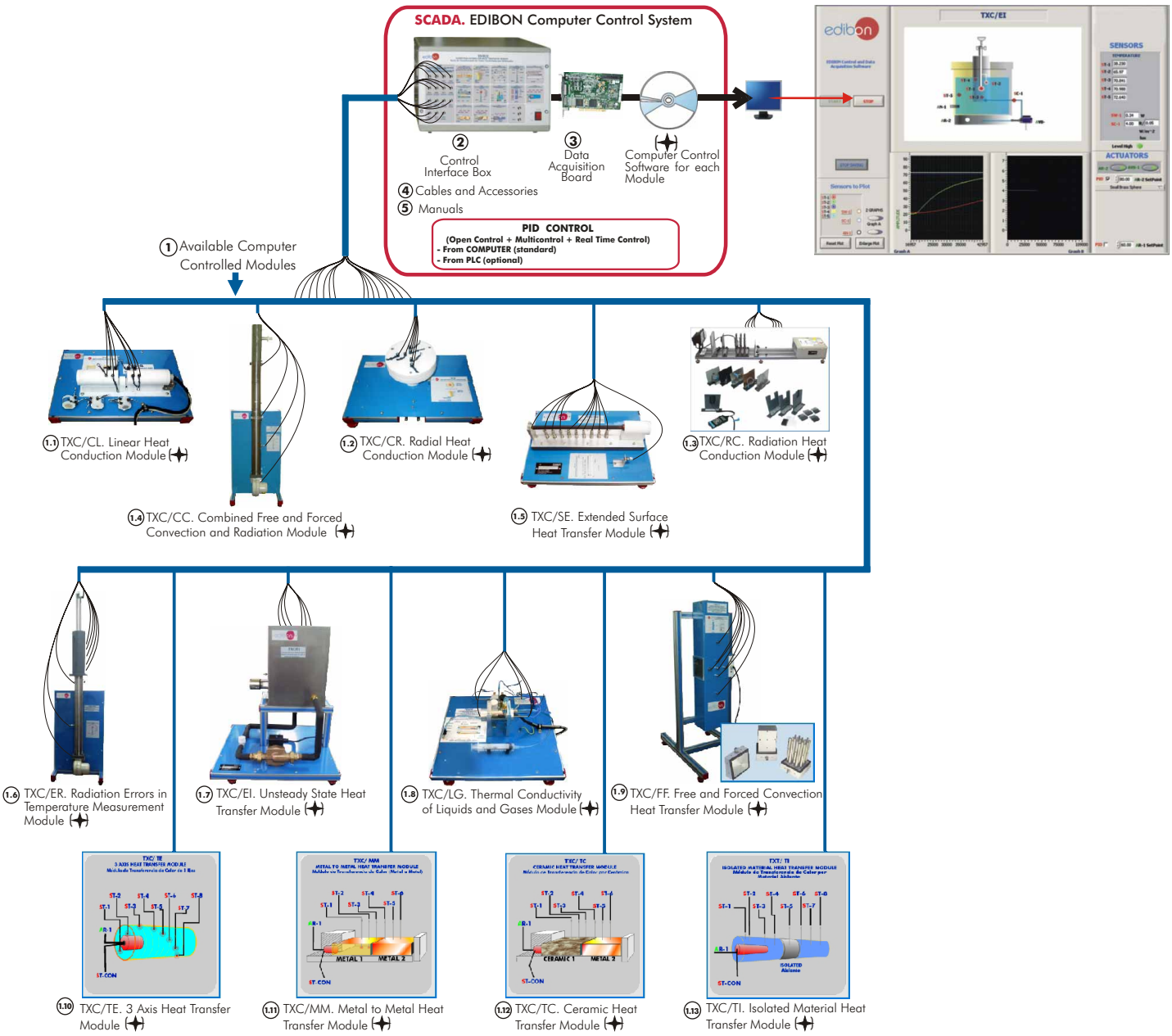
Practices to be done with the Coil Vessel Heat Exchanger (TIVS):

158.- Global balance of energy in the exchanger and the study of losses.
159.- Determination of the exchanger effectiveness. NTU Method.
160.- Influence of the flow in the heating transfer. Calculation of Reynolds number.
161.- Influence of the stirring vessel in the heat transfer with operation in batches.
162.- Influence of the water volume in the vessel about the heat transfer with operation in batches.
163.- Control System: Temperature sensors calibration.
164.- Control System: Flow sensors calibration.
165.- Study of the hysteresis of the flow sensor.
166-184.- Practices with PLC.

Practices to be done with the Turbulent Flow Heat Exchanger (TIFT):

185.- Global energy balance in the exchangers and loss study.
186.- Determination of the exchanger effectiveness. NTU Method.
187.- Study of the heat transfer in crosscurrent and parallel flow conditions.
188.- Flow influence in heat transfer. Reynolds number calculation.
189.- Obtaining of the correlation that relates Nusselt number with Reynolds number and Prandtl number.
190.- Obtaining of the heat transfer coefficients by convection.
191.- Control system: Temperature sensors calibration.
192.- Control system: Flow sensors calibration.
193.- Study of the hysteresis in the flow sensors.
194-212.- Practices with PLC.

TSTCC. Computer Controlled **Heat Transfer Series:** ✱



SPECIFICATIONS SUMMARY

1 Available Computer Controlled Modules

1.1 TXC/CL. Linear Heat Conduction Module:

Unit to study the principles of linear heat conduction and to allow the conductivity of various solid conductors and insulators to be measured. It is given with interchangeable samples of different materials, different diameters and different insulating materials that allow to demonstrate the area effects, the conductivity and the combinations in series in the heat transmission process.

Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Input heat section. Electric heater (heating resistance) with power regulation (150W), computer controlled. Refrigeration section with a surface cooled by water. Central sections: with brass of 25 mm of diameter, with brass of 10 mm of diameter and with stainless steel of 25 mm of diameter.

Water flow regulation valve.

Sensors: 11 temperature sensors distributed in the heating section, refrigeration section and central sections; 1 temperature sensor at the water inlet of the unit; 1 temperature sensor at the water outlet of the unit and a water flow sensor.

Power measurement from the computer (PC).

Cables and Accessories, for normal operation.

This unit is supplied with 8 manuals.

Computer Control+Data Acquisition+Data Management Software for this Module:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.): 400 x 300 x 300 mm. Weight: 20 Kg.

This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

Continue...

PRACTICAL POSSIBILITIES

Practices to be done with the Linear Heat Conduction Module (TXC/CL):

1.- Conduction through a simple bar.

2.- Conduction through a compound bar.

3.- Determination of the thermal conductivity "k" of different materials (conductors and insulators).

4.- The thermal conductivity properties of insulators may be found by inserting paper or other elements between the heating and cooling sections.

5.- Insulation effect.

6.- Determination of the thermal contact resistance R_{tc}.

7.- Effect of the crossing sectional area.

8.- Understanding the use of the Fourier equation in determining rate of heat flow through solid materials.

9.- Observing unsteady-state conduction.

10.- Calibration of the temperature sensors.

11-29.- Practices with PLC.

Continue...

✱ Non computer controlled version available too.

TSTCC. Computer Controlled **Heat Transfer Series: ***

SPECIFICATIONS SUMMARY

①Available Computer Controlled Modules

①.②TXC/CR. Radial Heat Conduction Module:

Unit to study the principles of radial heat conduction, and to allow the conductivity of solid brass disk to be measured.
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Brass disk of 110 mm of diameter and 3 mm of thickness. Incorporated electric heater (150W), computer controlled. Peripherical cooling tube. Water flow sensor. Water flow regulation valve.
8 Temperature sensors: 6 temperature sensors distributed in the unit; 1 temperature sensor at the water inlet of the unit and 1 temperature sensor at the water outlet of the unit.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 400 x 300 x 300 mm. Weight: 20 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

①.③TXC/RC. Radiation Heat Conduction Module:

Unit designed to demonstrate the laws of radiant heat transfer and radiant heat exchange.
It basically consists in two independent parts. One of the parts is for the light radiation experiments and another part is for the thermal radiation experiments. The elements provided with the unit allow making the measuring of the temperature, radiation, intensity light and the power in the resistance or bulb.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
This unit consists on a metal plate with a resistance at one side and a lamp in the another side. Lengthwise of the metal plate you can place the elements supplied with the unit.
Heating resistance, computer controlled.
Lamp, with diffuser.
The unit is provided with accessories for light experiments and radiation experiments.
Light accessories: Luxmeter that allows to measure the intensity of the light. Filters: 3 Grey Neutral Density A153 filters, 1 Grey Neutral Density A152 filter and 1 Grey Neutral Density A154 filter. 3 Filter portholes.
Radiation accessories: Radiometer (it allows to measure the intensity of the radiation). Planes surfaces (they are elements for studying the radiation and each one contains one temperature sensor). Variable slit or aperture (it allows to regulate the area of the radiation).
7 Temperature sensors.
Power measurement from the computer (PC).
Radiation measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 1400 x 500 x 500 mm. Weight: 40 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

①.④TXC/CC. Combined Free and Forced Convection and Radiation Module:

Unit to study the principles of combined free and forced convection with radiation from a horizontal heater cylinder. It studies the variation experimented by the local heat transfer coefficient around of a horizontal cylinder. It is subject to a forced and a free convection.
Diagram in the front panel with similar distribution to the elements in the real unit.
Centrifugal fan (computer controlled) of 2650 rpm, which provides a maximum flow of 1200l/min.
Stainless steel conduct with interior cover, including: temperature sensor in order to measure the temperature of inlet air, flow sensor and temperature sensor in order to measure the temperature of outlet air.
Heater: copper cylinder with exterior cover: interior resistance of 150W., temperature sensor for measuring the temperature of the cylinder.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 430 x 350 x 1300 mm. Weight: 50 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

①.⑤TXC/SE. Extended Surface Heat Transfer Module:

Unit designed to demonstrate the temperature profiles and heat transfer characteristics for an extended surface. It studies the effect of adding fins to a body in order to extend its surface for a change in the cooling rate. Fins of different materials and cross section shapes are used to analyse the effect of cooling.
Diagram in the front panel with similar distribution to the elements in the real unit.
150 W Resistance, embedded in a copper capsule, to permit a good contact with the interchangeable fins.
The fins are interchangeable, providing two different materials: brass and stainless steel and three different cross section shapes: square, circular and hexagonal.
The power to the resistance is controlled from the computer with the SCADA software.
11 Temperature sensors.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 600 x 300 x 175 mm. Weight: 20 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

Continue...

PRACTICAL POSSIBILITIES

Practices to be done with the Radial Heat Conduction Module (TXC/CR):

30.- Radial conduction.
31.- Determination of the thermal conductivity "k".
32.- Determination of the thermal contact resistance R_{tc}.
33.- Effect of the crossing sectional area.
34.- Insulation effect.
35.- Understanding the use of the Fourier equation in determining rate of heat flow through solid materials.
36.- Calibration of the temperature sensors.
37-55.- Practices with PLC.

Practices to be done with the Radiation Heat Conduction Module (TXC/RC):

56.- Inverse of the distant square law for the radiation.
57.- Stefan Boltzmann Law.
58.- Emission power I.
59.- Emission power II.
60.- Kirchorff Law.
61.- Area factors.
62.- Inverse of the distant square law for the light.
63.- Lambert´s Cosine Law.
64.- Lambert Law of Absorption.
65.- Sensors calibration.
66-84.- Practices with PLC.

Practices to be done with the Combined Free and Forced Convection and Radiation Module(TXC/CC):

85.- Demonstration of the combined transmission effect of the radiation and convection on the surface of the cylinder. Determination of the combined transmission effect of heating by forced convection and radiation.
86.- Demonstration of the influence of air flow in the heating transfer. Determination of the combined transmission effect of heating by forced convection and radiation.
87.- Demonstration of the influence of input power in the heating transfer. Determination of the combined transmission effect of heating by forced convection and radiation.
88.- Demonstration of the combined transmission effect of the radiation and convection on the surface of the cylinder. Determination of the combined transmission effect of heating by free convection and radiation.
89.- Determination of the airflow.
90.- Control System: Temperature sensors calibration.
91.- Control System: Air flow sensor calibration.
92-110.- Practices with PLC.

Practices to be done with the Extended Surface Heat Transfer Module(TXC/SE):

111.- Heat transfer from a Fin.
112.- Effect of cross section shape in heat transfer from a Fin.
113.- Heat transfer from Fins of two different materials.
114.- Measuring the temperature distribution along an extended surface.
115.- Sensor calibration.
116-134.- Practices with PLC.

Continue...

* Non computer controlled version available too.

TSTCC. Computer Controlled **Heat Transfer Series: ***

SPECIFICATIONS SUMMARY

①Available Computer Controlled Modules

1.6 TXC/ER. Radiation Errors in Temperature Measurement Module:

Unit to demonstrate how temperature measurements can be influenced by sources of thermal radiation. The objective of this module is to measure the error in a black thermocouple due the radiation with respect with another normal thermocouple where there are not radiative shielding in comparison when there are radiative shielding, error in function of material of the thermocouple's capsule, size of the thermocouple, etc.
Diagram in the front panel with similar distribution to the elements in the real unit.
Centrifugal fan (computer controlled): 2650 rpm. Maximum flow of 1200l/min.
Stainless steel conduct with interior cover, including: temperature sensor, in order to measure the temperature of inlet air; flow sensor and temperature sensor, in order to measure the temperature of outlet air.
Copper cylinder with exterior cover: interior resistance of 150W; temperature sensor for measuring the temperature of the cylinder.
5 Temperature sensors with different styles and sizes of bead installed in the duct to demonstrate the differences in readings obtained. Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control+Data Acquisition+Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 430 x 350 x 1300 mm. Weight: 50 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.7 TXC/EI. Unsteady State Heat Transfer Module:

Unit designed to allow practices and exercises to be performed in unsteady state heat transfer. It studies the transient conduction with convection. Using different shapes (rectangular slabs, spheres and cylinders) of different materials, the temperature of other shapes and materials can be predicted.
Diagram in the front panel with similar distribution to the elements in the real unit.
Dual concentric open top tanks filled with water, total tank capacity: 40 litres, 300 x 350 x 400 mm. concentric tank: 1.2 l., diameter: 70 mm.
Different shapes of different size and material are studied: brass spheres, stainless steel spheres, brass cylinder, stainless steel cylinder, aluminium rectangular slab and stainless steel rectangular slab.
Each shape is fitted with a temperature sensor at the center of the object.
The shapes are installed in special holder at the center of the top cover of the large tank. The holder also has a temperature sensor that enters in the water bath at the same time as the shape.
Heating element, computer controlled, with a power of 3000 W.
Water pump with variable speed.
Sensors: 3 Temperature sensors allow controlling the stability of the temperature of the water bath. Flow sensor. 2 Temperature sensors: the first one permits to record the evolution of the temperature of the shape at its center and the second one, works as a stopwatch, it will indicate the precise moment in which the shape is submerged.
Level switch. Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control+Data Acquisition+Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 600 x 600 x 750 mm. Weight: 60 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.8 TXC/LG. Thermal Conductivity of Liquids and Gases Module:

This unit has been designed to enable students to easily determine the thermal conductivity of liquids and gases. By the realization of the practices the student can determine the thermal conductivity of any suitable gas or compatible liquid with materials on construction.
Diagram in the front panel with similar distribution to the elements in the real unit.
Aluminium body (cylinder) with brass jacket that contains the test fluid and the refrigeration water. Variable heating resistance (in the cylinder), computer controlled, (150 W).
6 Temperature sensors. Water flow sensor. Water flow regulation valve. Valves. Syringe.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control+Data Acquisition+Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 500 x 400 x 300 mm. Weight: 40 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.9 TXC/FF. Free and Forced Convection Heat Transfer Module:

This unit allows to study the efficiency of different exchangers, analyzing the heat transmission coefficients of each of the exchangers exposed to different airflows. A fan placed in the upper part of the tunnel allows controlling the airflow that goes through the tunnel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Stainless steel tunnel of rectangular section, 700 mm long. In the tunnel three type of different heat exchangers can be set.
Methacrylate viewer that allows a good visualization of the exchanger that is in use.
Stabilizers to guarantee an uniform air flux.
9 Temperature sensors: 2 Temperature sensors measure the air temperature at the inlet and outlet of the area of heat exchange. Temperature measurements, at different distances of the base of the dowels and blade exchangers, are made by other five temperature sensors that are introduced by one side of the tunnel. 1 temperature sensor for the heating resistance. 1 temperature sensor in the exchangers.
Flow sensor, for measuring the air flow generated.
3 Aluminium exchangers: flat heat exchanger, dowels heat exchanger, blade heat exchanger.
Heating resistance of 150W for each exchanger, computer controlled.
Variable speed fan, computer controlled.
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control+Data Acquisition+Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions: 370 x 610 x 920 mm. Weight: 25 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

Continue...

PRACTICAL POSSIBILITIES

Practices to be done with the Radiation Errors in Temperature Measurement Module (TXC/ER):

135.- Radiation errors in temperature measurement.
136.- Measurement the errors in thermocouples in function of its painting, material of its capsules, size.
137.- Effect of air velocity on measurement error.
138.- Control System: Temperature sensors calibration.
139.- Control System: Air flow sensors calibration.
140-158.- Practices with PLC.

Practices to be done with the Unsteady State Heat Transfer Module(TXC/EI):

159.- Predicting temperature at the center of a cylinder using transient conduction with convection.
160.- Predicting the conductivity of a similar shape constructed from a different material.
161.- Conductivity and temperature dependence on volume.
162.- Conductivity and temperature dependence on surrounding temperature T^{∞}.
163.- Sensors calibration.
164-182.- Practices with PLC.

Practices to be done with the Thermal Conductivity of Liquids and Gases Module (TXC/LG):

183.- Obtaining of the curve of thermal conductivity of the air.
184.- Thermal conductivity in vacuum.
185.- Water thermal conductivity determination.
186.- Thermal conductivity determination of a mineral oil.
187.- Calibration of the Unit.
188.- Control System: Calibration of the sensors.
189.- Dry air thermal conductivity under atmospheric pressure.
190-208.- Practices with PLC.

Practices to be done with the Free and Forced Convection Heat Transfer Module (TXC/FF):

209.- Demonstration of the basic principles of free and forced convection.
210.- Comparison between free and forced convection.
211.- Free convection in flat surfaces.
212.- Forced convection in flat surfaces.
213.- Dependence of the heat transmission with the temperature.
214.- Dependence of the heat transmission with the speed of the fluid.
215.- Dependence of the heat transmission with the exchanger geometry.
216.- Temperature distribution in the additional surfaces.
217.- Study of the advantage of using spiked and bladed surfaces in heat transmission in free convection.
218.- Study of the advantage of using spiked and bladed surfaces in heat transmission in forced convection.
219.- Comparative study between the free convection of a horizontal surface and vertical surface.
220.- Sensors calibration.
221-239.- Practices with PLC.

Continue...

* Non computer controlled version available too.

TSTCC. Computer Controlled **Heat Transfer Series: ***

SPECIFICATIONS SUMMARY

①Available Computer Controlled Modules

1.10 TXC/TE. 3 Axis Heat Transfer Module:

Diagram in the front panel with similar distribution to the elements in the real unit.
3 Axis conduction module.
Electric heater (heating resistance), computer controlled.
8 Temperature sensors.
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions: 300 x 300 x 300 mm. Weight: 20 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.11 TXC/MM. Metal to Metal Heat Transfer Module:

Diagram in the front panel with similar distribution to the elements in the real unit.
Electric heater (heating resistance), computer controlled.
6 Temperature sensors.
Materials to test: copper, brass, stainless steel, aluminium (to choose).
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions: 300 x 300 x 300 mm. Weight: 20 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.12 TXC/TC. Ceramic Heat Transfer Module:

Diagram in the front panel with similar distribution to the elements in the real unit.
Electric heater (heating resistance), computer controlled.
6 Temperature sensors.
Suitable for ceramic materials.
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 300 x 300 x 300 mm. Weight: 25 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.13 TXC/TI. Isolated Material Heat Transfer Module:

Diagram in the front panel with similar distribution to the elements in the real unit.
Electric heater (heating resistance), computer controlled.
8 Temperature sensors.
Suitable for fibrous, granular and sheet materials.
Suitable for homogeneous and non-homogeneous materials.
Suitable for soft, semi-rigid and rigid materials.
Cables and Accessories, for normal operation.
This unit is supplied with 8 manuals.
Computer Control + Data Acquisition + Data Management Software for this Module:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.
Dimensions (approx.): 300 x 300 x 300 mm. Weight: 20 Kg.
This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

Items Common for the Modules type "TXC"

②TSTCC/CIB. Control Interface Box:

This control interface is common for the modules type "TXC" and can work with one or several modules.
Control interface box with process diagram in the front panel.
The unit control elements are permanently computer controlled.
Simultaneous visualization in the computer of all parameters involved in the process.
Calibration of all sensors involved in the process.
Real time curves representation about system responses.
All the actuators' values can be changed at any time from the keyboard.
Shield and filtered signals to avoid external interferences.
Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Real time PID control for parameters involved in the process simultaneously. Open control allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.
Three safety levels, one mechanical in the unit, other electronic in the control interface and the third one in the control software.
Dimensions (approx.): 490 x 330 x 310 mm. Weight: 10 Kg.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot.
16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferbasic/TSTCC.pdf

PRACTICAL POSSIBILITIES

Practices to be done with the 3 Axis Heat Transfer Module (TXC/TE):

240.- Calibration processes.
241.- Temperature sensors calibration.
242.- Determination of the thermal conductivity "k", through 3 axis.
243-261.- Practices with PLC.

Practices to be done with the Metal to Metal Heat Transfer Module (TXC/MM):

262.- Calibration processes.
263.- Temperature sensors calibration.
264.- Determination of the thermal conductivity "k".
265.- Insulation effect.
266.- Determination of the thermal contact resistance.
267-285.- Practices with PLC.

Practices to be done with the Ceramic Heat Transfer Module (TXC/TC):

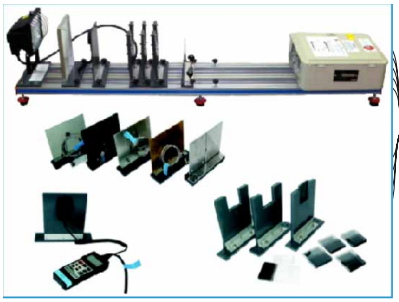
286.- Calibration processes.
287.- Temperature sensors calibration.
288.- Determination of the thermal conductivity "k".
289.- Calculation of the heat transfer properties of specimens.
290-308.- Practices with PLC.

Practices to be done with the Isolated Material Heat Transfer Module (TXC/TI):

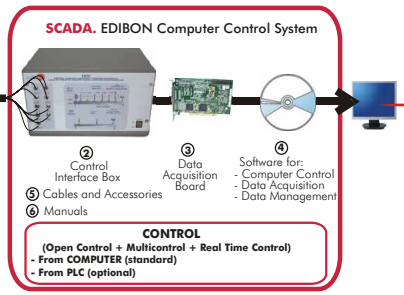
309.- Calibration processes.
310.- Temperature sensors calibration.
311.- Determination of the thermal conductivity "k".
312.- Calculation of the heat transfer properties of specimens.
313-331.- Practices with PLC.

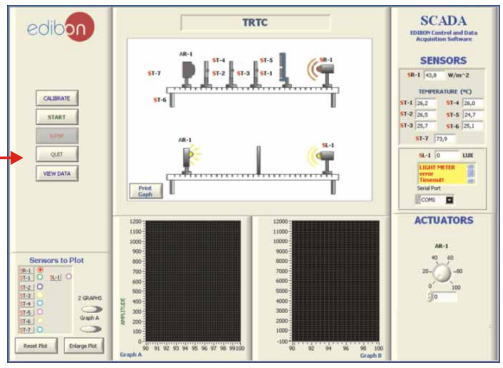
* Non computer controlled version available too.

TRTC. Computer Controlled **Thermal Radiation and Light Radiation Unit**



① Unit: TRTC. Thermal Radiation and Light Radiation Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① TRTC. Unit:

Unit designed to demonstrate the laws of radiant heat transfer and radiant heat exchange. It basically consists in two independent parts. One of the parts is for the light radiation experiments and another part is for the thermal radiation experiments.

Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

This unit consist on a metal plate with a resistance at one side and a lamp in another side. Lengthwise of the metal plate you can place the elements supplied with the unit.

Heating resistance, computer controlled. Lamp, with diffuser.

The unit is provided with accesories for light experiments and radiation experiments.

Light accesories: Luxmeter that allows to measure the intensity of the light. 5 Different grey natural filters. 3 Filter portholes.

Radiation accesories:

Radiometer.

Planes surfaces. They are elements for studying the radiation and each one contains one temperature sensor.

Variable slit or aperture. It allows to regulate the area of the radiation.

7 Temperature sensors. Power measurement from the computer. Radiation measurement from the computer.

② TRTC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TRTC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1400 x 500 x 500 mm. Weight: 40 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TRTC.pdf

PRACTICAL POSSIBILITIES

1.- Inverse of the distant square law for the radiation.
2.- Stefan Boltzmann Law.
3.- Emission power I.
4.- Emission power II.
5.- Kirchorff Law.
6.- Area factors.
7.- Inverse of the distant square law for the light.
8.- Lambert's Cosine Law.
9.- Lambert Law of Absorption.

Other possible practices:

10.- Sensors calibration.

11-29.- Practices with PLC.

TMT. **Temperature Measurement Unit**

SPECIFICATIONS SUMMARY

Bench-top unit to demonstrate the characteristics of the more common temperature sensing an measuring devices.

Anodized aluminium structure and panels in painted steel.

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

Platinum resistance thermometer with digital temperature display. Thermistor thermometer probe with digital temperature display.

A range of "K" type thermocouples (6 units), thermocouple type "T"and thermocouple type "J", which may be connected to either a digital indicator displaying temperature or directly to a millivolt meter.

Selector switch for enabling up to eleven sensors or thermocouple circuits to be connected to a digital temperature display.

Digital millivolt meter.

Vapour pressure thermometer, which works following the relation between the temperature in a liquid and its vapour pressure.

Bi-metal dial thermometer. Dry and wet bulb hygrometer.

Self-adhesive patch temperature indicators.

Alcohol in glass thermometer and storage case.

Water heater with power regulator and thermostatic protection.

High and ambient temperature air blower.

Vacuum flask which may be used for ice-water mixture, getting low temperatures.

Connecting wires. Plugs. Protection devices.

Thermocouples parallel or series associations.

Cables and accessories, for normal operation.

Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.): 800 x 600 x 700 mm. Weight: 50 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TMT.pdf

PRACTICAL POSSIBILITIES

1.- Determining concepts of temperature measurements and scales.
2.- Thermometric properties and characteristic behaviour of different sensors.
3.- Operation, application and assessment of the characteristics of different temperature sensing and indicating devices.
4.- Measuring precision, sensitivity and measuring errors of the different thermometers.
5.- Introduction to calibration techniques and physical principes of each system.
6.- Calibration errors.
7.- Errors associated to a bad electrical connection.
8.- Conduction and transmission errors.
9.- Dynamic response.
10.- Installation methods.
11.- Temperature scales: alcohol thermometer.
12.- The bimetallic thermometer.
13.- The vapour pressure thermometer.
14.- The Peltier thermoelectric effect.
15.- The Seebeck thermoelectric effect.
16.- Intermediate metals Law.
17.- Intermediate temperatures Law.
18.- Direct measurement thermocouple.
19.- Parallel association of thermocouples.
20.- Series association of thermocouples.
21.- Platinum resistance thermometer.
22.- Thermistor.
23.- Wet and dry bulb thermometer.

TMCP. **Pressure Measurement and Calibration Unit**

SPECIFICATIONS SUMMARY

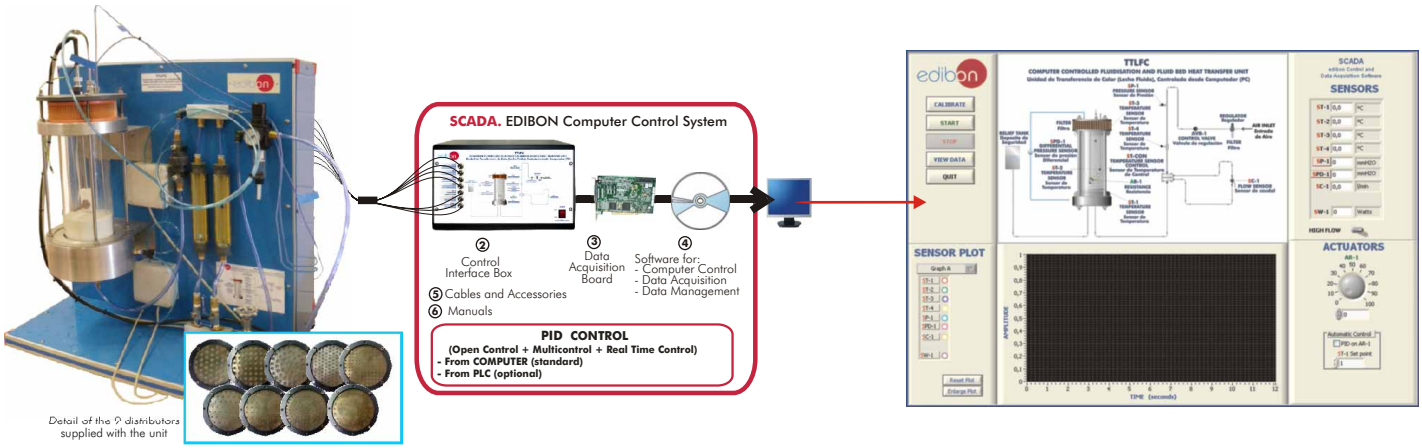
TMCP. Pressure Measurement and Calibration Unit is designed to study pressure and how different methods and tehcniques can be used to measure this variable.
This unit introduces students to pressure, pressure scales and common devices available to measure pressure.
Bench-top unit mounted on an anodized aluminum structure and panel in painted steel.
Dead-weight pressure calibrator, using water, consists of a precision piston and a cylinder, with a set of weights to generate different pressures.
Bourdon type manometer, connected to the dead-weight calibrator.
Electronic pressure sensor, connected to the dead-weight calibrator.
Both Bourdon manometer and pressure sensor are mounted on a manifold block with a separate reservoir (to contain water) .
Valves for allowing the priming, restricted flow of water to demonstrate the application of damping and the connection of other alternative devices for calibration.
Electronic console: Protection devices. Sensor connectors. Digital meter with selector switch to display the output from the pressure sensor and the conditioned reading in engineering units. Conditioning circuit with span and zero controls to allow the output to be displayed as a direct reading pressure meter calibrated in units of pressure.
Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.):
Unit: 500 x 350 x 350 mm. Weight: 15 Kg.
Electrical console: 310 x 220 x 145 mm. Weight: 3 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TMCP.pdf

PRACTICAL POSSIBILITIES

1.- Study the concept of pressure.
2.- Study of the concepts of measurement and calibration (gauge and absolute pressures, zero error, non-linearity, scale error, conversion of arbitrary scale into energy units).
3.- Study of pressure scales.
4.- Study of the function of a dead-weight pressure calibrator.
5.- Study of the operation of a Bourdon type manometer.
6.- Study of the characteristic behaviour of a Bourdon type manometer.
7.- Calibration of a Bourdon type manometer in engineering units.
8.- Calibration of a Bourdon type manometer in arbitrary units (angular displacement of needle).
9.- Study of the characteristic behaviour of a pressure sensor.
10.- Calibration of a pressure sensor and signal conditioning circuit in engineering units
11.- Calibration of a pressure sensor (voltage output from sensor).
12.- Study of the sources of error in measurement and calibration (signal conditioning, display resolution; wear, friction and backlash, etc.).
13.- Study of calibration of conditioning circuits and display using a reference signal.

TTLFC. Computer Controlled **Fluidisation and Fluid Bed Heat Transfer Unit** ✱



① Unit: TTLFC. Fluidisation and Fluid Bed Heat Transfer Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

①TTLFC. Unit:
The TTLFC unit has been designed to provide visual and quantitative results related to the flow of air through both a packed and a fluidised bed of granular material. Clear experimental set-up for investigations of the heat transfer in a fluidised bed. It also provides quantitative results related to heat transfer in a fluidised bed.
Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Bed chamber: crystal cylinder in which is contained a granular material through which a fluid (air) passes and which feeds the bed through a distributor in its lower part. It has two temperature sensors, and two stainless steel couplings that carry a heating resistance (computer controlled) and the pressure probes.
Granular material (glass perls): 1 Kg. (170-300 microns) and 1 Kg. (250-420 microns).
Heating element (150 W), computer controlled: cylindrical heating with a cooper-covered resistance. It has two temperature sensors on the surface, one indicates the surface temperature, and the other is associated to a controller that prevents the temperature from exceeding a pre established value.
Distributor: in the lower part of the bed chamber. 9 different types of distributors supplied with the unit.
Air filter. Regulator and filter. Pressure relief tank. Flow sensor. Pressure sensor. Differential pressure sensor. Temperature sensor in the chamber air intake. Power measurement from the computer (PC).

②TTLFC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TTLFC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 750 x 500 x 750 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TTLFC.pdf

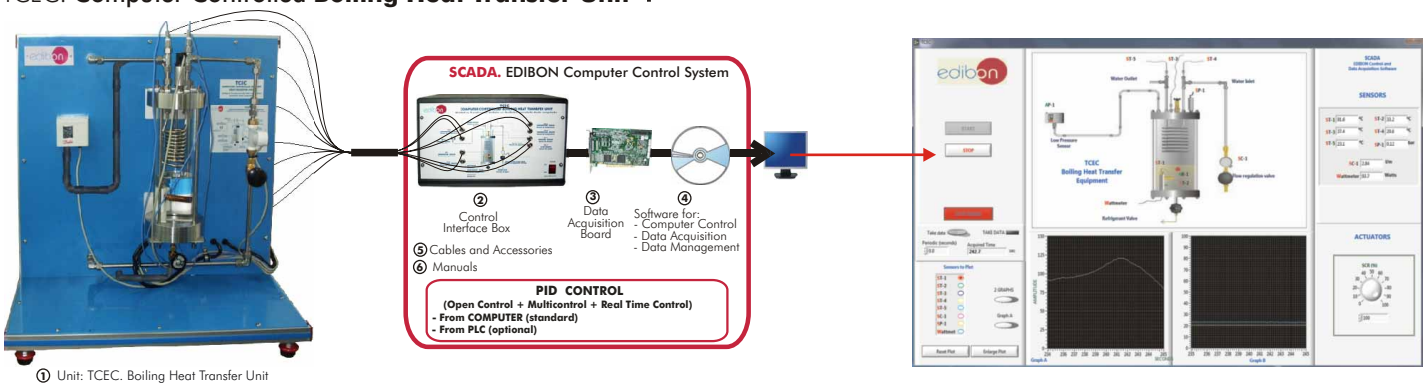
✱ Non computer controlled version available too.

PRACTICAL POSSIBILITIES

1.- Observation of the behaviour in a fluidised bed of a wide range of granular materials, from onset of fluidisation to entrainment.
2.- Study of the behaviour of particles in a bed when an ascendant airflow is applied.
3.- Study of the relation between bed height, drop pressure and ascendent air velocity through the particle bed.
4.- Investigation of the effect of distributor design on bed behaviour.
5- Measurement of air flow and pressure drop through a variety of granular materials.
6.- Demonstration of separation by particle size and density.
7.- Study of the variation of the heat transfer coefficient in a fluidised bed by effect of the following parameters:
Superficial velocity.
Depth of immersion of the hot surface in the bed.
Particle size.

Other possible practices:
8.- Sensors calibration.
9-27.- Practices with PLC.

TCEC. Computer Controlled **Boiling Heat Transfer Unit** ✱



① Unit: TCEC. Boiling Heat Transfer Unit

SPECIFICATIONS SUMMARY
Items supplied as standard

①TCEC. Unit:
Students can investigate the modes of boiling and can make qualitative and quantitatives studies and assessments of convective, nucleate and film boiling. This unit allows the student to see the processes taking place inside a transparent cylinder and measure temperatures and heat flux under steady state conditions. Wide range of conditions can be investigated.
Bench-top unit, designed to employ the coolant SES-36.
Diagram in the front panel with similar distribution to the elements in the real unit.
Chamber: internal diameter: 90 mm., external diameter: 100 mm., and length: 300 mm. Heating resistance, computer controlled (690 W). Serpentine condenser: a copper tube plated with a surface of 0.043 m^2. Load valve placed in the bottom part of the cylinder and it is used for charging and discharging of the unit.
Water flow control valve, located in the conduction line of water, that regulates the water flow that inputs the serpentine.
Purge and safety valve. 5 Temperature sensors: to measure the temperature of the hot surface, of the coolant, at the water inlet, at the water outlet and to determine the temperature of the saturated vapour. Pressure sensor. The electric power consumed by the heating resistance is controlled from the computer. Flow sensor. Temperature circuit breaker. High-pressure cut out.

② TCEC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TCEC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 700 x 700 x 720 mm. Weight: 70 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCEC.pdf

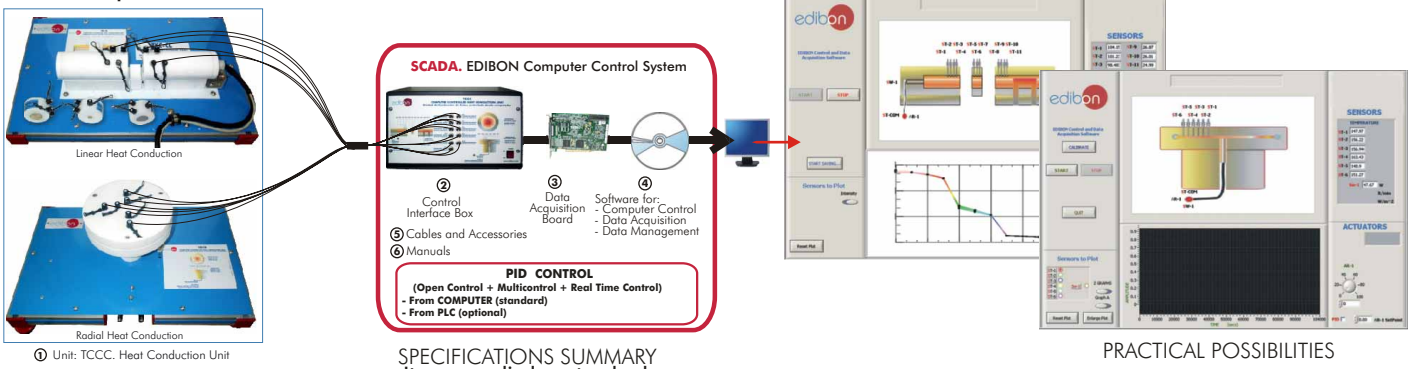
PRACTICAL POSSIBILITIES

1.- Visual demonstration of the three boiling modalities (convective, nucleate and film boiling).
2.- Determination of the thermal flow and the superficial heat transfer coefficient.
3.- Effect of the pressure on the critical thermal flow.
4.- Film condensation.
5.- Demonstration of the liquid dragging for the vapour.
6.- Relationship between the pressure and the temperature.
7.- Air effect in an installation.

Other possible practices:

8.- Temperature sensors calibration.
9.- Flow sensor calibration.
10.- Pressure sensor calibration.
11.- Study of the hysteresis of the flow sensor.
12.- Gauge pressure/Enthalpy.
13.- Properties of the SES-36.
14-32.- Practices with PLC.

TCCC. Computer Controlled **Heat Conduction Unit**



① Unit: TCCC. Heat Conduction Unit

SPECIFICATIONS SUMMARY
Items supplied as standard

①TCCC. Unit:
Heat Conduction Unit "TCCC" has been designed to demonstrate the heat transmission principles for conduction, allowing the study of the linear and radial conduction.
Diagrams in the front panels with similar distribution to the elements in the real units. The unit consists of two separate modules:
TXC/CL. Linear Heat Conduction Module:
Input heat section. Electric heater, computer controlled. Refrigeration section with a surface cooled by water. Central sections: with brass of 25 mm of diameter, with brass of 10 mm of diameter and with stainless steel of 25 mm of diameter. Water flow sensor. Water regulation flow valve. 13 Temperature sensors.
TXC/CR. Radial Heat Conduction Module:
Brass disk of 110 mm of diameter and 3 mm of thickness. Incorporated electric heater, computer controlled. Peripheral cooling tube. Water flow sensor. Water regulation flow valve. 8 Temperature sensors.
Power measurement from the computer (PC).

②TCCC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TCCC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = TXC/CL module: 400 x 300 x 300 mm. Weight: 20 Kg. TXC/CR module: 400 x 300 x 300 mm. Weight: 20 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCCC.pdf

PRACTICAL POSSIBILITIES

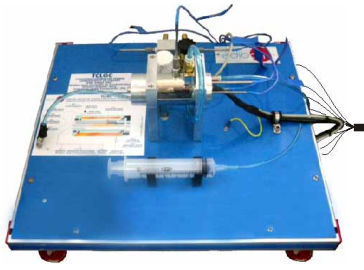
1.- Conduction through a simple bar.
2.- Conduction through a compound bar.
3.- Determination of the thermal conductivity "k" of different materials (conductors and insulators).
4.- The thermal conductivity properties of insulators may be found by inserting paper or other elements between the heating and cooling sections.
5.- Insulation effect.
6.- Determination of the thermal contact resistance R_{tc}.
7.- Effect of the crossing sectional area.
8.- Radial conduction.
9.- Understanding the use of the Fourier equation in determining rate of heat flow through solid materials.
10.- Observing unsteady-state conduction.

Other possible practices:

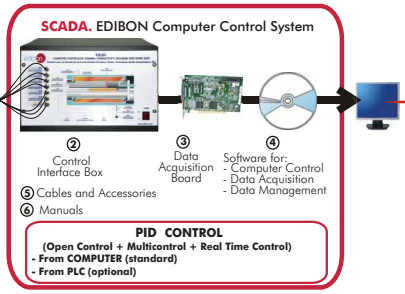
11.-Calibration processes.
12.-Calibration of the temperature sensors.
13-31.- Practices with PLC.

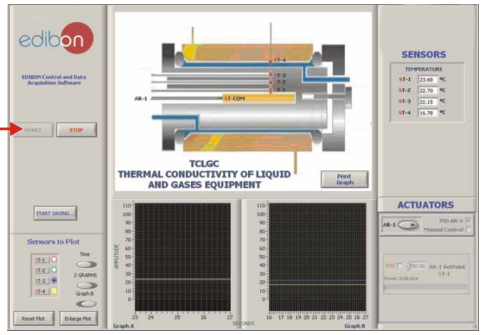
✱ Non computer controlled version available too.

TCLGC. Computer Controlled **Thermal Conductivity of Liquids and Gases Unit**



① Unit: TCLGC. Thermal Conductivity of Liquids and Gases Unit





SPECIFICATIONS SUMMARY
Items supplied as standard

①TCLGC. Unit:
Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Aluminium body (cylinder) with brass jacket that contains the test fluid and the refrigeration water. Variable heating resistance (in the cylinder), computer controlled. The power is measured by a sensor. Water flow regulation valve. Valves. Syringe.
6 Temperature sensors. Water flow sensor.

②TCLGC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TCLGC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 500 x 400 x 300 mm. Weight: 40 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCLGC.pdf

PRACTICAL POSSIBILITIES

1.- Obtaining of the curve of thermal conductivity of the air.

2.- Thermal conductivity in vacuum.

3.- Water thermal conductivity determination.

4.- Thermal conductivity determination of a mineral oil.

5.- Calibration of the Unit.

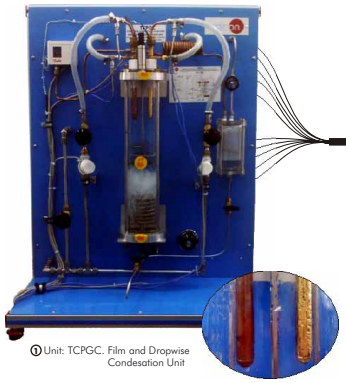
6.- Control system: Calibration of the sensors.

Other possible practices:

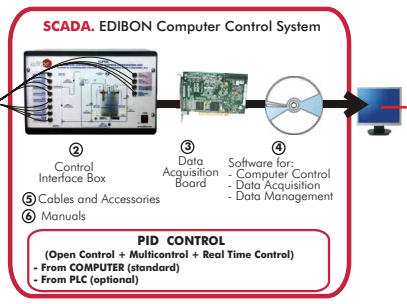
7.- Dry air thermal conductivity under atmospheric pressure.

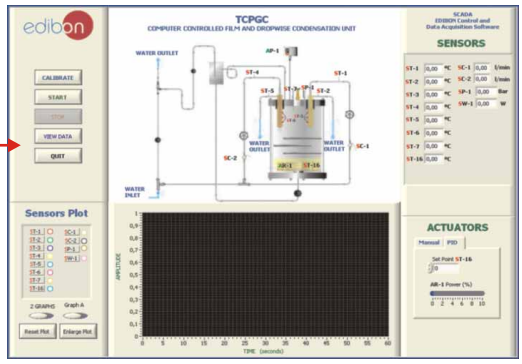
8-26 .- Practices with PLC.

TCPGC. Computer Controlled **Film and Dropwise Condensation Unit** ✱



① Unit: TCPGC. Film and Dropwise Condesation Unit





SPECIFICATIONS SUMMARY
Items supplied as standard

①TCPGC. Unit:
The TCPGC unit has been specially designed for students use and to provide visual results and quantitative results related to heat transfer during condensation. Self-contained unit, which has its own steam generator and air extraction system, as well as condensers to provide dropwise and filmwise condensation.
Diagram in the front panel with similar distribution to the elements in the real unit.
Steam chamber: thick-walled glass cylinder with aluminium ends and P.T.F.E. seals.
2 Water cooled condensers, mounted in the upper cylinder cover:
Dropwise condenser-gold plated. Filmwise condenser-natural finish.
Each condenser is provided with three connected temperature sensors.
Electric heating element (3 KW. resistance) with thermal protection. Power of the resistance computer controlled.
Air extraction system, composed by air cooler, separator and water jet vacuum pump.
Pressure sensor, to measure the chamber pressure. 2 Water flow sensors, to measure the water flow rate through the condensers.Power measurement from the computer (PC).
Safety elements.

②TCPGC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safe levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TCPGC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 700 x 570 x 770 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCPGC.pdf

PRACTICAL POSSIBILITIES

1.- Investigation of the saturation pressure/temperature relationship for H_2O between about 20° C and 100°C.

2.- Visual demonstration of filmwise and dropwise condensation, and of nucleate boiling.

3.- Measurement of heat flow and surface heat transfer coefficient in both filmwise and dropwise condensation at pressures up to atmospheric.

4.- Demonstration and investigation of the effect of air in condensers.

5.- Demonstration of Dalton's Law.

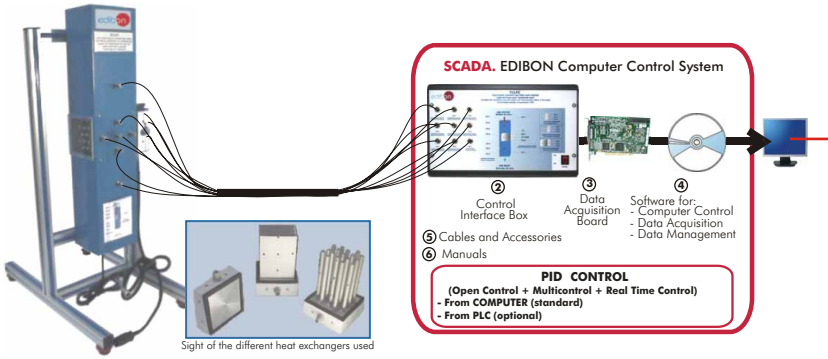
Other possible practices:

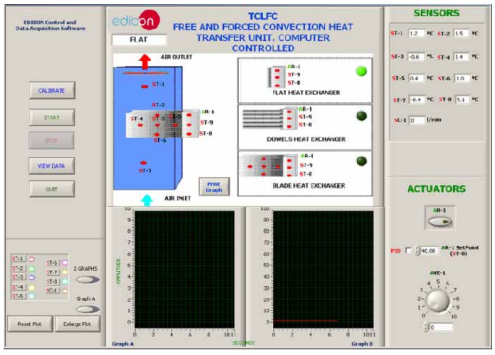
6.- Sensors calibration.

7-25 .- Practices with PLC.

✱ Non computer controlled version available too.

TCLFC. Computer Controlled **Free and Forced Convection Heat Transfer Unit**





① Unit: TCLFC. Free and Forced Convection Heat Transfer Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① TCLFC. Unit:
This Unit allows to study the efficiency of different exchangers, analyzing the heat transmission coefficients of each of the exchangers exposed to different airflows. Stainless steel tunnel of rectangular section, 700 mm long. In the tunnel three type of different heat exchangers can be set. Viewer that allows a good visualization of the exchanger that is in use. Stabilizers to guarantee an uniform air flux. 9 Temperature sensors: 2 temperature sensors measure the air temperature at the inlet and outlet of the area of heat exchange, temperature measurements, at different distances of the base of the dowels and blade exchangers, are made by other five temperature sensors that are introduced by one side of the tunnel, 1 temperature sensor for the heating resistance and 1 temperature sensor in the exchangers. Flow sensor, for measuring the air flow generated.
3 Aluminium exchangers: Flat heat exchanger, Dowels heat exchanger and Blade heat exchanger. Heating resistance of 150W for each exchanger, computer controlled.
Variable speed fan, computer controlled, which generates air flux through the tunnel.

② TCLFC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Realtime curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TCLFC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 370 x 610 x 920 mm. Weight: 25 Kg. Control Interface: 490x330x310 mm. Weight: 10 Kg.

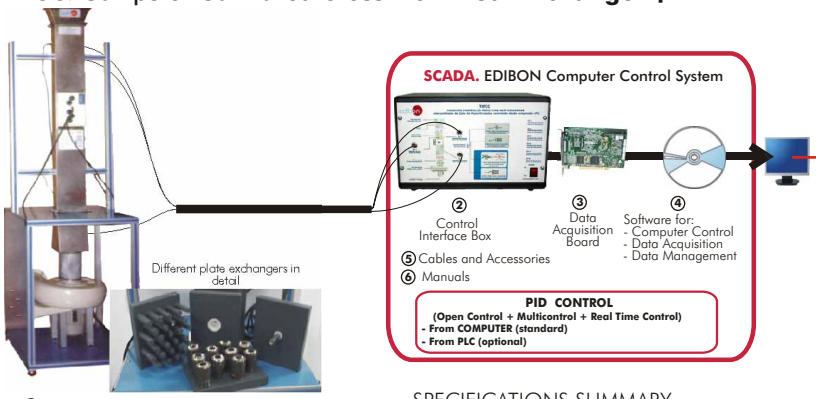
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCLFC.pdf

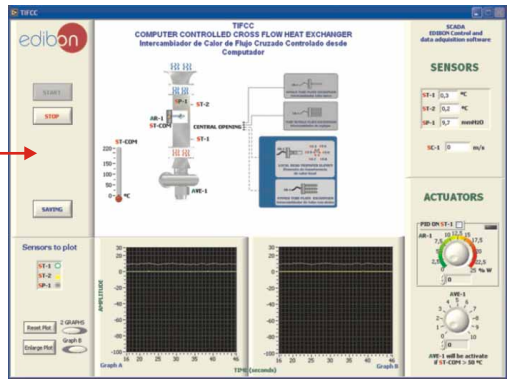
PRACTICAL POSSIBILITIES

1.- Demonstration of the basic principles of free and forced convection.
2.- Comparison between free and forced convection.
3.- Free convection in flat surfaces.
4.- Forced convection in flat surfaces.
5.- Dependence of the heat transmission with the temperature.
6.- Dependence of the heat transmission with the speed of the fluid.
7.- Dependence of the heat transmission with the exchanger geometry.
8.- Temperature distribution in the additional surfaces.
9.- Study of the advantage of using spiked and bladed surfaces in heat transmission in free convection.
10.- Study of the advantage of using spiked and bladed surfaces in heat transmission in forced convection.
11.- Comparative study between the free convection of a horizontal surface and vertical surface.

Other possible practices:
12.- Sensors calibration.
13-31.- Practices with PLC.

TIFCC. Computer Controlled **Cross Flow Heat Exchanger** ✱





① Unit: TIFCC. Cross Flow Heat Exchanger

SPECIFICATIONS SUMMARY

Items supplied as standard

①TIFCC. Unit:
This unit is used to study the phenomenon of heat transfer in convection in a crossed flow.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Mouth bell input of resistant stainless steel. Vertical air tunnel of stainless steel of rectangular section (65 x 170 mm.) and 1200 mm. of length. This tunnel has a rectangular central opening of 200 x 150 mm., placed in a longitudinal way, that is good to insert the different plates with the tubes in the current of air and to carry out the applicable experiments.
Flange of joining elastic tunnel-fab with band. Centrifugal fan, computer controlled. Air flow adjustable.
Temperature sensors. Differential pressure sensor.
Active element (heating resistance). It is a cylinder of thick walls heated electrically. The element incorporates one thermoelectric couple. Electrical power: 700W.
Exchangers included:
Single tube plate exchanger: can be installed in the air tunnel in order to study the behaviour of one single tube in the traverse current.
Tube bundle plate exchanger: a thick plate with 27 fixes tubes placed in an equilateral triangle. The tubes are placed in six lines and there is a removable tube next to the center of each line.

Optional (not included in the standard supply):
-TIFCC/A. Local Heat Transfer Element. -TIFCC/F. Finned Tube Plate Exchanger.

②TIFCC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TIFCC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 900 x 450 x 2000 mm. Weight: 100 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TIFCC.pdf

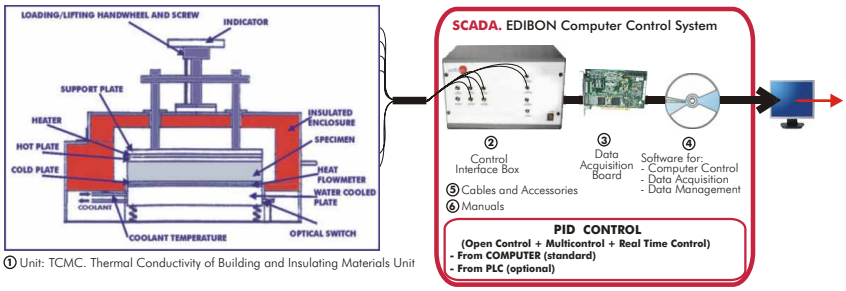
PRACTICAL POSSIBILITIES

1.- Investigation of convection processes.
2.- Determination of the heat transfer for a single tube.
3.- Determination of the heat transfer for a bench of tubes.
4.- Determination of the average heat transfer in a bench of tubes.
5.- Deduction of the relationship among the numbers of Nusselt, Reynolds and Prandtl.
6.- Effect produced by the external fins in the heat transfer process.
7.- Determination of the heat transfer for a bench of tubes with fins.
8.- Relationship between Nusselt´s an Reynolds´s numbers using the element TDC.
9.- Determination of local variation in the transmission coefficient of convective heat.
10.- Comparison of heat transfer for different heating elements.
11.- Comparison between different heating elements.
12.- Control System: Calibration of the temperature sensors.
13.- Calibration of the differential pressure sensor.
14.- Control System: Determination of the adjustment parameters of a PID-PWM controller.

Other possible practices:
15.- Determination of the airflow.
16.- Dynamic Simulation of the Control Systems.
17.- Operation and calibration of the process equipment and control elements.
18-36. Practices with PLC.

✱ Non computer controlled version available too.

TCMC. Computer Controlled **Thermal Conductivity of Building and Insulating Materials Unit**



① Unit: TCMC. Thermal Conductivity of Building and Insulating Materials Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① TCMC. Unit:

Unit for determination of thermal conductivity of building and other insulating materials.

Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Measurement of thermal conductivity for materials with thermal resistance in the range 0.1 to 1.4 m^2 K/W at mean temperatures up to 50° C. Suitable for sheet, fibrous, granular and cellular materials. Suitable for soft, rigid, and semi-rigid materials up to 5kg sample weight. Suitable for homogeneous and non-homogeneous materials.

Specimens size: 300 x 300 mm and up to 75 mm of thicknesses.

Thermal performance of single layer and composite materials of various thicknesses up to 75 mm. Insulated enclosure. Electric heater. Height adjustable 500W hot plate, controlled. Water-cooled cold plate. Loading/lifting handwheel and screw. Optical switch under the cold plate senses the compression of loading springs to ensure that a consistent pressure is applied to the specimen. Heat flow sensor, flitted to cold plate. Temperature sensors. A set of specimens, 8 pieces.

② TCMC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TCMC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 950 x 700 x 500 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCMC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the thermal conductivity of different materials.

2.- Determination of the thermal resistance.

3.- Thermal conductivity of several specimens connected in series.

4.- Industrial research capability.

Other possible practices:

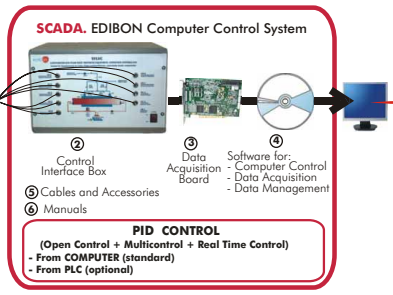
5.- Sensors calibration.

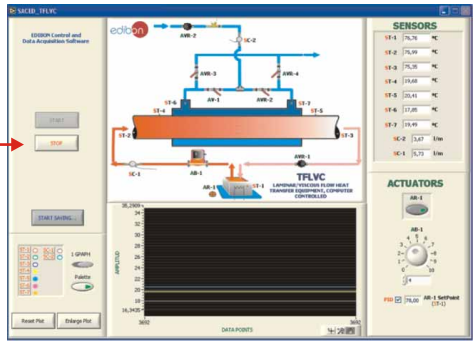
6-24.- Practices with PLC.

9.10- Heat Transfer (Special)

TFLVC. Computer Controlled **Laminar/Viscous Flow Heat Transfer Unit** ✱

① Unit: TFLVC. Laminar/Viscous Flow Heat Transfer Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① TFLVC. Unit:
The Laminar/Viscous Flow Heat Transfer Unit, computer controlled "TFLVC" is an unit at laboratory scale, designed to study heat transfer between hot oil flowing in laminar flow through an internal tube and cold water that flows through the annulus (ring-shaped area).
Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.
Heat exchanger constituted by two concentric tubes with hot oil flowing through the internal tube and cold water flowing through the ring-shaped area.
Exchanger length L = 0.92 m.
Internal tube: internal dia.: 10×10^{-3} m = 10 mm, external dia.: 12×10^{-3} m = 12 mm, depth = 10^{-3} m = 1 mm, heat transfer internal area: $A_{h_i} = 0.0289\ m^2$, heat transfer external area: $A_{h_e} = 0.0347\ m^2$.
External tube: internal dia.: 16×10^{-3} m = 16 mm, external dia.: 18×10^{-3} m = 18 mm, depth = 10^{-3} m = 1 mm.
Stainless steel heater tank, with: heating resistance (computer controlled) and temperature sensor to measure oil temperature. Pump, computer controlled, for pumping hot oil. 2 Flow sensors: for oil and for water. 7 Temperature sensor: 1 for the heater tank and 6 distributed along the exchanger. 2 Control valves for cold water and oil flow. 4 ball valves that may provide co-current or counter-current flow in the exchanger.

② TFLVC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TFLVC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1000 x 770 x 670 mm. Weight: 80 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TFLVC.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of a concentric tube heat exchanger with co-current and counter-current flow in laminar/viscous flow.

2.- Energy balance for the heat exchanger.

3.- Determination of surface heat transfer coefficients on the oil and water sides and determination of the overall heat transfer coefficient.

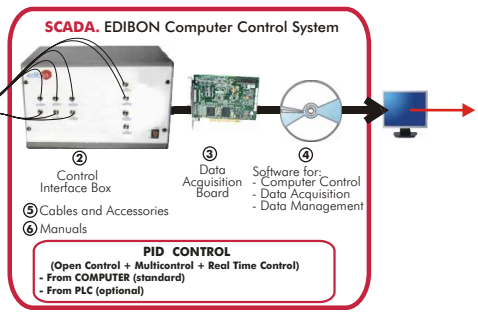
4.- Relationship between Nusselt Number and Graetz Number for Reynolds Numbers up to 1400.

Other possible practices:

5.- Sensors calibration.

6-24 .- Practices with PLC.

TIVAC. Computer Controlled **Steam to Water Heat Exchanger**



① Unit: TIVAC. Steam to Water Heat Exchanger

SPECIFICATIONS SUMMARY

Items supplied as standard

① TIVAC. Unit:
This unit has been designed to provide results (visual and quantitative) related to heat transfer in shell and tube type water cooled condensers.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Steam to water shell and tube condensing heat exchanger having its own 3KW steam generator and four U tube condensers. Three interchangeable manifolds allowing single, double or four pass operation. Heater. Circulating pump. Temperature sensors to measure steam chamber and condenser inlet and outlet temperatures. Pressure sensor to measure pressure drop across condenser. 2 Flow sensors to measure total water flow through condenser and water flow from mains. Pressure sensor for steam chamber pressure. Safety elements as pressure relief valve, pressure switch etc.

② TIVAC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TIVAC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 700 x 600 x 750 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TIVAC.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of the increase in heat exchanger effectiveness due to increasing the number of tube passes at constant flow rates.

2.- Visual demonstration of filmwise condensation and nucleate boiling.

3.- Measurement of the effect of coolant flow velocity and the number of tube passes on pressure drop.

4.- Investigation of the saturation pressure/temperature relationship for water at low pressures.

5.- Investigation of the effect of increasing flow velocity and number of tube passes on the overall heat transfer coefficient.

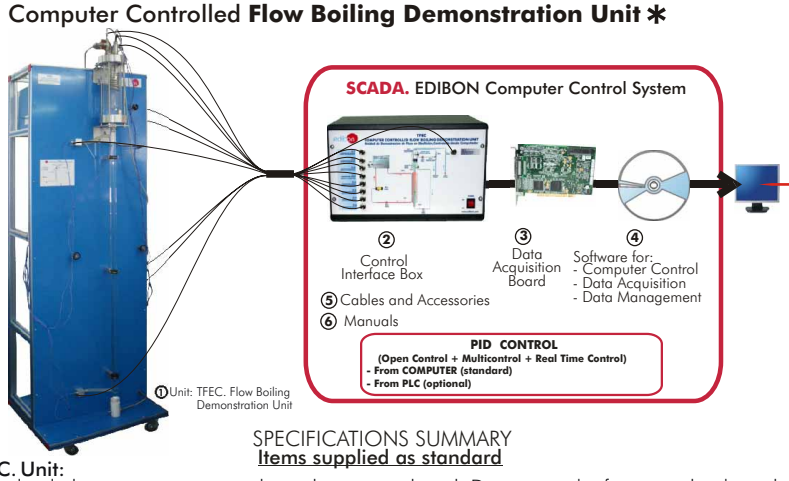
Other possible practices:

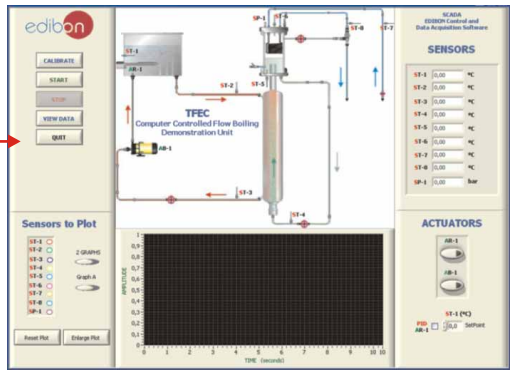
6.- Sensors calibration.

7-25 .- Practices with PLC.

✱ Non computer controlled version available too.

TFEC. Computer Controlled **Flow Boiling Demonstration Unit** ✱





SPECIFICATIONS SUMMARY
Items supplied as standard

① TFEC. Unit:
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit. Experiment visualisation tube of 1500 mm. length composed by two glass concentric tubes. Refrigerant control valve. Condensing chamber. Security valve, to avoid overpressures. Condensate coil. Thermostatic bath, that heats the water that flows by the experimental tube (heating resistance of 600W, computer controlled). Centrifugal pump for hot water impulsion, computer controlled. Water control valve regulates the water flow that enters in the condensate coil. Water jet pump for extracting the air and controlling the refrigerant pressure.
8 Temperature sensors, distributed along the process to know the heat transfers occurred.
1 Absolute pressure sensor. Water flow meter. Drain and security valve.
This unit has been designed for using SES36 refrigerant gas, free of CFC´s, compatible with the Environment.

② TFEC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TFEC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 750 x 700 x 2100 mm. Weight: 70 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TFEC.pdf

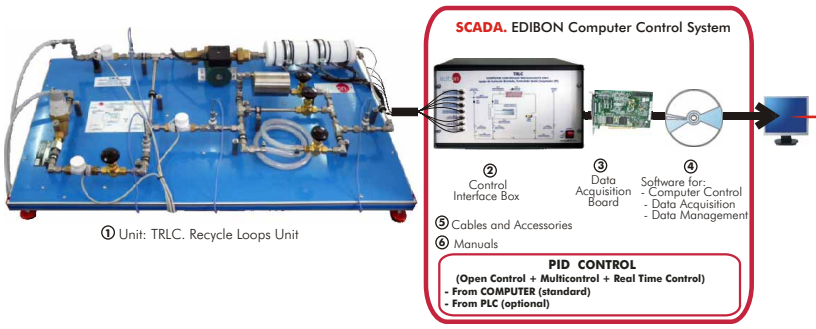
PRACTICAL POSSIBILITIES

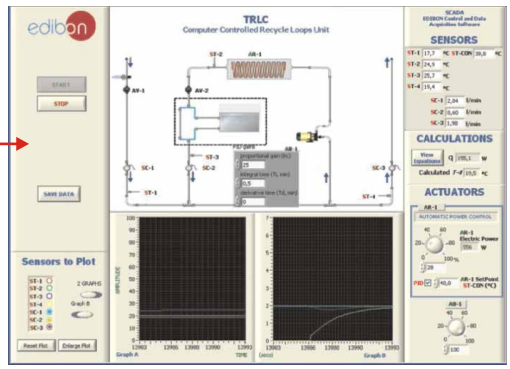
1.- Observation of:
- Single-phase liquid flow.
- Sub-cooled boiling.
- Bubbly flow.
- Slug regime.
- Annular flow.
- Film boiling.
- Drop flow (mist).
- Single-phase vapour flow.

2.- Demonstration of a heating process accompanied by vapour formation within a tube, including:
- Circulation promoted by natural convection.
- Nucleation in sub-cooled and saturated liquid.
- Convective heat transfer to sub-cooled liquid.
- Slugging.
- Droplet entrainment.
- Annular flow.
- Complete dry out to superheated vapour.

3.- Demonstration of effect of air in condensers.
4.- Demonstration of two phase flow with increasing vapour content.
5.- Effect of flow rate on the evaporation process.
6.- Effect of temperature on the evaporation process.
7.- Effect of pressure on the evaporation process.
8.- Relationship between pressure and temperature.
9.- Film condensation.
Other possible practices:
10.- Sensors calibration.
11-29.- Practices with PLC.

TRLC. Computer Controlled **Recycle Loops Unit** ✱





SPECIFICATIONS SUMMARY
Items supplied as standard

① TRLC. Unit:
Unit to demonstrate, both visually and experimentally, how a recycle loop works. It has a lot of teaching applications of which the carried out of mass and energy balances under steady and unsteady state conditions is emphasized.
Diagram in the front panel with similar distribution to the elements in the real unit.
Water inlet pipe, which incorporates a temperature sensor and a flow sensor. Water inlet flow regulation valve. Pressure regulation valve, to avoid overpressures.
Recycle loop, composed of: recirculation pump (computer controlled); heating resistance (2000W) that works with a PID control over the temperature sensor; protection thermostat for the heating resistance; water control valve; 3 temperature sensors and flow sensor.
Water outlet pipe, which incorporates a temperature sensor and a flow sensor.
Different volumes of recycle loop, usable without having to be dismounted.

② TRLC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TRLC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1110 x 630 x 300 mm. Weight: 40 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TRLC.pdf

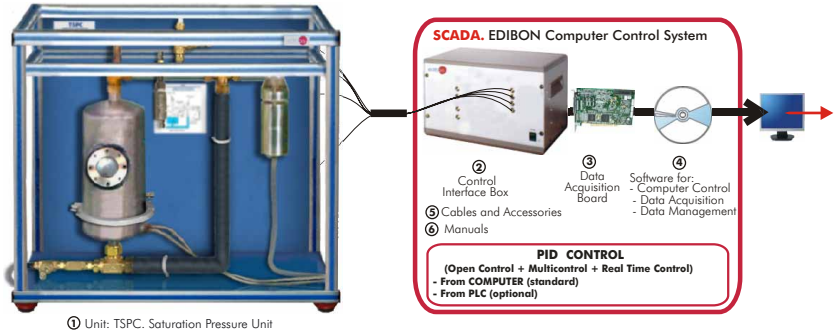
PRACTICAL POSSIBILITIES

1.- Understanding the meaning of recycle.
Steady state mass balances: (2)
2.- Demonstrating that whatever the recycle rate, the inlet flow rate always equals the outlet flow rate.
Unsteady state heat balances: (3-6)
3.- Determining the unit response when the electrical heater is switched on at different through flow rates.
4.- Determining the effect of a changes in the inlet flow.
5.- Determining the response when the electrical heater is switched off at different through flow rates.
6.- Determining the effect of recycle with no through flow.
Steady state heat balances: (7-8)
7.- With the electrical heater switched on and at a fixed water flow rate at the inlet we can check that different reclycled flow incites a variation in the outlet temperature.
8.- With the electrical heater switched on, the difference between inlet temperature and outlet temperature can be used to determine the heat quantity absorbed in the recycle loop.
9.- Use of the steady flow energy equation for the overall system.
10.- Use of the steady flow energy equation for the mixing process.
11.- Effects on response rates to parameter changes in recycle flow.
12.- Effects on response rates to parameter changes in through flow.
13.- Effects on response rates to parameter changes in loop volume.
14.- Effects on response rates to parameter changes in heater power.
Other possible practices:
15.- Sensors calibration.
16-34.- Practices with PLC.

✱ Non computer controlled version available too.

9.10- Heat Transfer (Special)

TSPC. Computer Controlled **Saturation Pressure Unit**



① Unit: TSPC. Saturation Pressure Unit

SPECIFICATIONS SUMMARY
Items supplied as standard

①TSPC. Unit:

The Saturation Pressure Unit has been designed to introduce students to how the temperature of water behaves at its boiling point variation in the absolute pressure. The quality of steam exiting the unit can be determined by a throttling calorimeter connected at the point of discharge. It allows the measurement of the relationship between temperature and pressure of the saturated vapour in the loop.

Boiler vessel and pipe loop with a pressure relief valve to limit the operation pressure and a pressure sensor that indicates the pressure in the unit for safe operation. Sight glass in the bolier allows observation of the boiling patterns. Control of heat input to the boiler using variable power control.

2 Electric heating elements (500W approx. each one) for heating the boiler, with variable power control and over-temperature protection. A throttling calorimeter allows the condition of the saturated steam to be determined by measuring the temperature of the steam following throttling to atmospheric pressure. Temperature sensors. Pressure in the loop is measured using and pressure sensor.

②TSPC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TSPC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 700 x 400 x 600 mm. Weight: 40 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TSPC.pdf

PRACTICAL POSSIBILITIES

1.- Measurement of the relationship between temperature and pressure of the saturated vapour in the loop.
2.- Understanding the origin and use of steam tables.
3.- Understanding saturation curves.
4.- To study the characteristics of a two phase fluid.
5.- Using a throttling calorimeter to determine the quality of wet steam.

Saturation Loop:(6 to 13)

6.- Observation of the patterns of boiling at the surface of the water.
7.- To study the concept of a saturation line.
8.- Gauge and absolute pressures.
9.- Measurement of the temperature of saturated steam over the range of pressures 0 to 7 bar gauge and comparison of the saturation curves obtained.
10.- Temperature scales.
11.- Observation of the effect of rate of response on the accuracy of measurement.
12.- To study the characteristic behaviour of a two phase fluid.
13.- The describing equation and linearisation.

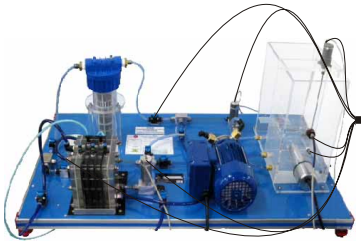
Throttling Calorimeter:(14 to 18)

14.- Determination of the condition of the wet steam (quality of the steam) produced by the saturation pressure unit at different operating pressures.
15.- The two property rule.
16.- The difference in enthalpy between phases-enthalpy of vaporisation.
17.- Use of steam tables.
18.- Use of the steady flow energy equation.

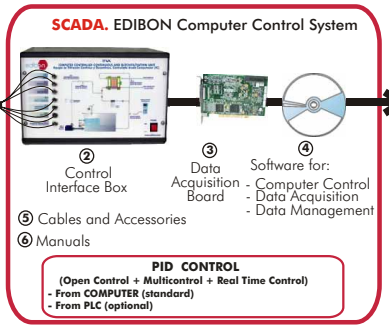
Other possible practices:

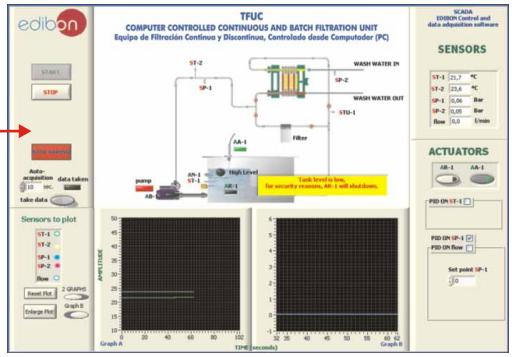
19.- Sensors calibration.
20-38.- Practices with PLC.

TFUC. Computer Controlled **Continuous and Batch Filtration Unit** ✱



①Unit TFUC. Continuous and Batch Filtration Unit





SPECIFICATIONS SUMMARY
Items supplied as standard

①TFUC. Unit:

This filtration unit demonstrates the principles of continuous and batch filtration. Anodized aluminium structure and panel in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Double tank, connecting to a centrifugal pump which feeds a slurry to one of the filters depending on the position of the valves. Centrifugal pump, computer controlled. PID controls enable constant flow rate and constant pressure operation. Heating resistance, computer controlled.

Vertical plates filter, composed of 4 sheets of nylon allowing us to filter the $CaCO_3$ suspension of known concentration. Filter cartridge will filter and "clean" water with small pieces of paper sample. Stirrer, computer controlled.

2 Temperature sensors. 2 Pressure sensors. 1 Differential pressure sensor, for flow measurement.

②TFUC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TFUC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 750 x 750 x 400 mm. Weight: 30 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TFUC.pdf

PRACTICAL POSSIBILITIES

1.- Understanding the principles of continuous and batch filtration using both constant pressure and constant flow operating modes (vertical plates and cartridge filters).
2.- Study of the filter plate at a constant pressure.
3.- Study of the filter plate at a constant flow.
4.- Study of the filter cartridge at constant pressure.
5.- Study of the filter cartridge at constant flow.
6.- Demonstrating filtration through membrane technology.
7.- Mass balancing.
8.- Precoat and body aid filtration.
9.- Demonstration of precoat filtration.
10.- Optimisation of filtration performance using body aid.
11.- Demonstration of Darcy's Law.
12.- Effect of body aid on medium and cake resistances.
13.- Determination of medium and cake resistances.
14.- Filter cake washing and dewatering.
15.- Study of commercial aspects of filtration and optimisation of filtration operations.

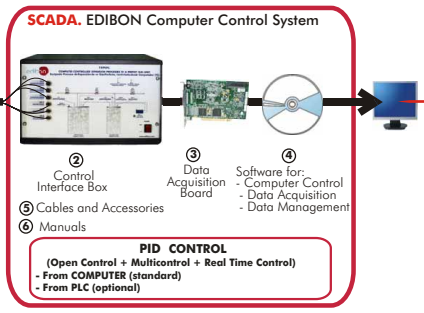
Other possible practices:

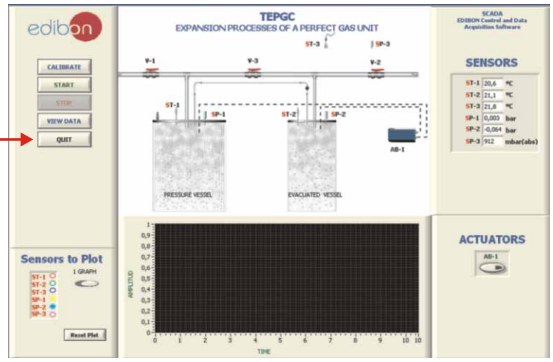
16.- Sensors calibration.
17-35.- Practices with PLC.

✱ Non computer controlled version available too.

TEPGC. Computer Controlled **Expansion Processes of a Perfect Gas Unit**

① Unit: TEPGC. Expansion Processes of a Perfect Gas Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

①TEPGC. Unit:
The "TEPGC" is a demonstration unit of expansion processes of a perfect gas. It uses the air to carry out the experiments and so to demonstrate the basic principles of Thermodynamics.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
2 Transparent interconnected vessels, one operating under pressure and the other under vacuum. The capacity of the pressurised vessel is 20 litres. The capacity of the evacuated vessel is 12 litres.
Each vessel with the following features:
Interconnection between the two vessels via a large diameter pipe and valve (fast change) and small diameter pipe and regulation valve (gradual change).
Connection to a large diameter pipe and valve to allow depressurisation/pressurisation of the vessel to/from the atmosphere.
Connection to sensor to measure the pressure/vacuum inside the vessel.
Connection to the air pump via isolating valve to allow the vessel to be pressurised/evacuated.
Temperature sensor for measuring the air temperature inside the vessel.
Relief valve to avoid over-pressurisation in the pressurized vessel.
Air pump, computer controlled. It allows the pressurisation or evacuation of the vessels.
This unit allows pressure and temperature changes to be controlled continuously using a computer.
The vessels can be operated singly or in combination allowing processes whereby air flows from a pressurised vessel to atmosphere, from atmosphere to an evacuated vessel or from a pressurised vessel to an evacuated vessel.
Total sensors included: 2 Temperature sensors. 2 Pressure sensors, one in each vessel. 1 Barometric pressure sensor. 1 Room temperature sensor.

②TEPGC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TEPGC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 705 x 570 x 1125 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransferspecial/TEPGC.pdf

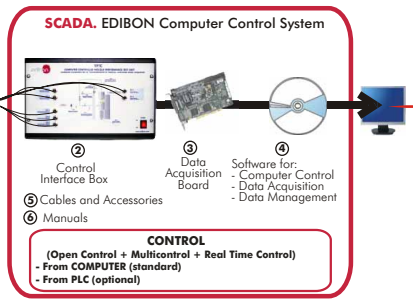
PRACTICAL POSSIBILITIES

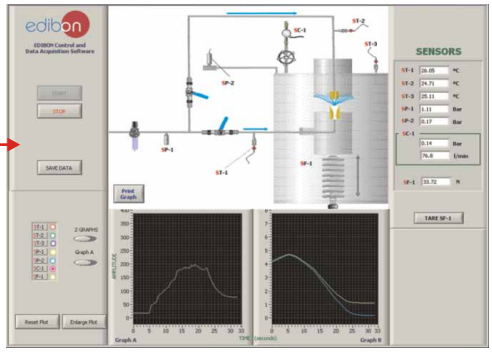
1.- To study of the pressure changes in the processes involves the 1st Law of Thermodynamics.
2.- Understanding of the 2nd Law of Thermodynamics and its corollaries.
3.- Different responses resulting from fast or slow changes in a process can be observed.
4.- Relationship between volume, pressure and temperature can be studied and used to determine other thermodynamic properties.
5.- Relationship between the pressure and temperature of air can be observed.
6.- To study the behaviour of a perfect gas and its describing equations.
7.- Study of the non-flow energy equation.
8.- Study of the unsteady-flow energy equation (in vacuum mode).
9.- Study of an adiabatic reversible process (isentropic expansion).
10.- Study of a constant volume process.
11.- Study of the conversion of pressure units.
12.- Study of an adiabatic irreversible process.
13.- Study of a constant internal energy process.
14.- Study of the polytropic processes, with the limiting case of $n=\gamma$.
15.- Study of the relative and absolute pressures.

Other possible practices:
16.- Sensors calibration.
17-35.- Practices with PLC.

TFTC. Computer Controlled **Nozzle Performance Test Unit**

① Unit: TFTC. Nozzle Performance Test Unit





SPECIFICATIONS SUMMARY
Items supplied as standard

①TFTC. Unit:
This unit has been specially designed to allow students to investigate the performance of a nozzle (kinetic energy and thrust).
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Chamber in stainless steel, diameter: 200 mm. approx. and height: 400 mm. approx.
Nozzles kit (5 nozzles) of 2 mm. of nominal throat. 1 convergent nozzle (with ratio:1) and 4 convergent-divergent nozzles with 1.2, 1.4, 1.6 and 2 ratio, respectively.
2 Pressure sensors, one to measure the chamber inlet pressure and other to measure the chamber pressure.
2 Temperature sensors to measure chamber inlets temperatures.
1 Temperature sensor to measure the chamber temperature.
Flow sensor to measure the chamber outlet air flow.
Force sensor.
2 deviation valves to direct air to the nozzle or to the chamber.
Chamber valve to control chamber pressure (outlet pressure valve).
Inlet pressure regulation valve with humidity filter, where the laboratory compressor will be connected.
Nozzles may be changed in seconds.

②TFTC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TFTC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 1000 x 700 x 600 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TFTC.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of the phenomenon of "choking".
2.- Determination of jet reaction and specific thrust at a variety of inlet and back pressure.
3.- Determination of inlet pressure effect on mass flow rate, for a given back pressure.
4.- Comparison of actual mass flow rate with the theoretical value.
5.- Determination of the back pressure effect on the mass flow rate.
6.- Calculation of nozzle efficiencies.
7.- Determination of the jet velocity and the nozzle efficiency.
8.- Determination of the jet reaction and the specific pushing.
9.- Simple and classical method used to determine jet velocity.
10.- Measurement of mass flow rate and coefficient of discharge.
11.- By means the sensors measurements we can get mass flow rate, jet speed, efficiency and pushing for a variety of nozzles operating for a wide range of pressure ratios from 1.0 to aproximately 0.5.

Other possible practices:
12.- Sensors calibration.
13-31.- Practices with PLC.

TPT. **Nozzle Pressure Distribution Unit**

SPECIFICATIONS SUMMARY

This unit has been specifically designed to demonstrate the phenomena associated to fluxes through nozzles and to allow the students investigating quickly the pressure distribution in it. Besides, it allows the investigation of the mass flow rate through convergent-divergent and convergent nozzles.
Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Nozzles: Convergent type (conical), with 6 pressure tappings. Convergent-divergent type, with 5 pressure tappings, for a design pressure ratio of 0.25. Convergent- divergent, with 8 pressure tappings, for a design pressure ratio of 0.1.
Nozzles can be changed quickly and easily.
2 Pressure meters (manometers), 100 mm. diameter, to measure air inlet and outlet pressures.
8 Pressure meters (manometers), 60 mm. diameter, to determine the pressure at the nozzle tappings.
Variable area type flow meter to indicate air flow at standard conditions. (Correction factors for other pressures and temperatures are provided).
2 Glass temperature meters, to indicate air temperature before and after nozzle.
Valves to give a fine control of air inlet pressure and outlet pressure.
Air filter and pressure regulator to provide constant pressure, clean and water free air to the unit.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): 1000 x 590 x 890 mm. Weight: 50 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TPT.pdf

PRACTICAL POSSIBILITIES

1.- Flow in convergent-divergent nozzle.
2.- Flow in convergent nozzle.
3.- Pressure distribution in a nozzle.
4.- Visual demonstration of the phenomenon of choking.
5.- Investigation of the relationship between inlet pressure and the mass flow rate.
6.- Demonstration of under expansion and over expansion with re-compression.
7.- Investigation of the relationship between outlet pressure and mass flow rate for a convergent nozzle.
8.- Investigation of the relationship between outlet pressure and mass flow rate for a convergent-divergent nozzle.
9.- Investigation of the pressure distribution in convergent and convergent-divergent nozzles when operating with several overall pressure ratios.
10.- Effect on temperature.
11.- Calibration.

TGV. **Steam Generator (3 kW)**

SPECIFICATIONS SUMMARY

Anodized aluminium structure and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Working range: 0-120º C, 0-2 bar.
Stainless steel water tank with a water inlet, a water outlet and two steam outlets.
Heat resistant protection screens.
Tank filling automatic system.
Temperature sensor.
Safety level switch. Safety pressure switch (2 bar).
Electric heating resistance: 3000 W.
Water input and output connections.
2 Steam output connections.
Electronic console: connector for the temperature sensor, digital display for water temperature (temperature sensor), heating resistance on/off indicator, connector for the level switch, water critical level indicator, connector for the safety pressure switch, main switch on the back part of the console (magnetothermic).
Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): Unit: 680 x 430 x 750 mm. Weight: 50 Kg.
Electronic console: 300 x 190 x 120 mm. Weight: 3 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TGV.pdf

TGV-6KW. **Steam Generator (6 kW)**

SPECIFICATIONS SUMMARY

Anodized aluminium structure and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Working range: 0-120º C, 0-2 bar.
Stainless steel water tank with a water inlet, a water outlet and two steam outlets.
Heat resistant protection screens.
Tank filling automatic system.
Temperature sensor.
Safety level switch. Safety pressure switch (2 bar).
Electric heating resistance: 6000 W.
Water input and output connections.
2 Steam output connections.
Electronic console: connector for the temperature sensor, digital display for water temperature (temperature sensor), heating resistance on/off indicator, connector for the level switch, water critical level indicator, connector for the safety pressure switch, main switch on the back part of the console (magnetothermic).
Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): Unit: 680 x 430 x 750 mm. Weight: 50 Kg.
Electronic console: 300 x 190 x 120 mm. Weight: 3 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TGV-6KW.pdf

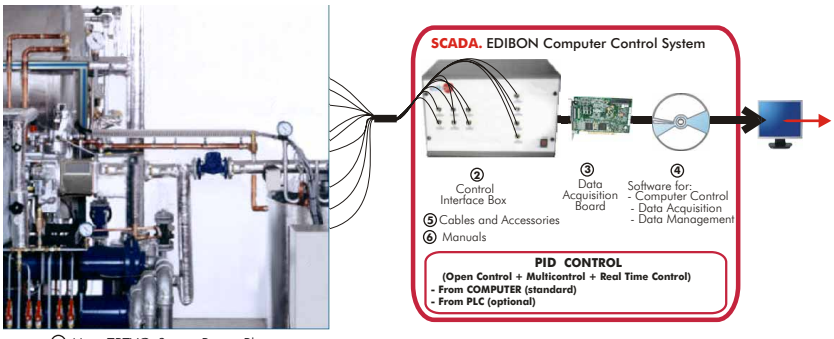
TGV-6KWA. **Steam Generator (6 kW)** (for high pressures and high temperatures)

SPECIFICATIONS SUMMARY

Anodized aluminium structure and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Working range: 0-160º C, 0-4 bar.
Stainless steel water tank with a water inlet, a water outlet and two steam outlets. Heat resistant protection screens.
Tank filling automatic system. 2 safety level switches. Solenoid valve (water inlet).
Temperature sensor.
Safety pressure switch (4 bar). Security valve: relief valve (4 bar).
Electrical heating resistance: 6000 W.
Manometer, range: 0-6 bar.
Water input and output connections. 2 Steam output connection.
Electronic console: connector for the temperature sensor, digital display for water temperature (temperature sensor), heating resistance on/off indicator, connectors for the level switches, water critical level indicator, connector for the safety pressure switch, on/off solenoid valve switch, main switch on the back part of the console (magnetothermic).
Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.): Unit: 680 x 430 x 760 mm. Weight: 52 Kg.
Electronic console: 300 x 190 x 120 mm. Weight: 3 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TGV-6KWA.pdf

TPTVC. Computer Controlled **Steam Power Plant**



① Unit: TPTVC. Steam Power Plant

SPECIFICATIONS SUMMARY

Items supplied as standard

①TPTVC. Unit:

Laboratory scale steam power plant designed for technical training of power plant engineering and power engines and machines. It demonstrates thermodynamics principles, energy conversion and mechanical power measurement.

Metallic structure and other main metallic elements in stainless steel. Diagram in the front panel.

Closed steam-water circuit. An oil-heated instantaneous boiler generates wet steam, a superheater steam provides superheated steam.

Boiler: thermal rating of 100 kW approx., nominal steam amount: 120 Kg/h at bar (approx.).

Superheater: outputs 5.1 kW, 240°C. approx.

Fuel tank. Burner. Steam turbine (single-stage impeller turbine with speed control), 1.5 kW at 3000 r.p.m. approx., vacuum or exhaust operation. DC generator as turbine load. Feed water tank with feed water treatment. Water cooled condenser (100 kW approx.). Condensate pump. Feed water pump. Sensors of: pressure, temperature, flow for fuel and for cooling water; and speed. Power meter.

②TPTVC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Realtime curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TPTVC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 3230 x 2000 x 2200 mm. Weight: 2000 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TPTVC.pdf

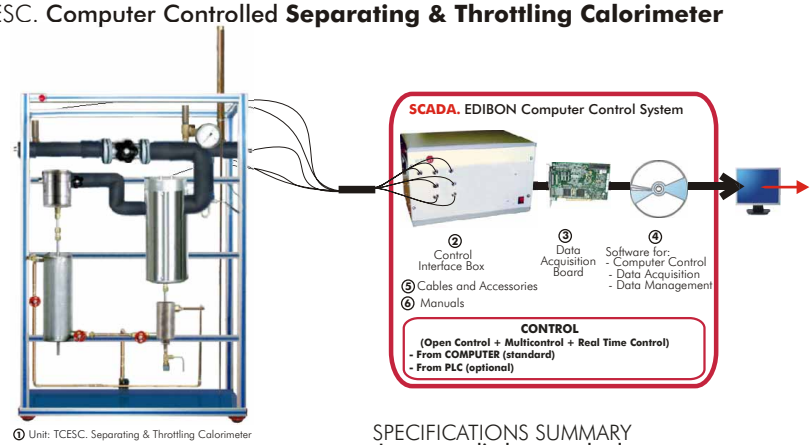
PRACTICAL POSSIBILITIES

1.- Study of a steam power plant and its components.
2.- Starting, operation and running down of a steam power plant.
3.- Study of a simple feed water treatment.
4.- Familiarisation with a closed steam-water circuit.
5.- Determination of condenser efficiency.
6.- Understanding of the First and Second Laws of Thermodynamics.
7.- Determination of boiler efficiency.
8.- Determination of fuel consumption.
9.- Power generation.
10.- Determination of mechanical/thermal efficiency of a turbine.
11.- Heat balance and energy utilization.
12.- Techniques for measuring and controlling pressure and temperature in a steam plant.
13.- Steam flow-rate measurements.

Other possible practices:

14.- Sensors calibration.
15-33.- Practices with PLC.

TCESC. Computer Controlled **Separating & Throttling Calorimeter**



① Unit: TCESC. Separating & Throttling Calorimeter

SPECIFICATIONS SUMMARY

Items supplied as standard

①TCESC. Unit:

Unit, computer controlled, to determine low and high water contents in two-phase liquid-water mixture and the dryness fraction of steam by means a separating and throttling calorimeters. It is a combined separating and throttling calorimeters.

Anodized aluminium structure and panels in painted steel. Main metallic elements in stainless steel. Diagram in the front panel.

Separating calorimeter with water-cooled re-cooler. Throttling calorimeter water-cooled with condenser.

Pipes. Steam line connections. Steam up to 10 bar and 240°C (approx) maximum can be studied. Safety valve, 10 bar approx. 2 Graduated glass containers (beakers). Pressure sensors. Temperature sensors. High pressure switch.

②TCESC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TCESC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1000 x 550 x 1650 mm. Weight: 55 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/nozzlessteam/TCESC.pdf

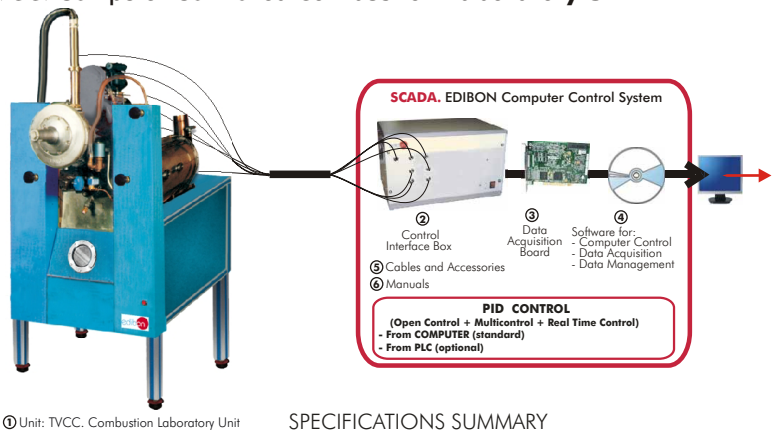
PRACTICAL POSSIBILITIES

1.- To determine the dryness fraction of steam.
2.- To use separating calorimeter for high water contents.
3.- To use throtting calorimeter for high vapour contents.

Other possible practices:

4.- Sensors calibration.
5-23.- Practices with PLC.

TVCC. Computer Controlled **Combustion Laboratory Unit**



① Unit: TVCC. Combustion Laboratory Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① TVCC. Unit:
Unit (with oil and/or gas burnes) designed for experimenting and studying burner operation and the combustion process.
Stainless steel and anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit.
Combustion chamber: water cooled chamber, dimensions: 460 dia. x 910 mm approx. Either an oil or gas burner can be fired. We can observe the flame through windows.
Burner for oil or gas. Fan and regulator. Water, gas and fuel control.
Flow sensors for cooling water, air and fuel. Gas flow sensor. Temperature sensors.
Gas analysation. Smoke Number can be determined for the oil burner with the smoke tester.

② TVCC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TVCC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

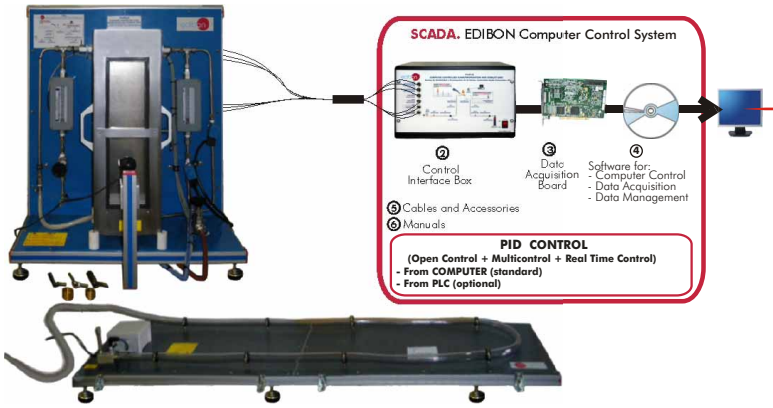
Dimensions (approx.) = Unit: 2200 x 1000 x 1700 mm. Weight: 200 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

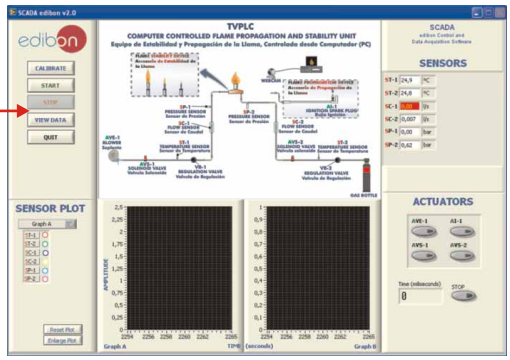
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/combustion/TVCC.pdf

PRACTICAL POSSIBILITIES

1.- To study burner operation and combustion process.
2.- Familiarisation of the adjustment and operation of a commercial oil or gas burner.
3.- Effect of air/fuel ratio on combustion efficiency as measured by flue gas constituents and temperature.
4.- Effect of air/fuel ratio on energy balance.
5.- Effect of air/fuel ratio on heat transfer.
6.- Effect of flame radiation on heat transfer and observed temperature.
7.- Comparison of flue gas analysis with theoretical predictions.
8.- Comparative performance of different fuels or fuel additives.
9.- Assessment of a burner, including:
Flame stability.
Flame shape.
Flame radiation.
Firing rate.
Turndown range.
Smoke emission.
10.- Extraction of gas samples from a range of locations within the combustion chamber.
11.- Comparison of oil and gas burners.
Other possible practices:
12.- Sensors calibration.
13-31.- Practices with PLC.

TVPLC. Computer Controlled **Flame Propagation and Stability Unit**





① Unit: TVPLC. Flame Propagation and Stability Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① TVPLC. Unit:
The Flame Propagation and Stability Unit (TVPLC) is a teaching equipment which has been designed to allow students to investigate the behaviour characteristics of flames and understanding of flame control techniques employed for designing combustion systems. We can determine the relationship between primary air/fuel ratios and flame speed or burner energy densities.
Burner with protective metallic box, with transparent window which ensure operation safety and complete experiment visibility. Manual lighter.
Circuit of air, to supply the necessary oxygen to the combustion process, composed by: pressure fan (computer controlled), electrovalve (computer controlled), air flow regulation valve, circuit of flexible tube for easy coupling to the burner.
Circuit of gas: circuit of stainless steel tube, fuel supply system (computer controlled), gas flow regulation valve, double solenoid electrovalve.
Ignition system, computer controlled, implemented for the Flame Propagation Accessory.
Four flame tubes, easily interchangeable, with four different sections. Flame stabilizers cones.
Flame Propagation Accessory, formed by: 5 meters transparent tube for visualizing the experiment and ignition spark plug.
Sensors: 2 temperature sensors (for air and gas), 2 pressure sensors (for air and gas) and 2 flow sensors (for air and gas).
Safety elements.

② TVPLC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TVPLC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

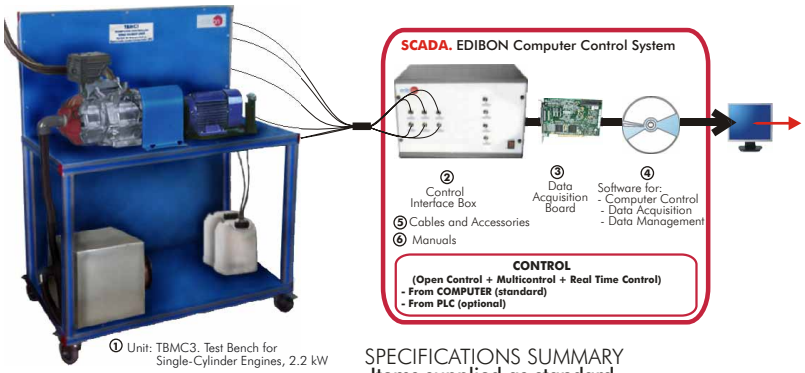
Dimensions (approx.) = Unit: 700 x 500 x 800 mm. Weight: 80 Kg.
Flame Propagation Accessory: 2000 x 500 x 150 mm. Weight: 30 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/combustion/TVPLC.pdf

PRACTICAL POSSIBILITIES

1.- Study of the flame stability of a burner.
2.- Study of the flame stability with stabilizer devices.
3.- Demonstration of the process of flame lift off.
4.- Demonstration of the process of flame light back.
5.- To investigate and to study methods of improving flame stability limits.
6.- Study of the data for the construction of flames stability diagrams.
7.- To investigate the relationship between flame speed and air/fuel ratio for a variety of gaseous fuels.
8.- Study of flame propagation.
9.- Practice of Smithells flame propagation.
10.- To investigate the vertical and horizontal flame movement.
11.- To study the effect of changing cross-section of the burner on flame speed.
12.- Effect of directional change on flame speed.
13.- To study methods of arresting of moving flames in the flame speed tube.
Other possible practices:
14.- Sensors calibration.
15-33.- Practices with PLC.

TBMC3. Computer Controlled **Test Bench for Single-Cylinder Engines, 2.2 kW**



① Unit: TBMC3. Test Bench for Single-Cylinder Engines, 2.2 kW

SPECIFICATIONS SUMMARY

Items supplied as standard

①TBMC3. Unit:
Test Bench with wheels for its mobility. Control and load unit for single-cylinder internal combustion engines (two-stroke and four-stroke). Maximum power output of: 2.2 kW.
Asynchronous motor with regenerative feedback unit as the brake for generating the engine load, and can be also used as starter motor. Engine started by asynchronous motor. Force transmission from the engine to the brake unit be means the use of a elastic claw coupling. Adjustment of the braking torque and the braking speed. Quietening vessel for intake air, with air filter and air hose. Coupling cover. Exhaust gas connection. Supply tanks for different fuels and pump. Speed sensor. Temperature sensors for air temperature, fuel temperature and exhaust gas temperature. Force sensor (torque). Flow sensors. Level sensor. Pressure sensors. Adjustable speed. Adjustable torque. Control of the pump, motor and engine, and consumption.
The complete test bench requires for working a choice (optional) test engines:
Test engines available: (not included in the standard supply)
-TM3-1. Air-cooled single-cylinder four-stroke petrol engine.
-TM3-2. Air-cooled single-cylinder four-stroke diesel engine.
-TM3-3. Air-cooled single-cylinder four-stroke petrol engine, with variable compression.
-TM3-4. Air-cooled single-cylinder two-stroke petrol engine.

②TBMC3/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TBMC3/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

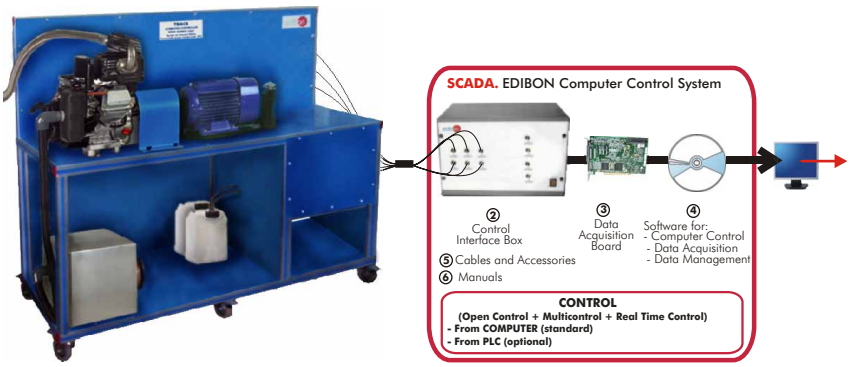
Dimensions (approx.)= Unit: 1230 x 1000 x 1500 mm. Weight: 125 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC3.pdf

PRACTICAL POSSIBILITIES

1.- Familiarisation with four-stroke petrol and diesel engines.
2.- Familiarisation with two-stroke petrol engines.
3.- Determination of specific fuel consumption.
4.- Torque curves.
5.- Power curves.
6.- Determination of volumetric efficiency.
7.- Determination of excess air factor.
8.- Measurement of the most important parameters involved in the process: temperature, torque, speed, etc.
9.- Determination of engine friction loss.
10.- Study of the effect of compression ratio, mixture and ignition point on engine characteristic curves and exhaust gas temperature.
11.- Determination of air ratio.
12.- Sensors calibration.
13-31.- Practices with PLC.

TBMC8. Computer Controlled **Test Bench for Single-Cylinder Engines, 7.5 kW**



① Unit: TBMC8. Test Bench for Single-Cylinder Engines, 7.5 kW

SPECIFICATIONS SUMMARY

Items supplied as standard

①TBMC8. Unit:
Test Bench with wheels for its mobility. Control and load unit for single-cylinder internal combustion engines (two-stroke and four-stroke). Maximum power output of: 7.5 kW.
Asynchronous motor with regenerative feedback unit as the brake for generating the engine load, and can be also used as starter motor. Engine started by asynchronous motor. Force transmission from the engine to the brake unit be means the use of a elastic claw coupling. Adjustment of the braking torque and the braking speed. Quietening vessel for intake air, with air filter and air hose. Coupling cover. Exhaust gas connection. Fuel tanks and pump. Speed sensor. Temperature sensors for air temperature, fuel temperature and exhaust gas temperature, etc. Force sensor (torque). Flow sensors. Level sensor. Pressure sensors. Adjustable speed. Adjustable torque. Control of the pump, motor and engine, and consumption.
The complete test bench requires for working a choice (optional) test engines:
Test engines available: (not included in the standard supply)
-TM8-1. Air-cooled single-cylinder four-stroke petrol engine.
-TM8-2. Air-cooled single-cylinder two-stroke petrol engine.
-TM8-3. Air-cooled single-cylinder four-stroke diesel engine.
-TM8-4. Four-stroke diesel engine, water cooled.

②TBMC8/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TBMC8/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

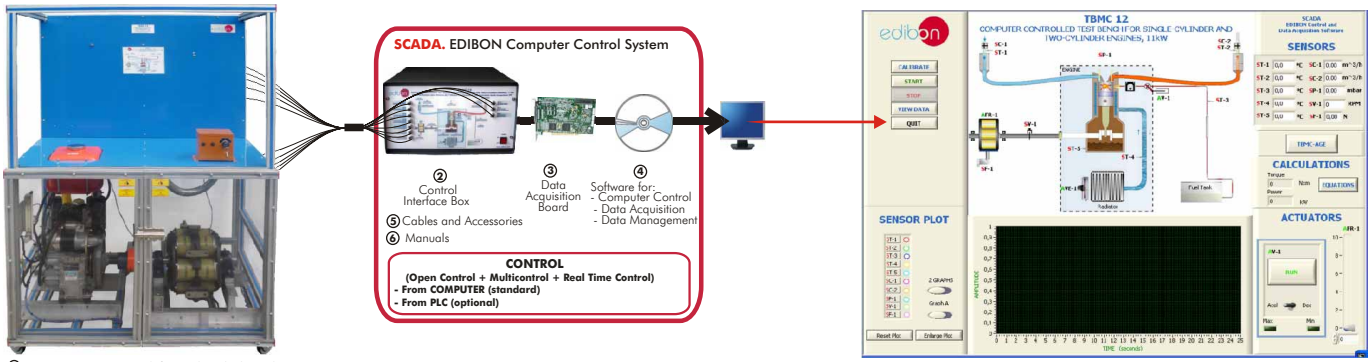
Dimensions (approx.)= Unit: 1600 x 1000 x 1500 mm. Weight: 200 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC8.pdf

PRACTICAL POSSIBILITIES

1.- Familiarisation with two-stroke petrol engines.
2.- Familiarisation with four-stroke petrol and diesel engines.
3.- Familiarisation with a water-cooled four-stroke diesel engine.
4.- Determination of specific fuel consumption.
5.- Torque curves.
6.- Power curves.
7.- Determination of volumetric efficiency.
8.- Determination of excess air factor.
9.- Measurement of the most important parameters involved in the process: temperature, torque, speed, etc.
10.- Determination of engine friction loss.
11.- Determination fuel-air ratio.
12.- Sensors calibration.
13-31.- Practices with PLC.

TBMC12. Computer Controlled **Test Bench for Single-Cylinder and Two-Cylinders Engines, 11 kW**



① Unit: TBMC12. Test Bench for Single-Cylinder and Two-Cylinders Engines, 11 kW

SPECIFICATIONS SUMMARY

Items supplied as standard

①TBMC12. Unit:
Combustion Engine Test Bench with wheels for its mobility. Control and load unit for four-stroke engines. Maximum power output of: 11 kW.
Transparent screens for protection and easy visualization of the tests. Eddy Current brake for generating the engine load, computer controlled. Engine started by a DC motor. Motor and engine control. Force transmission from the engine to the brake unit be means the use of an elastic claw coupling. Coupling cover. Adjustment of the braking torque and the speed. Quietening vessel for intake air, with air filter and air hose. Engine acceleration by means of the fuel valve, computer controlled (acceleration/deacceleration). Exhaust gas connection. Fuel tank with pump. Pump control. Consumption control. Speed sensor to measure the speed (rpm) of the motor. Temperature sensors for the measurement of cooling water temperature, air temperature, fuel temperature, oil temperature and exhaust gas temperature, etc. Force sensor (torque). Flow meters to measure the fuel consumption, air intake and exhaust gas. Barometric pressure sensor necessary for obtain the corrected power of an engine.
The complete test bench requires for working a choice (optional) of at least one of the combustion test engines:
Test Combustion Engines available: (not included in the standard supply)
-TM12-1. Water-cooled single-cylinder engine, with variable compression.
-TM12-2. Two-cylinders petrol engine.
-TM12-3. Two-cylinders diesel engine.

②TBMC12/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TBMC12/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1100 x 900 x 1700 mm. Weight: 260 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC12.pdf

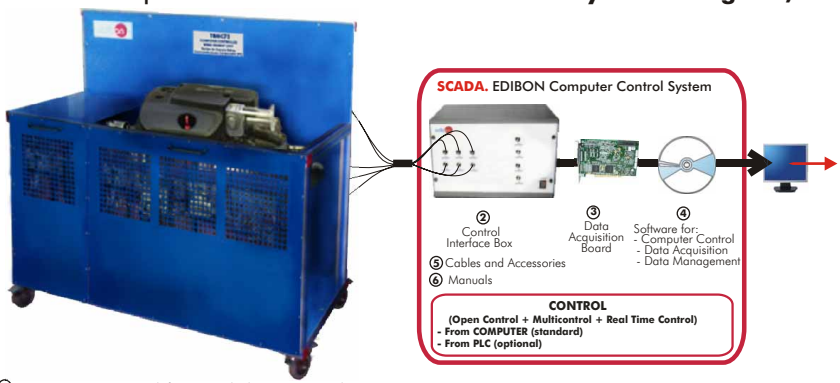
PRACTICAL POSSIBILITIES

1.- Familiarisation with single-cylinder and two-cylinders engines.
2.- Determination of specific fuel consumption.
3.- Torque curves.
4.- Power curves.
5.- Determination of volumetric efficiency.
6.- Determination of excess air factor.
7.- Measurement of the most important parameters involved in the process: temperature, torque, speed, pressure, etc.
8.- Determination of engine friction loss.
9.- Determination of fuel-air ratio.
10.- Determination of the frictional power (in passive mode).
11.- Energy balances (for water cooled engines).

Other possible practices:

12.- Sensors calibration.
13-31.- Practices with PLC.

TBMC75. Computer Controlled **Test Bench for Four-Cylinders Engines, 75 kW**



① Unit: TBMC75. Test Bench for Four-Cylinders Engines, 75 kW

SPECIFICATIONS SUMMARY

Items supplied as standard

①TBMC75. Unit:
Test Bench with wheels for its mobility. Control and load unit for four-stroke petrol or diesel internal combustion engines. Maximum power output of: 75 kW.
Air-cooled eddy current brake for applying load to the engines. Force transmission from the engine to the brake via rotationally elastic coupling and jointed shaft. Adjustment of the braking torque and the braking speed. Adjustment for "accelerate" engine. Quietening vessel for intake air, with air filter and air hose. Exhaust gas connection. Fuel tanks with pump. Speed sensor. Temperature sensors for air temperature, cooling water, fuel temperature, oil temperature and exhaust gas temperature, etc. Force sensor (torque). Flow sensors. Level sensor. Pressure sensors. Adjustable speed. Pump control. Adjustable torque. Engine control. Consumption control.
The complete test bench requires for working a choice (optional) test engines:
Test engines available: (not included in the standard supply)
-TM75-1. Water-cooled four-cylinders four-stroke petrol engine.
-TM75-2. Water-cooled four-cylinders four-stroke diesel engine.

②TBMC75/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TBMC75/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

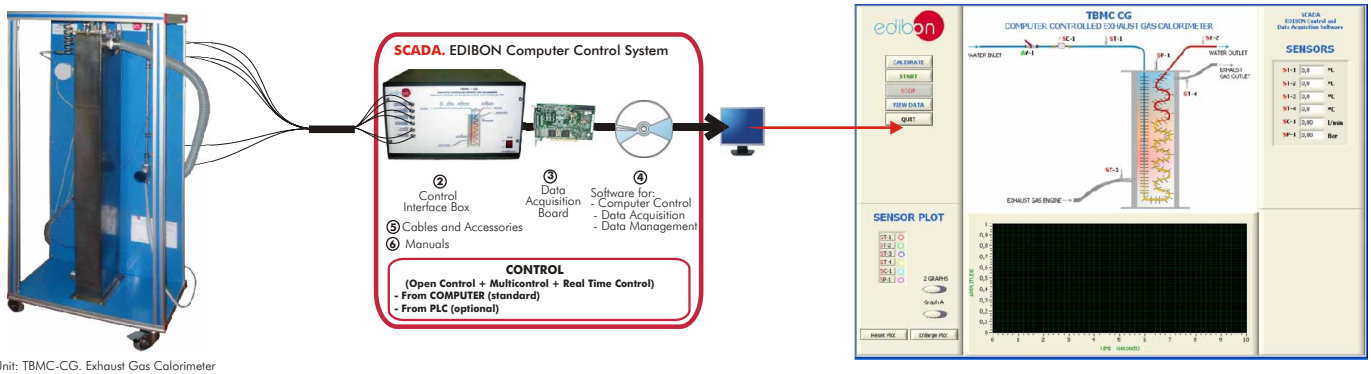
Dimensions (approx.)= Unit: 1900 x 1200 x 1600 mm. Weight: 300 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC75.pdf

PRACTICAL POSSIBILITIES

1.- Familiarisation with four-cylinders petrol and diesel engines.
2.- Determination of specific fuel consumption.
3.- Torque curves.
4.- Power curves.
5.- Determination of volumetric efficiency.
6.- Determination of excess air factor.
7.- Measurement of the most important parameters involved in the process: temperature, torque, speed, pressure, flow, etc.
8.- Determination of engine friction loss (in passive mode).
9.- Determination of fuel-air ratio.
10.- Energy balances.
11.- Sensors calibration.
12-30.- Practices with PLC.

TBMC-CG. Computer Controlled **Exhaust Gas Calorimeter**



① Unit: TBMC-CG. Exhaust Gas Calorimeter

SPECIFICATIONS SUMMARY

Items supplied as standard

①TBMC-CG. Unit:

The TBMC-CG Exhaust Gases Calorimeter developed by EDIBON is a suitable teaching equipment to measure the heat contained in the exhaust gases of a engine.

Anodized aluminium structure and panels in painted steel.

The main element consists on a double-wall tank, made in stainless steel, with a finned steel pipe heat exchanger inside.

Exchange volume: 13 l. Heat exchange area on exhaust gas side: 1.2 m^2. Heat exchange area on water side: 0.17 m^2.

Exhaust gas inlet at the bottom of the unit. Exhaust gas outlet at the upper part of the unit

Water inlet and outlet connections and hoses are supplied.

Connection between engine and calorimeter using an exhaust gas a heat-resistant hose.

Regulation valve for the cooling water flow rate.

4 Temperature sensors at different process stages. Flow sensor to measure the cooling water flow. Pressure sensor for gases under analysis.

Measuring ranges:

Exhaust gas temperature: 0-600º C. Water temperature: 0-600º C. Flow rate: 0-600 l./hour.

②TBMC-CG/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TBMC-CG/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 600 x 500 x 1500 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC-CG.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the heat content of exhaust gases from test engines.

2.- Heat and energy balance studies.

3.- Determination of exhaust gas thermal output power given up.

4.- To determine the specific heat capacity of exhaust gases.

Other possible practices:

5.- Sensors calibration.

6-24.- Practices with PLC.

TBMC-AGE. **Exhaust Gas Analyzer**

SPECIFICATIONS SUMMARY

Features:

Measurement of the volumetric concentrations according to the procedure of nondispersiva infrared absorption.
Engines selection: Gasoline, Butane (GPL), Propano, 2/4 times, 1 / 2 / 3 / 4 / 5 / 6 / 8 / 12 cylinders.
Fast WarmUp of the measure cell.
Auto-Check test.
Automatic and manual ZEROING.
Data base of engines.

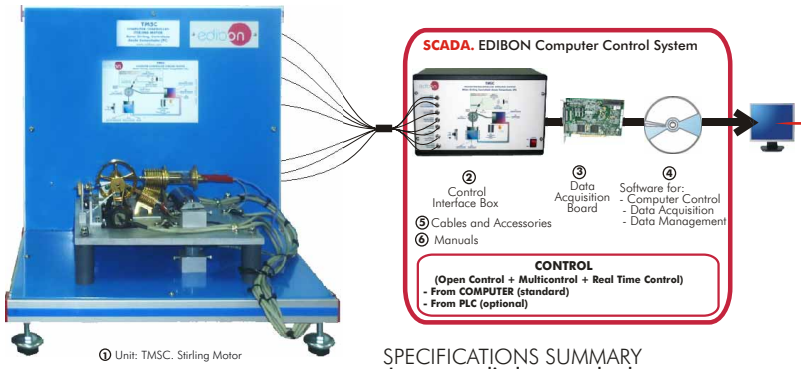
Measurements:

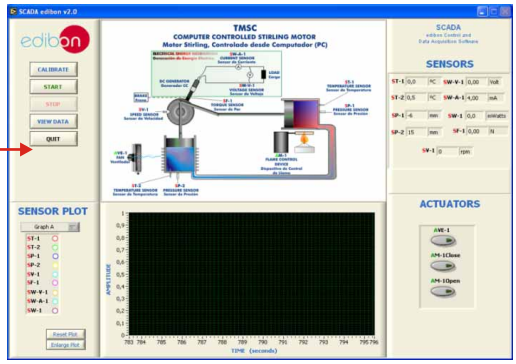
Carbon monoxide CO (%).
Carbon dioxide CO_2 (%).
HC gasoline, propano, methane (ppm).
Oxygen O_2 (%).
Carbon monoxide CO adjusted (%).
Lambda calculation.
Oil temperature.

Dimensions (approx.): 600 x 200 x 300 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC-AGE.pdf

TMSC. Computer Controlled **Stirling Motor**





SPECIFICATIONS SUMMARY

Items supplied as standard

① TMSC. Unit:
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
Stirling engine with a heating element controller (flame controller). Device to control the flame of the heating element, to cover it and to release it. Alcohol lamp as heating element. Fan in the cold cylinder, computer controlled. Braking system.
Electrical generator with a pulley for converting the generated mechanical energy into electrical energy. Equipped with an electrical load and current and voltage measurement system.
2 Tempeature sensors, one in the hot cylinder and the other in the cold cylinder.
2 Pressure sensors, one in the hot cylinder and the other in the cold cylinder.
Speed sensor (rpm). Force sensor (torque). Current sensor. Voltage sensor.
Power measurement from the computer (PC). Torque measurement by a brake and a force sensor.
Overtemperature protection with the activation of the device to control the flame.

② TMSC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TMSC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 400 x 350 x 450 mm. Weight: 20 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TMSC.pdf

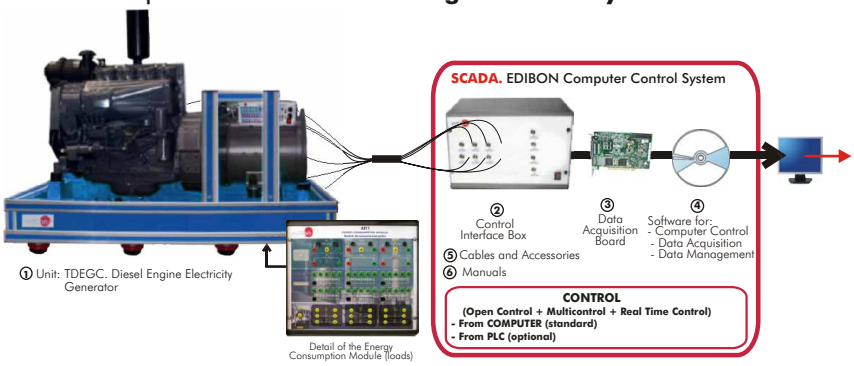
PRACTICAL POSSIBILITIES

1.- Study of the conversion of thermal-mechanical-electrical energy.
2.- Study of the relation between the temperatures difference of the thermal machine and the speed generated.
3.- Calculation of the "threshold" temperatures difference which generate motion.
4.- Study of the mechanical power in relation to speed.
5.- Study of the electrical power in relation to speed.
6.- Mechanical efficiency calculation.
7.- Electrical efficiency calculation.
8.- Study of the pV curve.
9.- Speed measurement (rpm).
10.- Torque measurement.
11.- Measurement of the generated electrical power.
12.- Temperature measurements.
13.- Pressure measurements.

Other possible practices:

14.- Sensors calibration.
15-33.- Practices with PLC.

TDEGC. Computer Controlled **Diesel Engine Electricity Generator**



SPECIFICATIONS SUMMARY

Items supplied as standard

① TDEGC. Unit:
A.C. Generator: three-phase generation: 6.5 kVA (5.2 kW) / 400 V / 9.4 A, frequency: 50 Hz.
Alternator: self-excited, self-regulated, with brush. Type: three-phase, synchronous.
Engine: type: 4-Stroke, cooling system: air, starter: electric, fuel: diesel.
Energy Consumption Module (loads) (AE11):
This module offer: Three-phase and single-phase resistances, inductances and capacitors.
3 Variable resistive laads. 3 Fixed resistive loads. 6 Inductive loads. 9 Capacitive loads.
SCADA System for Diesel Engine Generation Group:
Diesel Engine Set Supervision. Diesel Engine Set Control. Diesel Engine Set Protection.

② TDEGC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TDEGC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

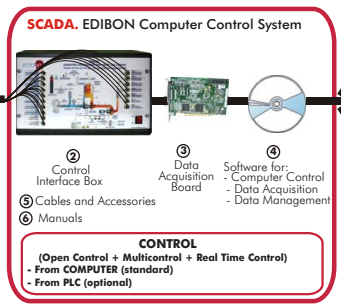
⑥ Manuals: This unit is supplied with 8 manuals.

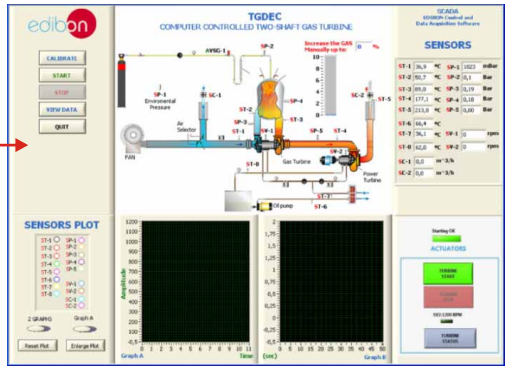
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TDEGC.pdf

TMHC. Computer Controlled **Test Bench for Hybrid Engine**

TGDEC. Computer Controlled **Two-Shaft Gas Turbine**

① Unit: TGDEC. Two-Shaft Gas Turbine





SPECIFICATIONS SUMMARY
Items supplied as standard

①TGDEC. Unit:
The TGDEC turbine is a teaching unit for the operation demonstration of a Double Shaft Gas Turbine for electric generation and for other uses too.
High Pressure Turbine, that it is the Gas Generative Turbine:speed range: 60,000-120,000 rpm.;max. compression ratio: 2:1; max. fuel consumption: 20 kg/hour.
Low Pressure Turbine (Power Turbine): speed range (r. p. m.): 15,000-25,000 rpm; electrical power: measurement range: 0-1,500W.
Asynchronous (motor) generator, computer controlled; speed range: 1,500-3,000 rpm.
Start fan for starting the turbine and gas sweep. Aspiration mufler. Line of fuel gas.
Ignition electrode, computer controlled. Ionization electrode, computer controlled.
Lubrication installation (oil tank, gear pump, filtration unit, etc).
Plate heat exchanger for cooling the oil of the turbines. Exhaust gas outlet and exhaust mufler.
Sensors and instrumentation: 8 temperature sensors, 2 speed sensors, 5 pressure sensors, 2 flow sensors, 4 manometers, 3 high pressure switches, ATEX flowmeter for measuring the gas consumption, current and voltage measurement, handling box with PLC and safety system to prevent faults.
Operation with propane.

②TGDEC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TGDEC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 2500 x 700 x 1800 mm. Weight: 235 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

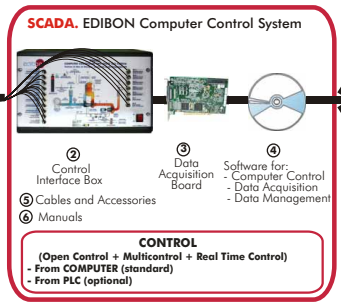
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/TGDEC.pdf

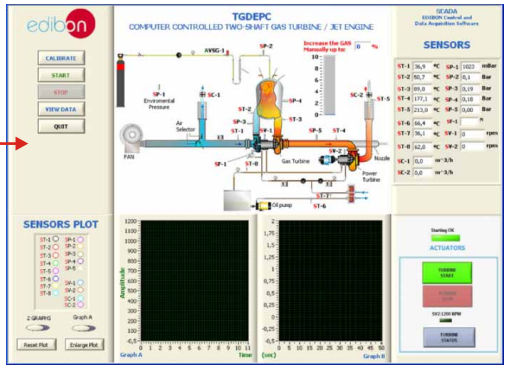
PRACTICAL POSSIBILITIES

1.- Study of a gas turbine operation.
2.- Determination of the gas turbine efficiency.
3.- Determination of the compressor operation point.
4.- Operation with power turbine.
5.- Determination of fuel consumption.
6.- Thermal efficiency.
7.- Air standard cycle.
8.- Heat balance.
9.- Work ratio.
10.- Pressure ratio.
11.- Pressure loss.
12.- Air and fuel ratio.
13.- Combustion efficiency.
14.- Recording the turbine characteristic curve.
15.- Determination of the efficiency of the compressor.
16.- Determination of the efficiency of high pressure turbine.
17.- Determination of the efficiency of output turbine (low pressure).
18.- Temperatures measurements.
19.- Effective turbine power output.
20.- Safety systems in the operation of a gas turbine.
Other possible practices:
21.- Sensors calibration.
22-40.- Practices with PLC.

TGDEPC. Computer Controlled **Two-Shaft Gas Turbine/Jet Engine**

① Unit: TGDEPC. Two-Shaft Gas Turbine/Jet Engine





SPECIFICATIONS SUMMARY
Items supplied as standard

①TGDEPC. Unit:
The TGDEPC turbine is a teaching unit for the operation demonstration of a Double Shaft Gas Turbine for electric generation and for other uses too. Moreover, the unit can be configurated as a Jet Engine.
High Pressure Turbine, that it is the Gas Generative Turbine: speed range: 60,000-120,000 rpm; max. compression ratio: 2:1; mMax. fuel consumption: 20 kg/hour.
Low Pressure Turbine (Power Turbine): speed range (r. p. m.): 15,000-25,000 rpm; electrical power: measurement range: 0-1,500W.
Asynchronous (motor) generator, computer controlled; speed range: 1,500-3,000 rpm.
Operation as a jet engine: turbine speed range: 60,000-160,000 rpm; trust nozzle, with force sensor; trust measuring range: 0-50 N.
Start fan for starting the turbine and gas sweep. Line of fuel gas. Ignition electrode, computer controlled. Ionization electrode, computer controlled. Lubrication installation (oil tank, gear pump, filtration unit, etc). Plate heat exchanger for cooling the oil of the turbines. Exhaust gas outlet and exhaust mufler.
Sensors and instrumentation: 8 temperature sensors, 2 speed sensors, 5 pressure sensors, 2 flow sensors, 1 force sensor, 4 manometers, 3 high pressure switches, ATEX flowmeter for measuring the gas consumption, current and voltage measurement, handling box with PLC and safety system to prevent faults.
Operation with propane.

②TGDEPC/CIB. Control Interface Box:
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TGDEPC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 2500 x 700 x 1800 mm. Weight: 250 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

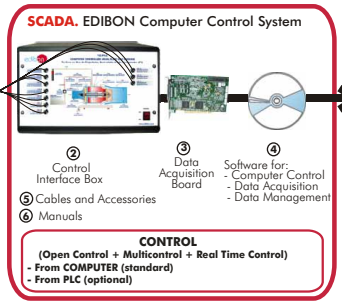
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/TGDEPC.pdf

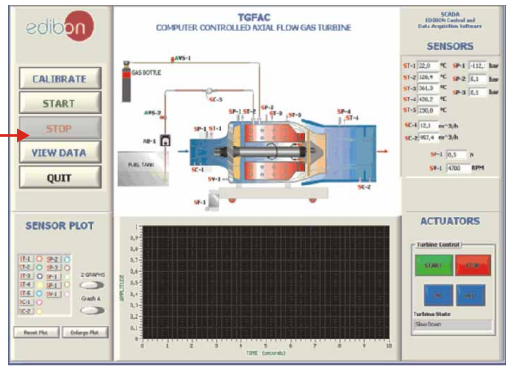
PRACTICAL POSSIBILITIES

1.- Study of a gas turbine operation.
2.- Determination of the gas turbine efficiency.
3.- Determination of the compressor operation point.
4.- Study of a gas turbine operation as a jet engine.
5.- Operation with power turbine.
6.- Determination of fuel consumption.
7.- Thermal efficiency.
8.- Air standard cycle.
9.- Heat balance.
10.- Work ratio.
11.- Pressure ratio.
12.- Pressure loss.
13.- Air and fuel ratio.
14.- Combustion efficiency.
15.- Recording the turbine characteristic curve.
16.- Determination of the efficiency of the compressor.
17.- Determination of the efficiency of high pressure turbine.
18.- Determination of the efficiency of output turbine (low pressure).
19.- Temperatures measurements.
20.- Effective turbine output power.
21.- Safety systems in the operation of a gas turbine.
22.- Thrust measurement.
Other possible practices:
23.- Sensors calibration.
24-42.- Practices with PLC.

TGFAC. Computer Controlled **Axial Flow Gas Turbine/Jet Engine**

① Unit: TGFAC. Axial Flow Gas Turbine/Jet Engine





SPECIFICATIONS SUMMARY

Items supplied as standard

①TGFAC. Unit:

The "TGFAC" Axial Flow Gas Turbine/Jet Engine developed by EDIBON is a demonstrating teaching equipment of a Gas Turbine as jet engine.

Axial flow gas turbine (jet turbine) of 200 N thrust at 110.000 rpm. It consists of a radial compressor, combustion chamber and expansion axial turbine. Jet engine with speed regulation, computer controlled.

Ignition System, computer controlled. Fuel feeding system, computer controlled.

Collector of inlet and exhaust duct with sensors to measure the gases flow rates.

3 Temperature sensors, for measurement of: inlet air temperature, inlet air temperature in the compressor, fuselage temperature. 2 temperature sensors for measurement of: combustion chamber temperature, exhaust gases temperature.

Speed sensor to measure the speed (rpm) of the turbine shaft. Load Cell-Force sensor for measurement of the turbine trust.

4 Pressure sensors, for measurement of: pressure at the gas inlet, pressure in the compressor, pressure in the combustion chamber, pressure at the gas outlet.

2 Flow sensors for: air inlet and gas outlet. Fflow sensor for the fuel consumption measurement.

Safety-devices. Emergency stop, located in the unit.

②TGFAC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TGFAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 700 x 500 x 800 mm. Weight: 70 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/TGFAC.pdf

PRACTICAL POSSIBILITIES

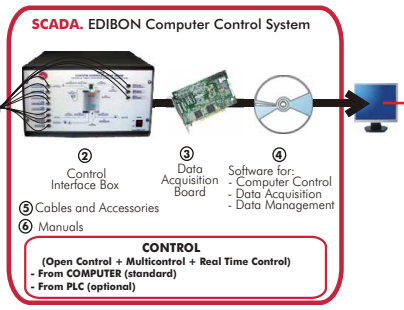
1.- Study of a gas turbine.
2.- Function and operation of a gas turbine as jet engine.
3.- Determination of fuel consumption.
4.- Air and fuel ratio.
5.- Recording the turbine characteristic.
6.- Determination of the efficiency of the compressor.
7.- Determination of the specific thrust.
8.- Determination of the efficiency of the turbine.
9.- Temperature measurements.
10.- Safety systems in the operation of a gas turbine.
11.- Energy global balance.

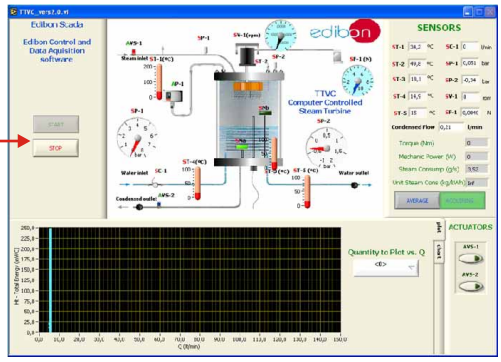
Other possible practices:

12.- Sensors calibration.
13-31.- Practices with PLC.

TTVC. Computer Controlled **Steam Turbine**

① Unit: TTVC. Steam Turbine





SPECIFICATIONS SUMMARY

Items supplied as standard

①TTVC. Unit:

The TTVC Unit consists of a steam turbine which works in single stage. It has an injection nozzle with an incidence angle of 20° referred to the rotation plane.

Bench top unit mounted on an anodized aluminium structure and panels in painted steel.

Steam turbine mounted on a vertical shaft: axial flow turbine type De Laval, of single stage; maximum speed: 20,000 rpm.

Nozzle: inlet diameter: 1.5 mm., outlet diameter: 3 mm., discharge angle: 20°.

Turbine rotor: external diameter: 84 mm., internal diameter: 45 mm., number of blades: 25.

Brake: Type friction by means of a band. Water cooled condenser.

Sensors: Pressure sensor for inlet steam. Pressure sensor in the condenser. Load cell. Force sensor. Speed sensor. Flow sensor for refrigeration water. Level sensor to measure the condensate volume or flow. 5 Temperature sensors in different points of the unit. 2 Solenoid valves for system security. 1 Solenoid valve to evacuate the condenser.

Safety protections.

②TTVC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④TTVC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) =Unit: 700 x 600 x 800 mm. Weight: 60 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/TTVC.pdf

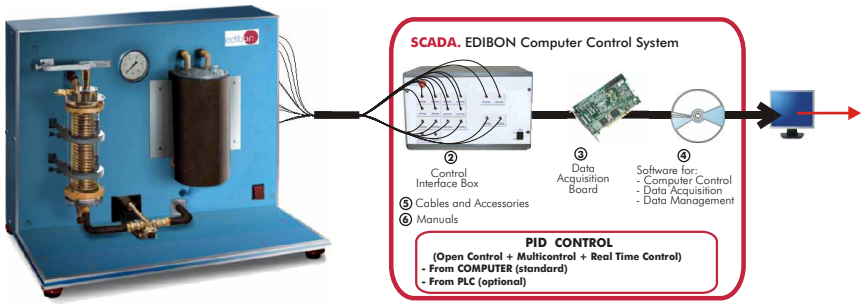
PRACTICAL POSSIBILITIES

1.- Calculation of the real flow of condensate.
2.- Determination of the injector discharge coefficient.
3.- Obtaining the characteristic curves of the steam turbine.
4.- Turbine efficiency.
5.- Thermal balances.
6.- Determination of friction losses at various exhaust pressures.
7.- Determination of torque, power and specific steam consumption when operating at constant inlet pressure but with varying exhaust pressure.
8.- Determination of torque, power and specific steam consumption when operating at constant exhaust pressure but with varying inlet pressure.
9.- Determination of power to heat ratio when used as a back pressure turbine.
10.- Determination of thermal efficiency.
11.- Determination of Isentropic efficiency.
12.- Study of the specific steam consumption of the turbine.

Other possible practices:

13.- Sensors calibration.
14-32 .- Practices with PLC.

HTVC. Computer Controlled **Solar/Heat Source Vapour Turbine**



① Unit: HTVC. Solar/Heat Source Vapour Turbine

SPECIFICATIONS SUMMARY

Items supplied as standard

①HTVC. Unit:

This unit has been designed to provide an easily understood vapour power plant and to demonstrate, on a lab scale, the ability to produce shaft power from Solar Radiation.

Compact and bench-top unit, using R141b refrigerant.

Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Vapour generator: copper generating coil in water filled tank with thermostatically controlled heater.

Single stage impulse turbine, power output 35W at 20000 rev. min^{-1} approx.

Condenser: water cooled coil housed in a chamber. Feed pump (single acting plunger pump). Accumulator. Circulating pump to circulate water though vapour generator tank and solar panels.

Up to 12 Temperature sensors. 2 Pressure sensors. Flow sensors. Torque and speed measurement. High pressure cut-out.

Optional accessory: (not included in the standard supply)

Solar Panels and Installation Kit: Two solar panels. Water flow sensor. Temperature sensors. Expansion tank. Pipe, fittings, etc.

②HTVC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④HTVC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1000 x 500 x 925 mm. Weight: 80 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/HTVC.pdf

PRACTICAL POSSIBILITIES

1.- Production of torque/speed and power/speed curves for the turbine.

2.- Easy and clearly observed demonstration of a classic Rankine cycle.

3.- Determination of thermal efficiency at a range of turbine inlet and exhaust pressures.

4.- Use of property charts or tables and the application of the First Law of Thermodynamics to produce energy balances.

5.- Estimation of total frictional losses in turbines.

6.- Comparison of performance with the Rankine Cycle, (including the external isentropic efficiency of turbines).

Other possible practices:

7.- Sensors Calibration.

Possible Practices with OPTIONAL Solar Panels:

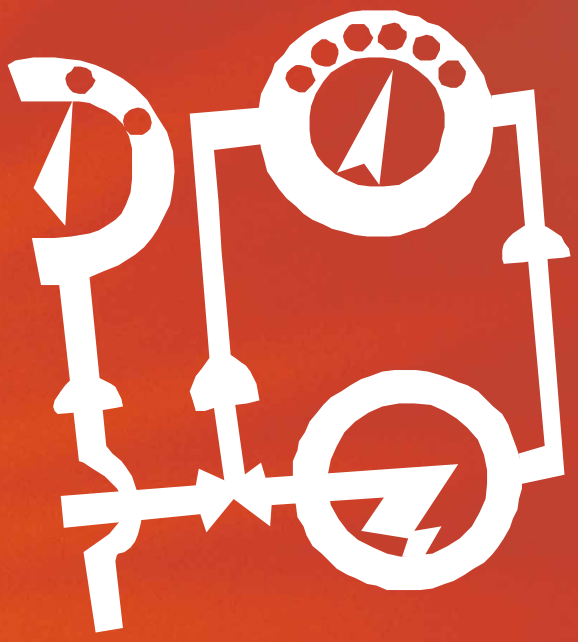
8.- Measurement of the solar energy collection at a range of mean water temperatures.

9.- Demonstration of the production of shaft work from solar radiation.

10-28.- Practices with PLC.

Summarized
Catalogue

four (4)



10. Process Control

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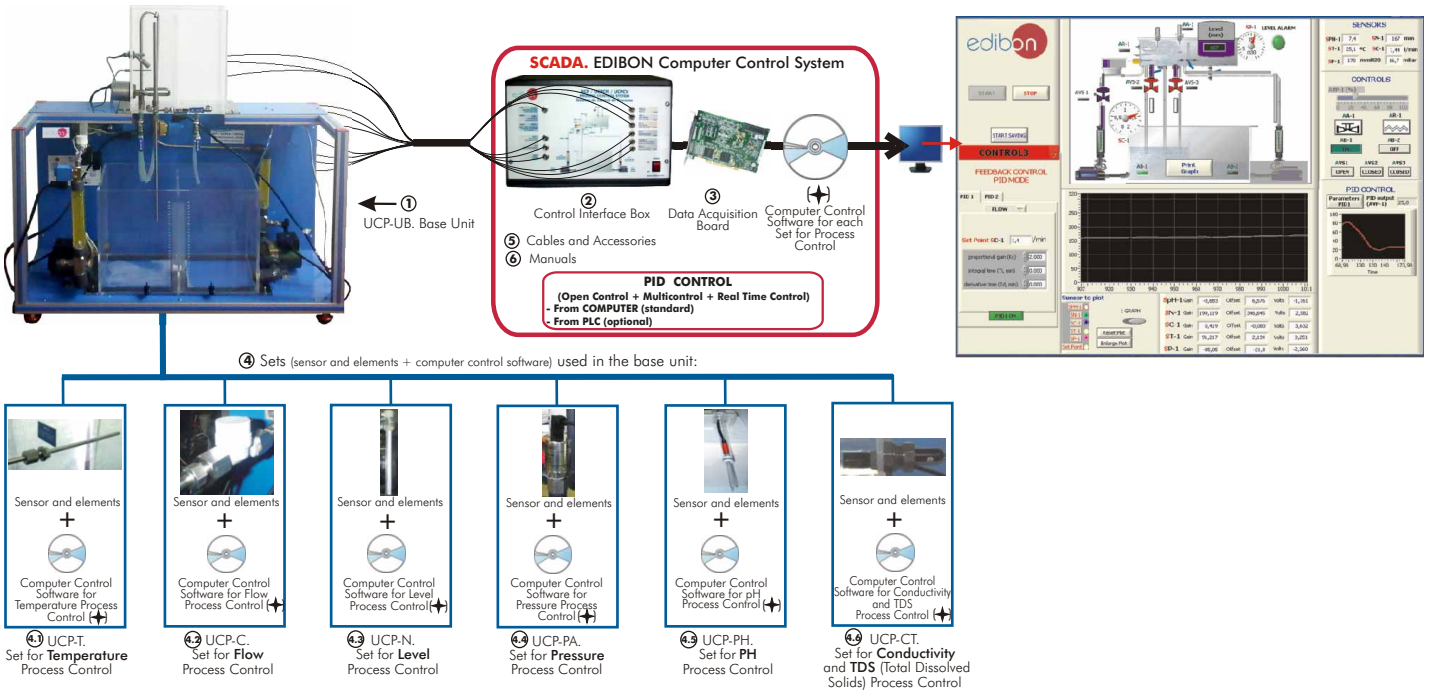
10.- Process Control

Equipment list

UCP. Computer Controlled **Process Control System, with electronic control valve :**



SPECIFICATIONS SUMMARY

Common items for all Process Control parameters:

① UCP-UB. Unit:
This unit is common for all Sets for Process Control type "UCP" and can work with one or several sets.
Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit. Main tank and collector with an orifice in the central dividing wall. (2 x 25 dm^3), and drainage in both compartments. Dual process tank (2 x 10 dm^3), interconnected through an orifice and a ball valve and an overflow in the dividing wall; a graduate scale and a threaded drain of adjustable level with bypass. Centrifugal pumps. Variable area flow meters (0.2-2 l/min, and 0.2-10 l/min), and with a manual valve. Line of on/off regulation valves (solenoid), and manual drainage valves of the upper tank. Proportional valve: motorized control valve.

② UCP/CIB. Control Interface Box :
This is common for all Sets for Process Control type "UCP" and can work with one or several sets.
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/ Outputs.

④ Sets (sensor and elements + computer control software) used in the base unit: (These Sets will be supplied and installed in the Base Unit and ready for working)

④.1 UCP-T. Set for Temperature Process Control:
Temperature sensor "J type". Electric resistor (0.5 KW). Helix agitator. On/off level switch.
Computer Control Software for Temperature Process Control:
(#) Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

④.2 UCP-C. Set for Flow Process Control:
Turbine type flow sensor.
Computer Control Software for Flow Process Control. **(#)**

④.3 UCP-N. Set for Level Process Control:
0-300mm level sensor (of capacitive immersion, 4-20mA).
Computer Control Software for Level Process Control. **(#)**

④.4 UCP-PA. Set for Pressure Process Control:
Pressure sensor.
Computer Control Software for Pressure Process Control. **(#)**

④.5 UCP-PH. Set for pH Process Control:
pH sensor. Helix agitator.
Computer Control Software for pH Process Control. **(#)**

④.6 UCP-CT. Set for Conductivity and TDS (Total Dissolved Solids) Process Control:
Conductivity and TDS (Total Dissolved Solids) sensor.
Computer Control Software for Conductivity and TDS Process Control.**(#)**

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions(approx.)= UCP-UB. Unit: 500 x 1000 x 1000 mm. Weight: 40 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/UCP.pdf

PRACTICAL POSSIBILITIES

Temperature Process Control:
1.- Temperature control loops (Manual).
2.- Temperature control loops (On/Off).
3.- Temperature control loops (Proportional).
4.- Temperature control loops (Proportional + Integral).
5.- Temperature control loops (Proportional + Derivative).
6.- Temperature control loops (Proportional + Derivative +Integral).
7.- Adjustment of the constant of a controller of temperature (Ziegler-Nichols).
8.- Adjustment of the constant of a controller of temperature (Reaction Curves).
9.- Temperature sensor calibration.

Flow Process Control:
10.- Flow control loops (Manual).
11.- Flow control loops (On/Off).
12.- Flow control loops (Proportional).
13.- Flow control loops (Proportional + Integral).
14.- Flow control loops (Proportional + Derivative).
15.- Flow control loops (Proportional + Derivative + Integral).
16.- Adjustment of the flow controller constants (Ziegler-Nichols).
17.- Adjustment of the flow controller constants (Reaction Curves).
18.- Flow sensor calibration.

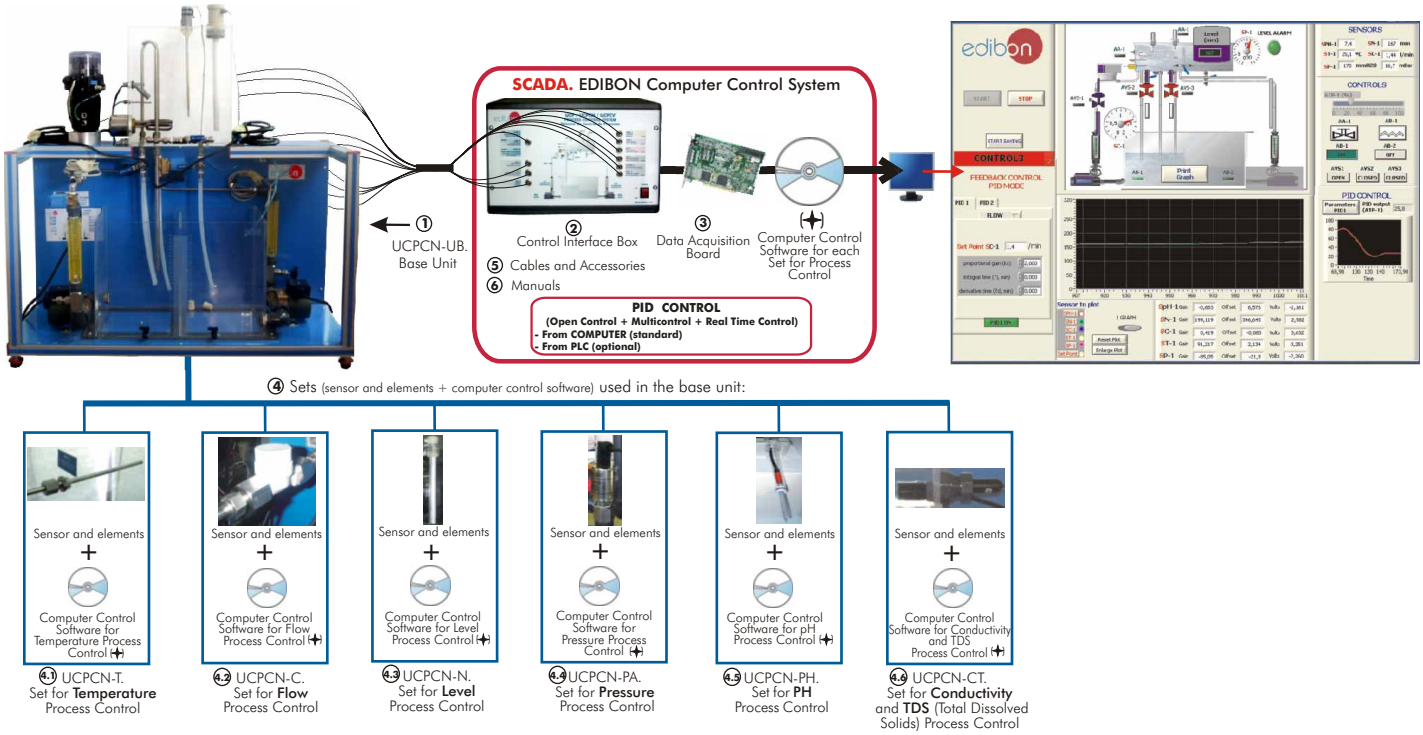
Level Process Control:
19.- Level control loops (Manual).
20.- Level control loops (On/Off).
21.- Level control loops (Proportional).
22.- Level control loops (Proportional + Integral).
23.- Level control loops (Proportional + Derivative).
24.- Level control loops (Proportional + Derivative + Integral).
25.- Adjustment of the constants of a flow controller (Ziegler-Nichols).
26.- Adjustment of the constants of a flow controller (Reaction Curves).
27.- Level sensor calibration.

Pressure Process Control:
28.- Pressure control loops (Manual).
29.- Pressure control loops (On/Off).
30.- Pressure control loops (Proportional).
31.- Pressure control loops (Proportional + Integral).
32.- Pressure control loops (Proportional + Derivative).
33.- Pressure control loops (Proportional + Derivative + Integral).
34.- Adjustment of the constant of a Pressure controller (Ziegler-Nichols).
35.- Adjustment of the constant of a Pressure controller (Reaction Curves).
36.- Pressure sensor calibration.

pH Process Control:
37.- pH control loops (Manual).
38.- pH control loops (On/Off).
39.- pH control loops (Proportional).
40.- pH control loops (Proportional + Integral).
41.- pH control loops (Proportional + Derivative).
42.- pH control loops (Proportional + Derivative + Integral).
43.- Adjustment of the constant of a pH controller (Ziegler-Nichols).
44.- Adjustment of the constant of a pH controller (Reaction Curves).
45.- pH sensor calibration.

Conductivity and TDS (Total Dissolved Solids) Process Control:
46.- Conductivity control loops (Manual).
47.- Conductivity control loops (On/Off).
48.- Conductivity control loops (Proportional).
49.- Conductivity control loops (Proportional + Integral).
50.- Conductivity control loops (Proportional + Derivative).
51.- Conductivity control loops (Proportional + Derivative + Integral).
52.- Adjustment of the constant of a Conductivity controller (Ziegler-Nichols).
53.- Adjustment of the constant of a Conductivity controller (Reaction Curves).
54.- TDS control loops (Manual).
55.- TDS control loops (On/Off).
56.- TDS control loops (Proportional).
57.- TDS control loops (Proportional + Integral).
58.- TDS control loops (Proportional + Derivative).
59.- TDS control loops (Proportional + Derivative + Integral).
60.- Adjustment of the constant of a TDS controller (Ziegler-Nichols).
61.- Adjustment of the constant of a TDS controller (Reaction Curves).
62.- Conductivity and TDS sensor calibration.
63-81.- Practices with PLC.

UCPCN. Computer Controlled **Process Control System, with pneumatic control valve :**



SPECIFICATIONS SUMMARY

Common items for all Process Control parameters:

① UCPCN-UB. Unit:
This unit is common for all Sets for Process Control type "UCPCN" and can work with one or several sets.
Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit. Main tank and collector with an orifice in the central dividing wall.(2 x 25 dm^3), and drainage in both compartments. Dual process tank (2 x 10 dm^3), interconnected through an orifice and a ball valve and an overflow in the dividing wall; a graduate scale and a threaded drain of adjustable level with bypass. Centrifugal pumps. Variable area flow meters (0.2-2 l/min, and 0.2-10 l/min), and with a manual valve. Line of on/off regulation valves (solenoid), and manual drainage valves of the upper tank. Pneumatic Control Valve.

② UCPCN/CIB. Control Interface Box :
This is common for all Sets for Process Control type "UCPCN" and can work with one or several sets.
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/ Outputs.

④ Sets (sensor and elements + computer control software) used in the base unit: (These Sets will be supplied and installed in the Base Unit and ready for working)

④.1 UCPCN-T. Set for Temperature Process Control:
Temperature sensor "J type". Electric resistor (0.5 KW). Helix agitator. On/off level switch.
Computer Control Software for Temperature Process Control:
(#) Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

④.2 UCPCN-C. Set for Flow Process Control:
Turbine type flow sensor.
Computer Control Software for Flow Process Control. **(#)**

④.3 UCPCN-N. Set for Level Process Control:
0-300mm level sensor (of capacitive immersion, 4-20mA).
Computer Control Software for Level Process Control. **(#)**

④.4 UCPCN-PA. Set for Pressure Process Control:
Pressure sensor.
Computer Control Software for Pressure Process Control. **(#)**

④.5 UCPCN-PH. Set for pH Process Control:
pH sensor. Helix agitator.
Computer Control Software for pH Process Control. **(#)**

④.6 UCPCN-CT. Set for Conductivity and TDS (Total Dissolved Solids) Process Control:
Conductivity and TDS (Total Dissolved Solids) sensor.
Computer Control Software for Conductivity and TDS Process Control.**(#)**

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions(approx.) = UCPCN-UB. Unit: 500 x 1000 x 1000 mm. Weight: 40 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/UCPCN.pdf

PRACTICAL POSSIBILITIES

Temperature Process Control:
1.- Temperature control loops (Manual).
2.- Temperature control loops (On/Off).
3.- Temperature control loops (Proportional).
4.- Temperature control loops (Proportional + Integral).
5.- Temperature control loops (Proportional + Derivative).
6.- Temperature control loops (Proportional + Derivative +Integral).
7.- Adjustment of the constant of a controller of temperature (Ziegler-Nichols).
8.- Adjustment of the constant of a controller of temperature (Reaction Curves).
9.- Temperature sensor calibration.

Flow Process Control:
10.- Flow control loops (Manual).
11.- Flow control loops (On/Off).
12.- Flow control loops (Proportional).
13.- Flow control loops (Proportional + Integral).
14.- Flow control loops (Proportional + Derivative).
15.- Flow control loops (Proportional + Derivative + Integral).
16.- Adjustment of the flow controller constants (Ziegler-Nichols).
17.- Adjustment of the flow controller constants (Reaction Curves).
18.- Flow sensor calibration.

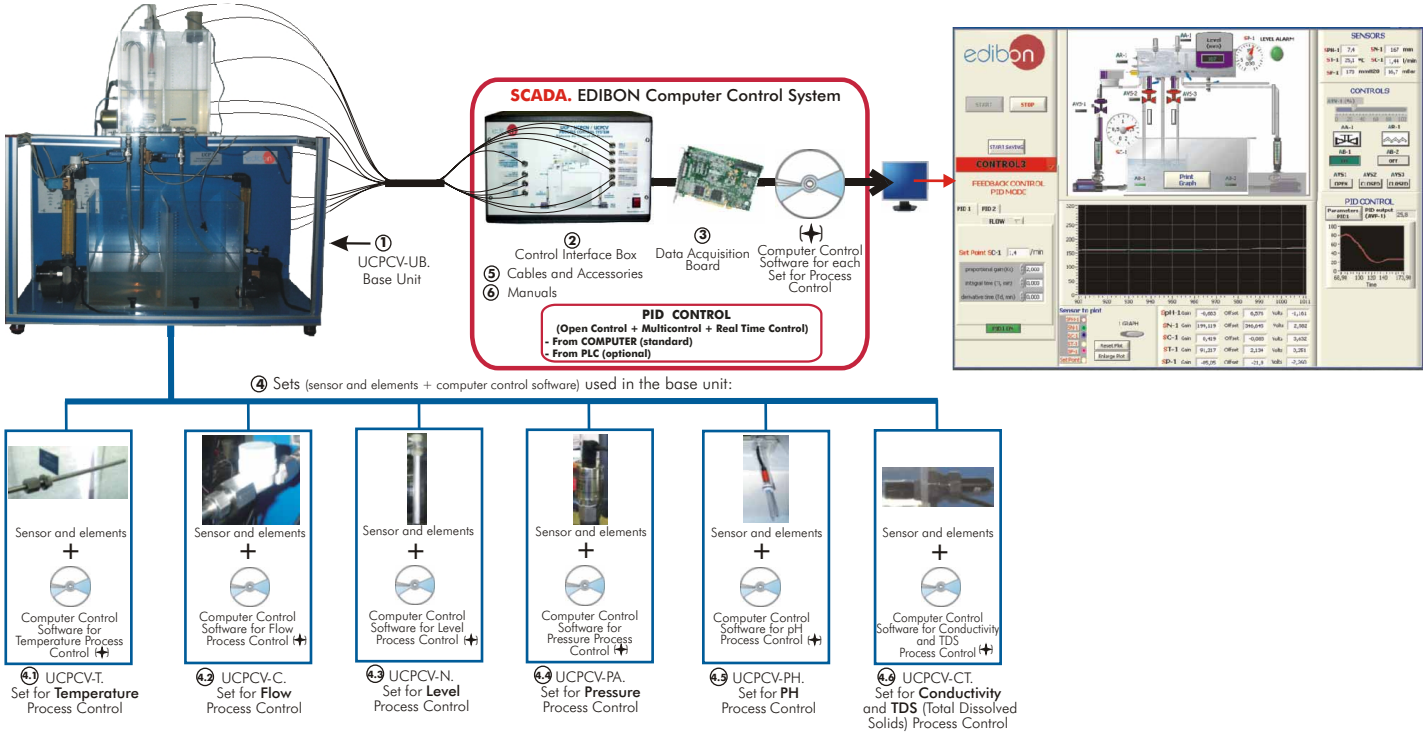
Level Process Control:
19.- Level control loops (Manual).
20.- Level control loops (On/Off).
21.- Level control loops (Proportional).
22.- Level control loops (Proportional + Integral).
23.- Level control loops (Proportional + Derivative).
24.- Level control loops (Proportional + Derivative + Integral).
25.- Adjustment of the constants of a flow controller (Ziegler-Nichols).
26.- Adjustment of the constants of a flow controller (Reaction Curves).
27.- Level sensor calibration.

Pressure Process Control:
28.- Pressure control loops (Manual).
29.- Pressure control loops (On/Off).
30.- Pressure control loops (Proportional).
31.- Pressure control loops (Proportional + Integral).
32.- Pressure control loops (Proportional + Derivative).
33.- Pressure control loops (Proportional + Derivative + Integral).
34.- Adjustment of the constant of a Pressure controller (Ziegler-Nichols).
35.- Adjustment of the constant of a Pressure controller (Reaction Curves).
36.- Pressure sensor calibration.

pH Process Control:
37.- pH control loops (Manual).
38.- pH control loops (On/Off).
39.- pH control loops (Proportional).
40.- pH control loops (Proportional + Integral).
41.- pH control loops (Proportional + Derivative).
42.- pH control loops (Proportional + Derivative + Integral).
43.- Adjustment of the constant of a pH controller (Ziegler-Nichols).
44.- Adjustment of the constant of a pH controller (Reaction Curves).
45.- pH sensor calibration.

Conductivity and TDS (Total Dissolved Solids) Process Control:
46.- Conductivity control loops (Manual).
47.- Conductivity control loops (On/Off).
48.- Conductivity control loops (Proportional).
49.- Conductivity control loops (Proportional + Integral).
50.- Conductivity control loops (Proportional + Derivative).
51.- Conductivity control loops (Proportional + Derivative + Integral).
52.- Adjustment of the constant of a Conductivity controller (Ziegler-Nichols).
53.- Adjustment of the constant of a Conductivity controller (Reaction Curves).
54.- TDS control loops (Manual).
55.- TDS control loops (On/Off).
56.- TDS control loops (Proportional).
57.- TDS control loops (Proportional + Integral).
58.- TDS control loops (Proportional + Derivative).
59.- TDS control loops (Proportional + Derivative + Integral).
60.- Adjustment of the constant of a TDS controller (Ziegler-Nichols).
61.- Adjustment of the constant of a TDS controller (Reaction Curves).
62.- Conductivity and TDS sensor calibration.
63-81.- Practices with PLC.

UCPCV. Computer Controlled **Process Control System, with speed controller :**



SPECIFICATIONS SUMMARY

Common items for all Process Control parameters:

① UCPCV-UB. Unit:
This unit is common for all Sets for Process Control type "UCPCV" and can work with one or several sets.
Anodized aluminium structure. Diagram in the front panel with similar distribution to the elements in the real unit. Main tank and collector with an orifice in the central dividing wall.(2 x 25 dm^3), and drainage in both compartments. Dual process tank (2 x 10 dm^3), interconnected through an orifice and a ball valve and an overflow in the dividing wall; a graduate scale and a threaded drain of adjustable level with bypass. Centrifugal pumps. Variable area flow meters (0.2-2 l/min, and 0.2-10 l/min), and with a manual valve. Line of on/off regulation valves (solenoid), and manual drainage valves of the upper tank. Speed controller (into the Control Interface Box).

② UCPCV/CIB. Control Interface Box :
This is common for all Sets for Process Control type "UCPCV" and can work with one or several sets.
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/ Outputs.

④ Sets (sensor and elements + computer control software) used in the base unit: (These Sets will be supplied and installed in the Base Unit and ready for working)

④.1 UCPCV-T. Set for Temperature Process Control:
Temperature sensor "J type". Electric resistor (0.5 KW). Helix agitator. On/off level switch.
Computer Control Software for Temperature Process Control:
(#) Flexible, open and multicontrol software. Management, processing,comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

④.2 UCPCV-C. Set for Flow Process Control:
Turbine type flow sensor.
Computer Control Software for Flow Process Control. **(#)**

④.3 UCPCV-N. Set for Level Process Control:
0-300mm level sensor (of capacitive immersion, 4-20mA).
Computer Control Software for Level Process Control. **(#)**

④.4 UCPCV-PA. Set for Pressure Process Control:
Pressure sensor.
Computer Control Software for Pressure Process Control. **(#)**

④.5 UCPCV-PH. Set for pH Process Control:
pH sensor. Helix agitator.
Computer Control Software for pH Process Control. **(#)**

④.6 UCPCV-CT. Set for Conductivity and TDS (Total Dissolved Solids) Process Control:
Conductivity and TDS (Total Dissolved Solids) sensor.
Computer Control Software for Conductivity and TDS Process Control.**(#)**

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions(approx.) = UCPCV-UB. Unit: 500 x 1000 x 1000 mm. Weight: 40 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 12 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/UCPCV.pdf

PRACTICAL POSSIBILITIES

Temperature Process Control:
1.- Temperature control loops (Manual).
2.- Temperature control loops (On/Off).
3.- Temperature control loops (Proportional).
4.- Temperature control loops (Proportional + Integral).
5.- Temperature control loops (Proportional + Derivative).
6.- Temperature control loops (Proportional + Derivative +Integral).
7.- Adjustment of the constant of a controller of temperature (Ziegler-Nichols).
8.- Adjustment of the constant of a controller of temperature (Reaction Curves).
9.- Temperature sensor calibration.

Flow Process Control:
10.- Flow control loops (Manual).
11.- Flow control loops (On/Off).
12.- Flow control loops (Proportional).
13.- Flow control loops (Proportional + Integral).
14.- Flow control loops (Proportional + Derivative).
15.- Flow control loops (Proportional + Derivative + Integral).
16.- Adjustment of the flow controller constants (Ziegler-Nichols).
17.- Adjustment of the flow controller constants (Reaction Curves).
18.- Flow sensor calibration.

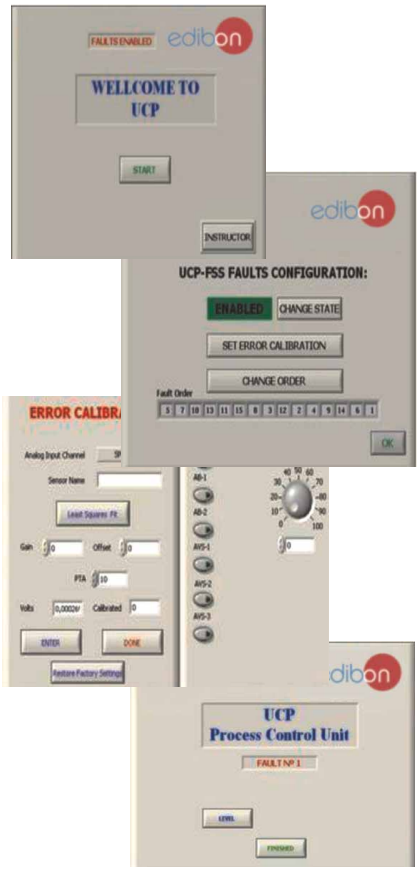
Level Process Control:
19.- Level control loops (Manual).
20.- Level control loops (On/Off).
21.- Level control loops (Proportional).
22.- Level control loops (Proportional + Integral).
23.- Level control loops (Proportional + Derivative).
24.- Level control loops (Proportional + Derivative + Integral).
25.- Adjustment of the constants of a flow controller (Ziegler-Nichols).
26.- Adjustment of the constants of a flow controller (Reaction Curves).
27.- Level sensor calibration.

Pressure Process Control:
28.- Pressure control loops (Manual).
29.- Pressure control loops (On/Off).
30.- Pressure control loops (Proportional).
31.- Pressure control loops (Proportional + Integral).
32.- Pressure control loops (Proportional + Derivative).
33.- Pressure control loops (Proportional + Derivative + Integral).
34.- Adjustment of the constant of a Pressure controller (Ziegler-Nichols).
35.- Adjustment of the constant of a Pressure controller (Reaction Curves).
36.- Pressure sensor calibration.

pH Process Control:
37.- pH control loops (Manual).
38.- pH control loops (On/Off).
39.- pH control loops (Proportional).
40.- pH control loops (Proportional + Integral).
41.- pH control loops (Proportional + Derivative).
42.- pH control loops (Proportional + Derivative + Integral).
43.- Adjustment of the constant of a pH controller (Ziegler-Nichols).
44.- Adjustment of the constant of a pH controller (Reaction Curves).
45.- pH sensor calibration.

Conductivity and TDS (Total Dissolved Solids) Process Control:
46.- Conductivity control loops (Manual).
47.- Conductivity control loops (On/Off).
48.- Conductivity control loops (Proportional).
49.- Conductivity control loops (Proportional + Integral).
50.- Conductivity control loops (Proportional + Derivative).
51.- Conductivity control loops (Proportional + Derivative + Integral).
52.- Adjustment of the constant of a Conductivity controller (Ziegler-Nichols).
53.- Adjustment of the constant of a Conductivity controller (Reaction Curves).
54.- TDS control loops (Manual).
55.- TDS control loops (On/Off).
56.- TDS control loops (Proportional).
57.- TDS control loops (Proportional + Integral).
58.- TDS control loops (Proportional + Derivative).
59.- TDS control loops (Proportional + Derivative + Integral).
60.- Adjustment of the constant of a TDS controller (Ziegler-Nichols).
61.- Adjustment of the constant of a TDS controller (Reaction Curves).
62.- Conductivity and TDS sensor calibration.
63-81.- Practices with PLC.

UCP/FSS. **Faults Simulation System** (Process Control Unit)



SPECIFICATIONS SUMMARY

The "FAULTS" mode consists on causing several faults in the unit normal operation. The student must find them and solve them.
There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:
- An incorrect calibration is applied to them. In this case, the student should proceed to calibrate the affected sensor through the values collection.
- Non-linearity. When we have the measures taken by the sensor, a quadratic or inverse function is applied to them. Thus, the value measured will not be the real one, as in the case above mentioned, but when we calibrate again, the sensor will not operate linearly and we will not be able to calibrate it by lest squares fits.

Faults affecting the actuators:
- Actuators canals interchange at any time during the program execution. This error does not admit any solution.
- Response reduction of an actuator. By the reduction of the output voltage in analog outputs, we can get an response with a fraction of what it should be, either with a manual execution or with any control type (ON/OFF, PID...).

Faults in the controls execution:
- Inversion of the performance in ON/OFF controls. The state of some actuator is inverted, when it should be ON is OFF instead, and vice versa. The student should provide the correct operating logic.
- Reduction or increase of the calculated total response. We multiply by a factor the total response calculated by the PID, causing, thus, the reduction or increase of the action really applied to the actuator, and the consequent instability of the control. The student should notify it and try to calculate this factor.
- The action of some controls is annulled.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/UCP.pdf

PRACTICAL POSSIBILITIES

Incorrect Calibration:
1.- Load the calibration error of the PH sensor.
2.- Load the calibration error of the Level sensor.
3.- Load the calibration error of the Flow sensor.
4.- Load the calibration error of the Temperature sensor.

Non Linearity:
5.- Non inverse linearity of the pH sensor.
6.- Non quadratic linearity of the Level sensor.
7.- Non quadratic linearity of the Flow sensor.
8.- No inverse linearity of the Temperature sensor.

Interchange of actuators:
9.- Interchange the bombs AB-1 and AB-2 between them during the operations of the controls ON/OFF and PID. (Affected sensor: Level sensor).

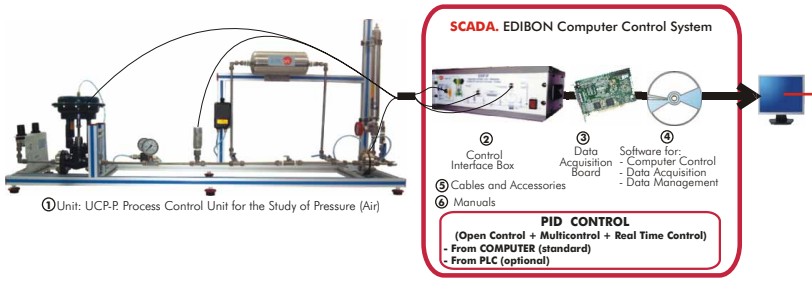
Reduction of an actuator response:
10.- In the PID, the real response of the proportional valve is half the amount calculated by the PID control. Thus, the maximum real opening that will be able to reach is 50%. (Affected sensor: Flow sensor).

Inversion of the performance in ON/OFF controls:
11.- In the ON/OFF control, the actuation sensor of the AVS-1 is inverted, acting, thus, on the same way as the others 2 valves (for a good control, it should operate the other way around to how the others 2 do it). (Affected sensor: pH).

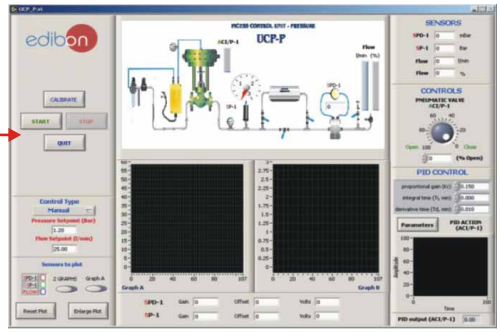
Reduction or increase of the calculated total response:
12.- In the PID, the real action in the resistance is half of the total calculated. (Affected sensor: Temperature sensor).

The action of some controls is annulled:
13.- The Integral control does not work. It is reduced to a PD control (Proportional-Derivative).
14.- The Derivative Control does not work. It is reduced to a PI Control (Proportional-Integral).
15.- The Integral and Derivative controls do not work. They are reduced to a Proportional Control.

UCP-P. Computer Controlled **Process Control Unit for the Study of Pressure (Air)**



①Unit: UCP-P. Process Control Unit for the Study of Pressure (Air)



SPECIFICATIONS SUMMARY

Items supplied as standard

①UCP-P. Unit:
This unit basically consist of the following elements:
Pneumatic circuit consisting of a tank, valves, pressure sensors, pressure regulators and pressure manometers.
For the pressure and flow control, a pneumatically operated control valve, an I/P converter and an absolute pressure sensor and a differential pressure sensor are used.
Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
2 Pressure regulators, one for controlling the pneumatically operated control valve and the second for suppling the necessary flow and/or pressure to the circuit that is to be adjusted.
I/P Converter.
On/off valves. Inlet/outlet valves.
Pneumatically operated control valve.
Storage (air) tank, capacity: 2 l.
Absolute pressure sensor. Differential pressure sensor.
Diaphragm. Flow meter. 3 pressure manometers.

②UCP-P/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, other electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:
PCI Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④UCP-P/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)=Unit: 1000 x 500 x 600 mm. Weight: 20 Kg. Control Interface: 490 x 330 x 175 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/UCP-P.pdf

PRACTICAL POSSIBILITIES

1.- Calculating the fluid flow in function of different pressure sensor.
2.- Calibration processes.
3.- Pressure sensor calibration. Study of the hysteresis curve.
4.- I/P converter calibration.
5.- Identification of the pneumatic valve type.
6.- Determination of the influence of the flow rate of the conduction.
7.- Pressure control in conduction using a PID controller.
8.- Proportional control (P) characteristics.
9.- Characteristics of a proportional and integral control (P+I).
10.- Characteristics of a proportional and derivative control (P+D).
11.- Optimization of the variables of a PID controller.
12.- Optimization of the variables of the PID controller, flow control.
13.- Flow rate control in conduction with a PID controller.
14-32.- Practices with PLC.

CECI. **Industrial Controllers Trainer**

SPECIFICATIONS SUMMARY

Trainer for industrial process controllers. This trainer allows students the study and familiarisation with the function and operation of a industrial process controller.
Configurable digital controller:
2 inputs, 1 output. Configurable as P, PI or PID controller. Proportional gain X_p: 0 -999.9%. Integral action time T_n: 0-3600s. Derivative time T_v: 0-1200s. RS232 interface for configuration on computer (PC).
Digital voltmeter: 0 -20V.
Signal generator with potentiometer. Reference variables generator: 2 voltages selectable. Output voltage: 0-10V.
Controlled system simulator:
Controlled system type: First order lag. Time constant: 20s.
All variables accessible as analog signals at lab jacks .
Possibility of connection of external instruments via lab jacks (for example: line recorder, plotter, oscilloscope...).
Configuration software CD. Interface cable. Set of lab cables.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.)= 490 x 330 x 310 mm. Weight: 8 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/CECI.pdf

PRACTICAL POSSIBILITIES

To study methods and terminology of process control:
1.- Closed loop control.
2.- Static and dynamic transfer function.
3.- To study the step response.
4.- Reference variable step.
To learn and to familiarise with a process controller:
5.- Configuration level.
6.- Parameter level.
7.- Operation control levels.
Control parameters:
8.- Setting input channels.
9.- Setting output channels.
10.- To use computer (PC)-based configuration tools.
11.- Scaling displays.

CRCI. **Industrial Controllers Networking**

SPECIFICATIONS SUMMARY

This trainer enables to take the first steps in process automation using field buses. This trainer demonstrates the operation of a process control system based on a simple application. This trainer allows student the familiarisation with the function and operation of an industrial process controller.
2 Digital process controllers, with field bus interface:
Configurable as P, PI or PID controller. Proportional gain X_p: 0-999.9%. Integral action time T_n: 0-3600s. Derivative time T_v: 0- 1200s. Controller parameter setting via field bus system.
2 Signal generators: 0-10V. Profibus DP interface card for computer (PC).
Process variables as analog signals: 0-10V. All variables accessible as analog signals at lab jacks.
Software CD with driver software, OPC server and process control software.
Possibility of connection of external instruments via lab jacks (for example: line recorder, oscilloscope, etc). Set of cables.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.)=490 x 330 x 310 mm. Weight: 12 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/CRCI.pdf

PRACTICAL POSSIBILITIES

1.- Function of a digital industrial controller.
2.- Layout of a field bus system.
To learn and to familiarise with the operation and structure of a process control system under Profibus DP:
3.- Controller parameter setting via field bus system.
4.- Profibus DP field bus system.
5.- OPC (OLE for Process Control) server function.
6.- Online controller parameters setting.
7.- Master / slave assignment.
8.- To configure and display alarms.
9.- Reading control variables and displaying them online.
10.- Scaling displays.
11.- Bus configuration.

CEAB. **Trainer for Field Bus Applications**

SPECIFICATIONS SUMMARY

This Trainer is used to teach the initial or first steps in field bus tecnology based on Profibus DP. The field bus permits networking terminal devices (controllers, actuators or sensors) in the plant system (field level) with the control room (control level).
Several devices (slaves) are activated and read by a computer (PC) with a Profibus DP interface (master).
Different subjects or topics can be covered and studied: bus topology, system configurator with Device Master File "DMF", communication protocols, tags, OPC server, output and input process data, etc.
Digital process controller, with Profibus DP interface:
Configurable as P, PI or PID controller. Proportional gain X_p:0-999.9%. Derivative time T_v:0-1200s. Integral action time T_n: 0-3600s.
Signal generators: 0-10V. Digital voltmeter: 0-20V.
Digital Profibus DP I module. Digital Profibus DP O module. Four digital inputs. Four digital outputs.
Analog Profibus DP I module. Analog Profibus DP O module. Four analog inputs: 0-10V. Two analog outputs: 0-10V.
Profibus DP interface card for computer (PC).
Process variables as analog signals at lab jacks: 0-10V.
Software CD with driver software, system configurator, OPC server and process control software.
Possibility of connection of external instruments via lab jacks (for example: chart recorder, oscilloscope, etc). Set of cables.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.)= 490 x 330 x 310 mm. Weight: 12 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/CEAB.pdf

PRACTICAL POSSIBILITIES

1.- Operation and function of a digital industrial controller.
2.- Function of an analog input/outputs module.
3.- Function of a digital input/output module.
4.- Layout of a field bus system.
5.- Familiarisation with the field bus stations.
6.- Defining the bus technology with the stations.
7.- Reading out and in, and online displaying of analog and digital process variables.
8.- Communication protocols.
9.- To define tags.
10.- Familiarisation with the device master file "DMF".
11.- OPC server.
12.- Access to the OPC database from the process control program.

CEAC. **Controller Tuning Trainer**

SPECIFICATIONS SUMMARY

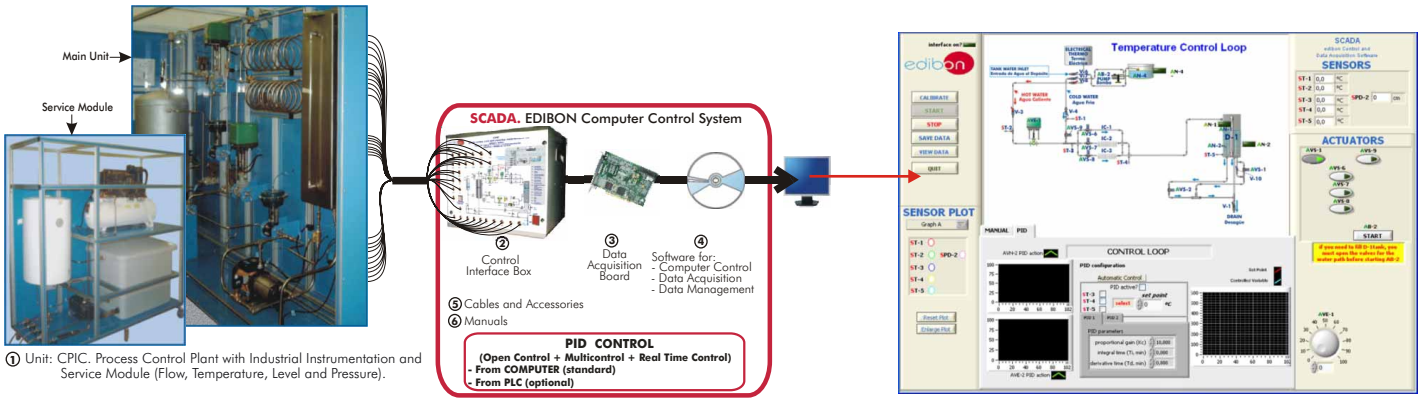
Trainer for controller tuning. This unit permits the interaction between controller and controlled system. The objective is that the closed control loop, formed by the controller and the controlled system, to show the desired optimum response.
With a simulation software the setting of controller parameters can be practised safely. Closed and open loop control, step response, stability, disturbance and control response are demonstrated.
This trainer no needs real controlled systems, the controlled system is simulated on a computer (PC) by the simulation program. In this program the most important types of controlled systems can be selected.
The process controller used can be easily configured from the computer (PC). The controller and the computer (PC) are connected by a data acquisition card with AD and DA converters.
Configurable digital process controller, with interface:
Configurable as P, PI or PID controller. Proportional gain X_p: 0-999.9%. Integral action time T_n: 0-3600s. Derivative time T_v: 0-1200s.
Interface for computer (PC). Data acquisition card for computer (PC).
Simulation Software for controlled system models, such as 1st and 2nd order lags, time-delayed systems etc. Controlled system simulation models with proportional, integral, 1st order lag, 2nd order lag, time-delayed response, non-linearity and limitation.
Configuration software for process controller. Recording and evaluation of time response on computer (PC). Set of cables.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.)= 490 x 330 x 310 mm. Weight: 8 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/fundamentals/CEAC.pdf

PRACTICAL POSSIBILITIES

1.- To use commonly applied tuning rules, such as Ziegler-Nichols.
2.- To study the difference between open and closed loop control.
3.- Control loop comprising controller and controlled system.
4.- To determine the system parameters.
5.- Closed-loop control system response.
6.- Choice of optimum controller parameters.
7.- Stability, steady state and transient response.
8.- Study and investigation of control and disturbance response.
9.- Study of the stability of the closed control loop.
10.- Learning methods and terminology involved in process control.
11.- To adapt the process controller to different controlled systems.
12.- Use and practices with the simulation software.

CPIC. Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (Flow, Temperature, Level and Pressure)



① Unit: CPIC. Process Control Plant with Industrial Instrumentation and Service Module (Flow, Temperature, Level and Pressure).

SPECIFICATIONS SUMMARY

Items supplied as standard

① CPIC. Unit:

CPIC is a "Computerized Industrial Process Control Plant", that offers, on a reasonable laboratory scale, the different process and elements that are commonly used by any kind the industry. It also shows the complexity that can take place while controlling in processes the same variable.

Metallic structure. Panels and main metallic elements in stainless steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Main Unit contains the following elements:

Two pneumatics valves with C_v: 0.25. Actuator (I/P) from 0.2 to 1.0 bar for electric signal from 4 to 20 mA.
Two electronic valves for electric signal from 4 to 20mA.
Twelve solenoid valves, normally closed.
Two solenoid valves, normally open, placed at the air loop and flow loop.
Three differential pressure sensors.
Five temperature sensors placed along the unit to control the temperature in different lines.
One level sensor (effective length: 300 mm.).
Four level switches.
Water pump: maximum water flow: 106 l./min. and maximum pressure: 7 bar.
Stainless steel water tank: maximum capacity: 100 l.
Stainless steel tank: maximum capacity: 200 l., maximum pressure:16 bar. It has eight takings, but only six are used in this unit. In the upper part, there is a safety valve that opens when the pressure exceeds 4 bar. Two takings are used to measure the water height by the means of a differential pressure sensor. Other differential pressure sensor gives us the inner pressure.

Service Module contains the following elements:

Heater unit: A tank with a maximum capacity of 80 litres and an electrical resistance of 1.2 kW as maximum electrical power, the temperature control is placed in the electrical resistance. It has a safety valve and purge valve. The lower part of the unit has an inlet pipe (cold water) and an outlet pipe (hot water).
Compressor unit: Maximum pressure: 10 bar. This unit has a regulating valve with a manometer to fix the outlet maximum pressure.
Water system: Water tank, capacity: 400 l. Water pump: 2500 l./h. The inlet pipe of the tank has an automatic filling system. Drain valve in the water tank.

② CPIC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Data acquisition National Instruments board to be placed in a computer slot. 16 analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ CPIC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second. It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)=

-Main Unit: 5000 x 1500 x 2500 mm. Weight: 1000 Kg.
-Service Module: 2000 x 1500 x 2000 mm. Weight: 200 Kg.
-Control Interface: 490 x 450 x 470 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/processcontrol/industrial/CPIC.pdf

PRACTICAL POSSIBILITIES

1.- Familiarisation with the different components of the system and their symbolic representation. Identification of components and description of their functions.
2.- The auxiliary systems: air and hot water supply.
3.- Flow sensors calibration.
4.- Temperature sensors calibration.
5.- Level sensor calibration.
6.- I/P converter calibration.
7.- Flow control loop (on/off).
8.- Flow control loop (proportional).
9.- Flow control loop (P+I).
10.- Flow control loop (P+D).
11.- Flow control loop (P+I+D).
12.- Adjust of the flow controller constants (Ziegler-Nichols).
13.- Adjust of the flow controller constants (reaction curves).
14.- Search of simple shortcomings in the loop of flow control.
15.- Temperature control loop (on/off).
16.- Temperature control loop (proportional).
17.- Temperature control loop (P+I).
18.- Temperature control loop (P+D).
19.- Temperature control loop (P+I+D).
20.- Adjust of the temperature controller constants (minimum area or reduction rate).
21.- Adjust of the temperature controller constants (minimum disturbance criterion).
22.- Adjust of the temperature controller constants (minimum width criterion).
23.- Study of the retards for speed/distance, exemplified through the temperature control loop.
24.- Study of the energy lost in the temperature control loop.
25.- Search of simple shortcomings in temperature control loop.
26.- Level control loop (on/off).
27.- Level control loop (proportional).
28.- Level control loop (P+I).
29.- Level control loop (P+D).
30.- Level control loop (P+I+D).
31.- Adjust of the level controller constants (minimum area or reduction rate).
32.- Adjust of the level controller constants (minimum disturbance criterion).
33.- Adjust of the level controller constants (minimum width criterion).
34.- Search of simple shortcomings in level control loop.
35.- Pressure control loop (on/off).
36.- Pressure control loop (proportional).
37.- Pressure control loop (P+I).
38.- Pressure control loop (P+D).
39.- Pressure control loop (P+I+D).
40.- Adjust of the pressure controller constants (minimum area or reduction rate).
41.- Adjust of the pressure controller constants (minimum disturbance criterion).
42.- Adjust of the pressure controller constants (minimum width criterion).
43.- Search of simple shortcomings in the pressure control loop.
44.- The use of the controllers in cascade, exemplified with the level/ flow control loop.
45.- Adjust of cascade control constants (minimum area or reduction rate).
46.- Adjust of cascade control constants (minimum disturbance criterion).
47.- Adjust of cascade control constants (minimum width criterion).
48.- Search of simple shortcomings in cascade control loop.
49.- Practical operation of the control plant to some wanted specific values: transfers without interferences.
50.- Calculation of the fluid flow in function of the differential pressure sensor.
51-69.- Practices with PLC.

Other available Units:

CPIC-C. **Computer Controlled Process Control Plant with Industrial Instrumentation and Service Module** (only Flow)

CPIC-T. **Computer Controlled Process Control Plant with Industrial Instrumentation and Service Module** (only Temperature)

CPIC-N. **Computer Controlled Process Control Plant with Industrial Instrumentation and Service Module** (only Level)

CPIC-P. **Computer Controlled Process Control Plant with Industrial Instrumentation and Service Module** (only Pressure)

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(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and **ECO-Management and Audit Scheme**
(environmental management)

Worlddidac Quality Charter Certificate
(Worlddidac Member)