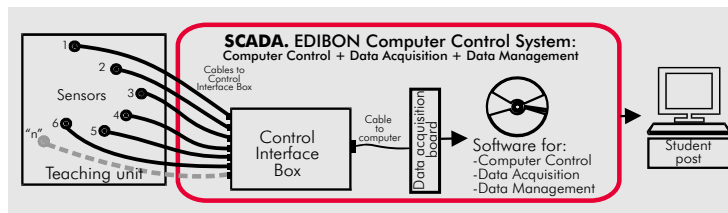


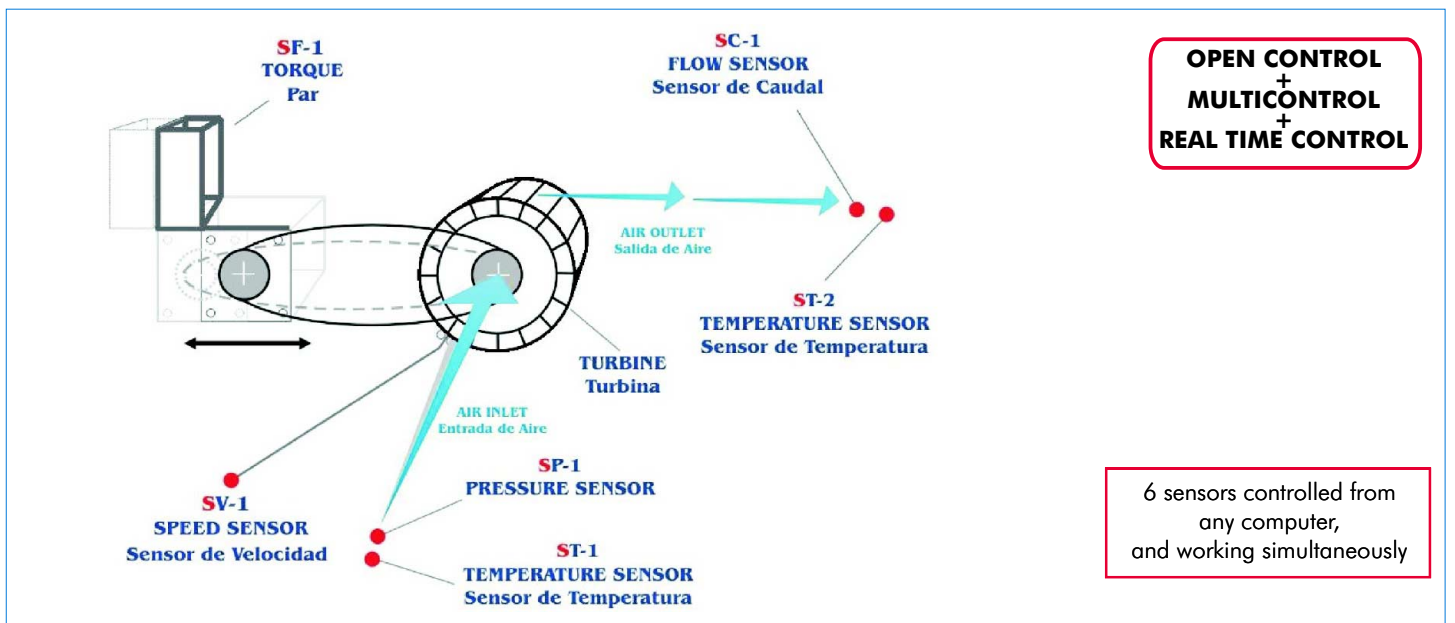
① Unit: HTRC. Experimental Reaction Turbine



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- Products
- Products range
- Units
- 8.-Fluid Mechanics & Aerodynamics

PROCESS DIAGRAM AND ELEMENTS ALLOCATION



ISO 9001 : 2000
Certificate of Approval



European Union Certificate



Certificates ISO 14001: 2004 and
ECO-Management and Audit Scheme
(environmental management)

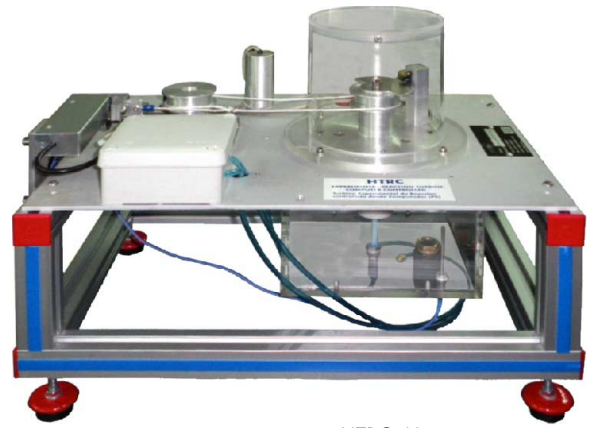


Worlddidac Quality Charter
Certificate
Worlddidac Member

Items supplied as standard

① **HTRC. Unit:**

- Bench top unit.
- Anodized aluminium structure and metallic panels.
- Main metallic elements in stainless steel.
- Diagram in the front panel with similar distribution to the elements in the real unit.
- Nozzle:
 - Diameter: 1 mm.
 - Discharge angle: 180°.
- Turbine rotor:
 - External diameter: 80 mm.
 - Internal diameter: 40 mm.
 - Number of nozzles: 2.
 - Nozzle internal angle: 180°.
 - Nozzle external angle: 180°.
 - Material used: Metal.
- Brake:
 - Pulley diameter: 60 mm.
 - Effective diameter: 50 mm.
- Pressure sensor: 0 to 250 psi. This sensor measures the air inlet pressure.
- Load cell: 0 - 20 N. Force sensor.
- Flow sensor: 0 to 150 l./min.
- Speed sensor: 0 to 6000 rpm.; for measuring the rotational speed of the turbine.
- 2 Temperature sensors, "J" type, range:-40 to 750°C; for measuring the air inlet and air outlet temperatures.
- Measurement of air pressure, air temperature, air flow, rotational speed and torque.
- Air supply: Maximum pressure: 7 bar. Maximum air flow: 0 to 150 l./min.



HTRC. Unit

② **HTRC/CIB. Control Interface Box :**

- Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.
- All sensors, with their respective signals, are properly manipulated from -10V. to +10V computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors. Single cable between the control interface box and computer.
- The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure. Simultaneously 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. Storage of all the process data and results in a file. Graphic representation, in real time, of all the process/system responses.
- All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process. All the actuators and sensors values and their responses are placed in only one computer screen.
- 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. Real time computer control for pumps, compressors, resistances, control valves, etc.
- 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 control interface and the third one in the control software.



HTRC/CIB

③ **DAB. Data Acquisition Board:**

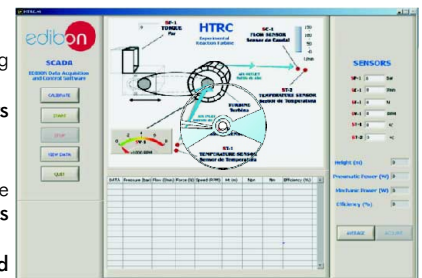
- PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
- Analog input: Number of channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V)=±10V. Data transfers=DMA, interrupts, programmed I/O. DMA channels=6.
- Analog output: Channels=2. Resolution=16 bits, 1 in 65536. Max. output rate up to: 833 KS/s. Output range(V)=±10V. Data transfers=DMA, interrupts, programmed I/O.
- Digital Input/Output: Channels=24 inputs/outputs. DO or DI Sample Clock frequency: 0 to 1 MHz.
- Timing: Counter/timers=2. Resolution: Counter/timers: 32 bits.



DAB

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

- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen.
- Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneously way.
- Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters. Management, processing, comparison and storage of data.
- Sampling velocity up to 250,000 data per second guaranteed. Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process. Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access at different work levels.
- This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



HTRC/CCSOF

⑤ **Cables and Accessories, for normal operation.**

⑥ **Manuals:** This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

***References 1 to 6: HTRC + HTRC/CIB + DAB + HTRC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PLC-PI. PLC Module:

Circuit diagram in the front panel.

Front panel:

Digital inputs(X) and Digital outputs (Y) block:

16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

Analog inputs block:

16 Analog inputs (-10V. to + 10V.)(through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V) (through SCSI connector).

Touch screen:

High visibility and multiple functions.

Display of a highly visible status.

Recipe function.

Bar graph function.

Flow display function.

Alarm list.

Multi language function.

True type fonts.

Back panel:

Power supply connector.

Fuse 2A.

RS-232 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

Panasonic PLC:

High-speed scan of 0.32 μsec. for a basic instruction.

Program capacity of 32 Ksteps, with a sufficient comment area.

Free input AC voltage(100 to 240 V AC).

DC input: 16 (24 VDC).

Relay output: 14 (250 VA AC/2 A).

High-speed counter.

Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

⑧ HTRC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.



PLC-PI

Items available on request

⑨ HTRC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

⑩ HTRC/FSS. Faults Simulation System.

Software Main Screens

Main screen

Note: SP=Pressure sensor. SC=Flow sensor. SF=Force sensor. SV=Speed sensor. ST=Temperature sensor.

Examples of Sensors Calibration screens

Reference Select	Sensors	Volts	Calibrated	ΔT
<input type="checkbox"/>	ST-1	0.2753	28.8346	28.83
<input checked="" type="checkbox"/>	ST-2	0.3335	29.7856	29.79
<input checked="" type="checkbox"/>	ST-3	0.331	29.0641	29.06
<input checked="" type="checkbox"/>	ST-4	0.3254	29.5453	29.55
<input checked="" type="checkbox"/>	ST-5	0.3295	28.4276	28.43
<input checked="" type="checkbox"/>	ST-6	0.3458	34.752	34.75
<input type="checkbox"/>		-0.0037	-0.0037	0
<input type="checkbox"/>		-0.004	-8.01826	8.02
<input type="checkbox"/>		3.4768	3.4768	3.46
<input type="checkbox"/>		3.215	291.898	291.89
<input type="checkbox"/>		3.066	3.066	3.07
<input type="checkbox"/>		2.6614	2.6614	2.66
<input type="checkbox"/>		2.4281	2.4281	2.43
<input type="checkbox"/>	SC-1	0.1291	0.1424	0.14
<input type="checkbox"/>	SC-2	0.0104	-0.0211	0.02
<input type="checkbox"/>	AN-1	5.9886	5.9886	5.99

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

- 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:

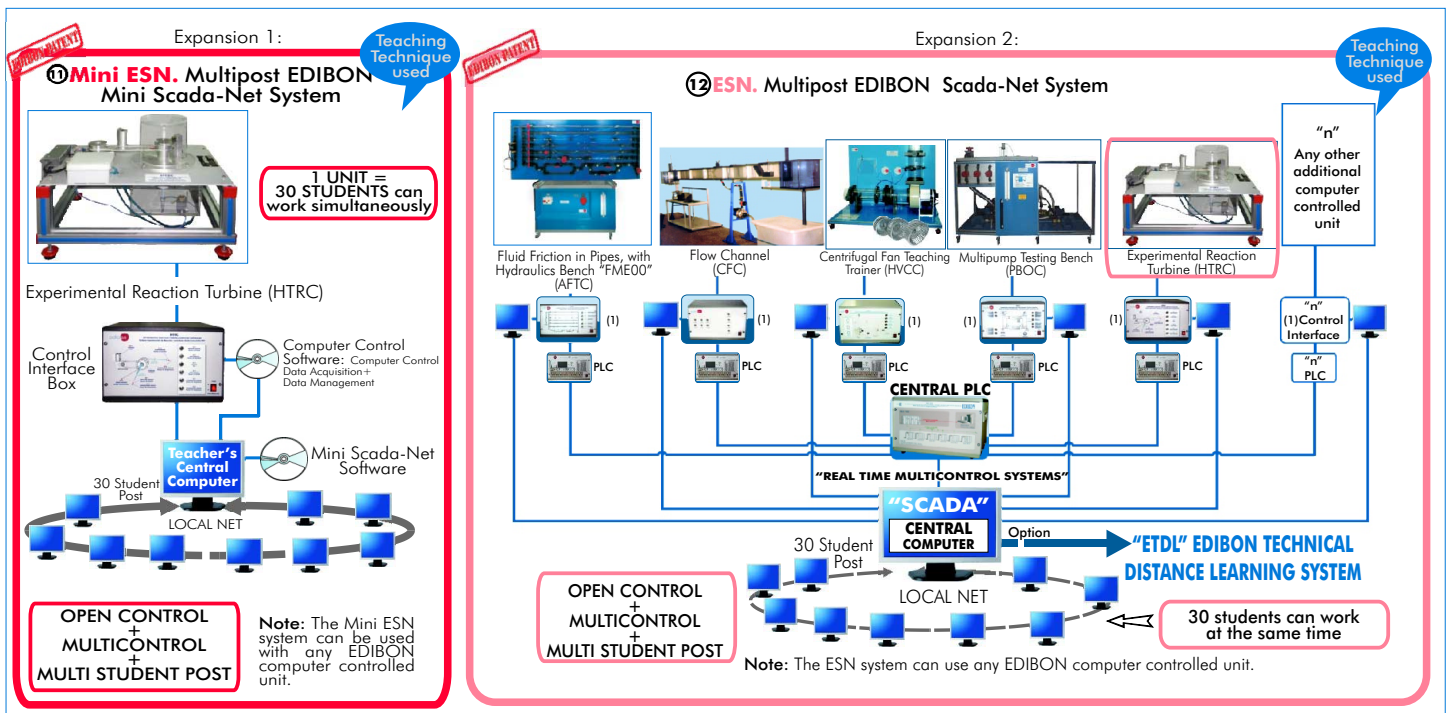
- 8.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

- 9.- Control of the HTRC unit process through the control interface box without computer.
- 10.- Visualization of all the sensors values used in HTRC unit process.
- 11.- Calibration of all sensors included in HTRC unit process.
- 12.- Hand on of all the actuators involved in the HTRC unit process.
- 13.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

- 14.- Simulation of outside actions, in the cases do not exist hardware elements (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 15.- PLC hardware general use and manipulation.
- 16.- PLC process application for the HTRC unit.
- 17.- PLC structure.
- 18.- PLC inputs and outputs configuration.
- 19.- PLC configuration possibilities.
- 20.- PLC program languages.
- 21.- PLC different programming standard languages.
- 22.- New configuration and development of new process.
- 23.- Hand on an established process.
- 24.- To visualize and see the results and to make comparisons with the HTRC unit process.
- 25.- Possibility of creating new process in relation with the HTRC unit.
- 26.- PLC Programming Exercises.
- 27.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

- ① Unit: HTRC. Experimental Reaction Turbine.
- ② HTRC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ HTRC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

* **IMPORTANT:** Under **HTRC** we always supply all the elements for immediate running as **1, 2, 3, 4, 5 and 6.**

Complementary items to the standard supply

PLC. Industrial Control Using PLC (7 and 8):

- ⑦ PCL-PI. PLC Module.
- ⑧ HTRC/PLC-SOF. PLC Control Software.
- ⑨ HTRC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ HTRC/FSS. Faults Simulation System. (Available on request).

Expansions

- ⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System.
- ⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.
- Computer (PC).

DIMENSIONS & WEIGHTS

- HTRC Unit :
 - Dimensions: 800 x 500 x 600 mm. approx.
 - Weight: 50 Kg. approx.
- Control Interface Box: -Dimensions: 490 x 330 x 310 mm. approx.
 - Weight: 10 Kg. approx.
- PLC Module (PLC-PI): -Dimensions: 490 x 330 x 310 mm. approx.
 - Weight: 30 Kg. approx.

* Specifications subject to change without previous notice, due to the convenience of improvements of the product.



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