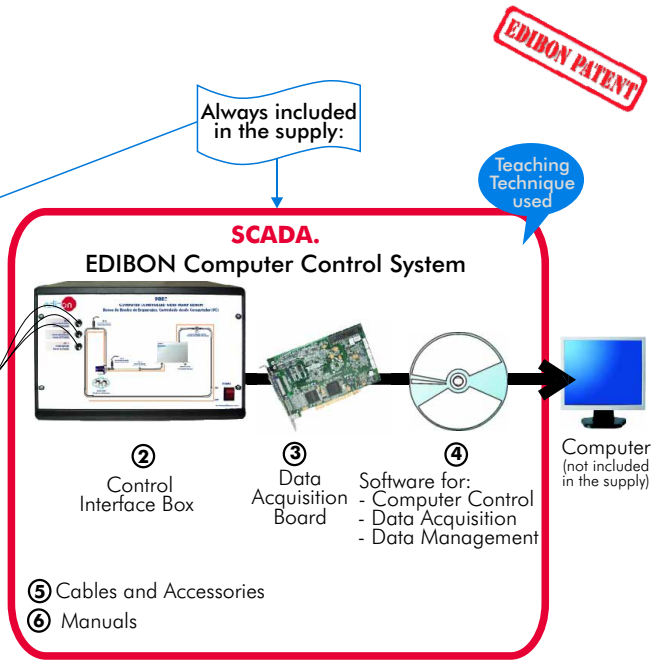
edibon
Technical Teaching Equipment

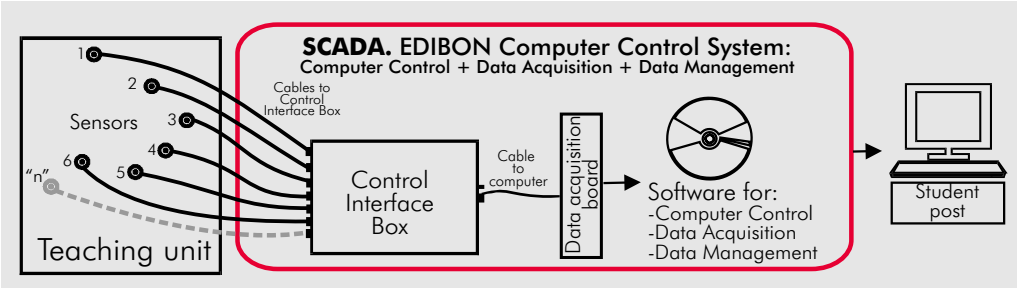
Computer Controlled **Gear Pump Bench**

PBEC

① Unit: PBEC. Gear Pump Bench



OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



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(total safety)

Certificates ISO 14000 and **ECO-Management and Audit Scheme**
(environmental management)

Worlddidac Quality Charter Certificate
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DESCRIPTION

PBEC is a bench-top unit consists of a gear pump computer controlled, a feed water tank, circulation pipes, regulation valves, as well as the enough control elements for the pump experiments: 2 pressure sensors and 1 flow sensor.

A frequency inverter for the pump, computer controlled, provides the possibility of regulation and measuring the pump motor speed.

Also the torque transferred can be measured.

The pump is installed in a pipes system which avoids the permanent water spending during the operation because it is a closed circuit.

PBEC unit has instrumentation and sensors to allow the measurement, from the computer (PC), of the most typical parameters of the gear pump:

- Motor speed.
- Total impelled flow.
- The admission and discharge pressure.
- Torque.
- Calculated values:
  - Total height.
  - Hydraulic power.
  - Mechanic power.
  - Efficiency.

Adjustable parameters, as:

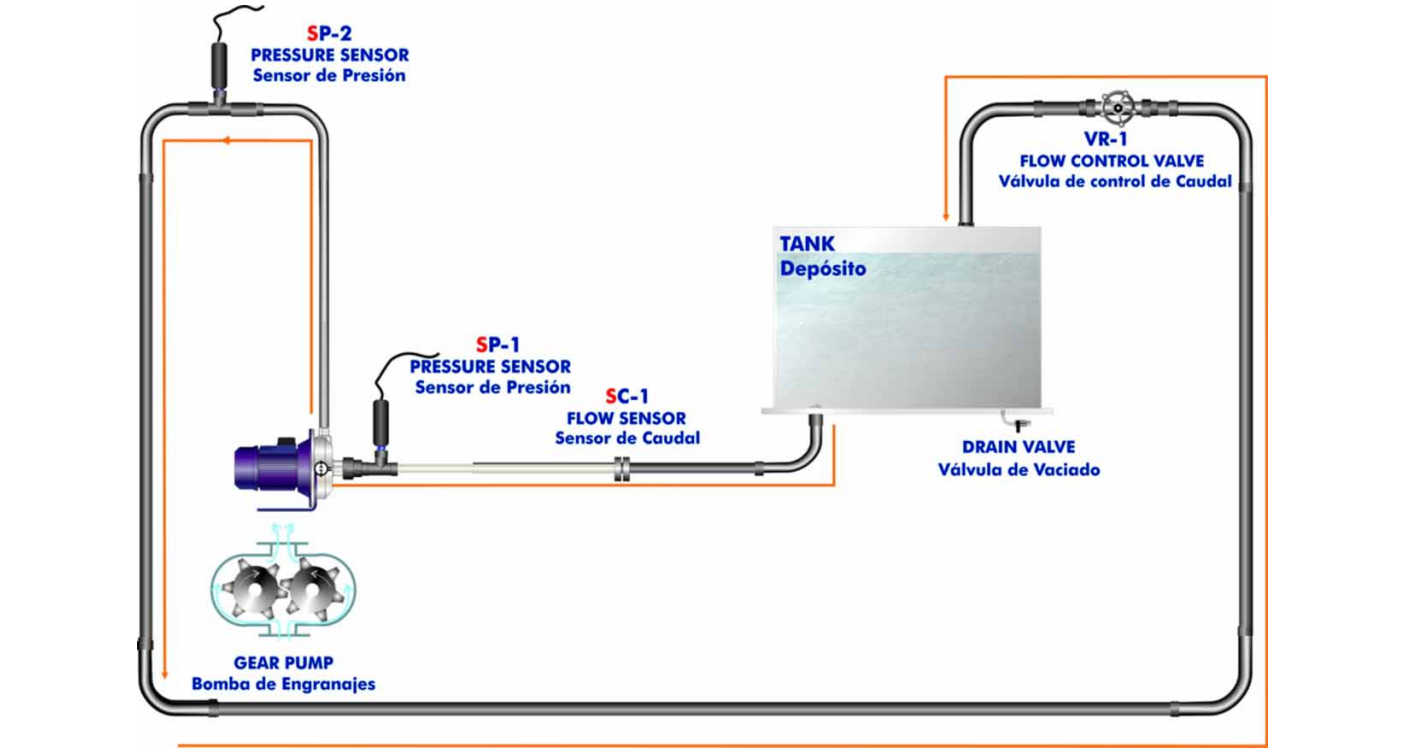
- Motor speed and flow.
- Position of the valve "VR1" (adjustable).

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), including: Control interface Box + Data Acquisition Board + Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

1 actuators and 3 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL



Items supplied as standard

① PBEC. Unit:

Bench-top unit.

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

Gear pump (motor - pump), computer controlled:

- Maximum flow: 15 l./min.
- Maximum height (approx.): 50 mwc (Meter of water column).

Electric AC motor:

- 0.5 HP (horsepower).
- 0 to 1400 rpm.

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 15 l./min

PBEC. Unit

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.
- Calculated values:
  - Total height.
  - Hydraulic power.
  - Mechanic power.
  - Efficiency.

Flow regulation valve.

Transparent water tank, capacity: 40 l. approx.

Pipes.

② PBEC/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 its 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 int 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.

PBEC/CIB

Continue...

Items supplied as standard (continuation)

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)=±10 V.

Data transfers=DMA, interrupts, programmed I/0.

Number of DMA channels=6.

DAB

Analog output:

Number of **Channels=2.**

Resolution=16 bits, 1 in 65536.

Maximum output rate up to: 833 KS/s.

Output range(V)=±10 V.

Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **Channels=24 inputs/outputs.**

D0 or DI Sample Clock frequency: 0 to 1 MHz.

Timing: **Counter/timers=2.**

Resolution: Counter/timers: 32 bits.

④ PBEC/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.

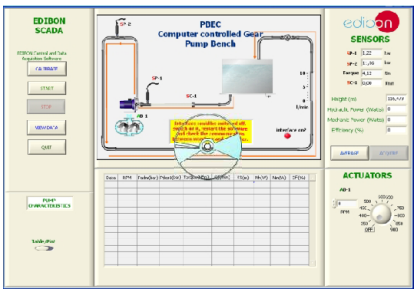
Calibration system for the sensors involved in the process.

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 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



PBEC/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: PBEC+ PBEC + DAB + PBEC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.

Continue...

Additional and optional 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.
USB 2.0 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 V DC).
Relay output: 14 (250 V A AC/2 A).
Program capacity: 32 ksteps.
High-speed counter.
Multi-point PID control.

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

Communication RS232 wire, to computer (PC).

PLC-PI

⑧ PBEC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

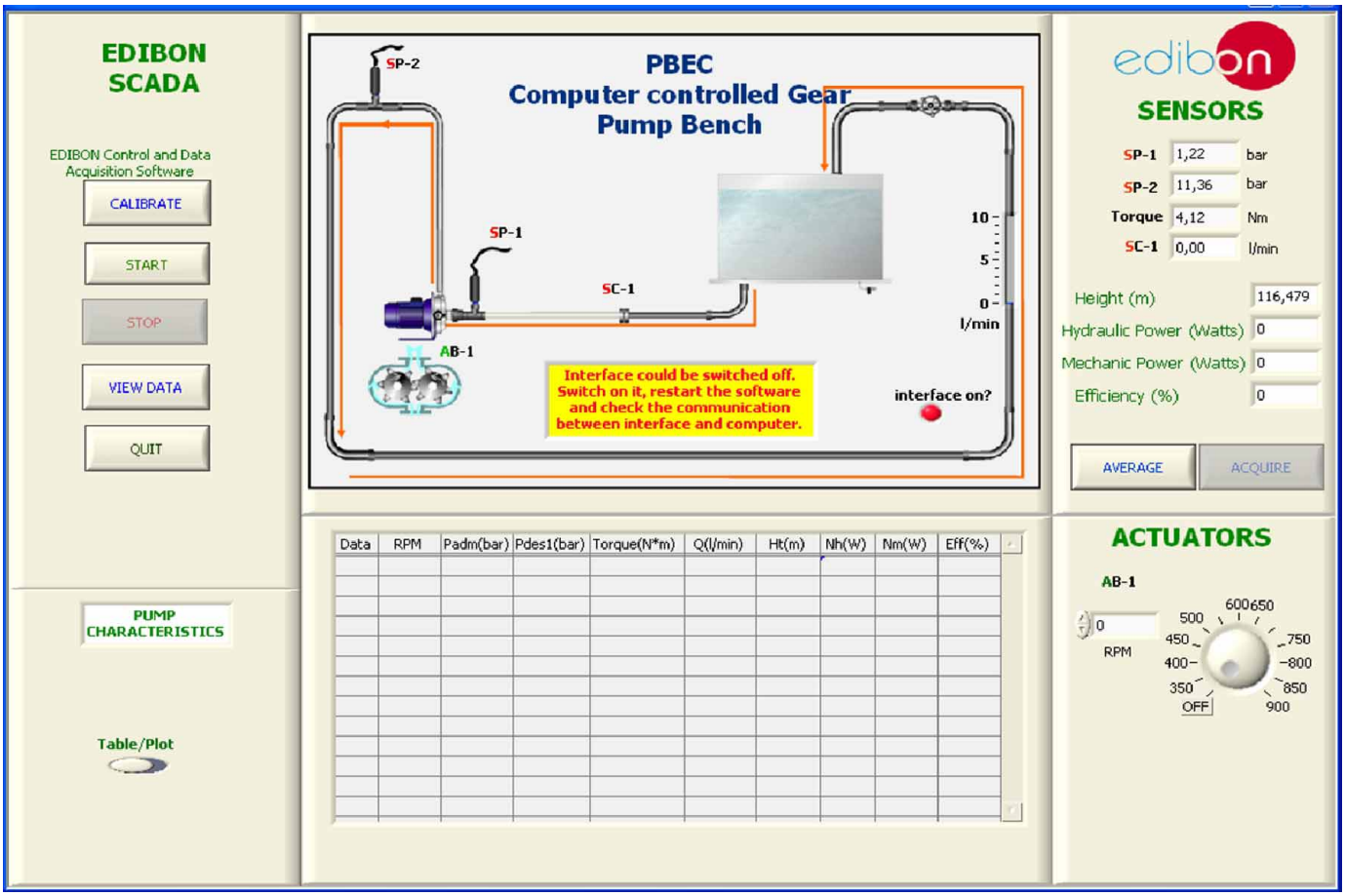
Items available on request

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

⑩ PBEC/FSS. Faults Simulation System.

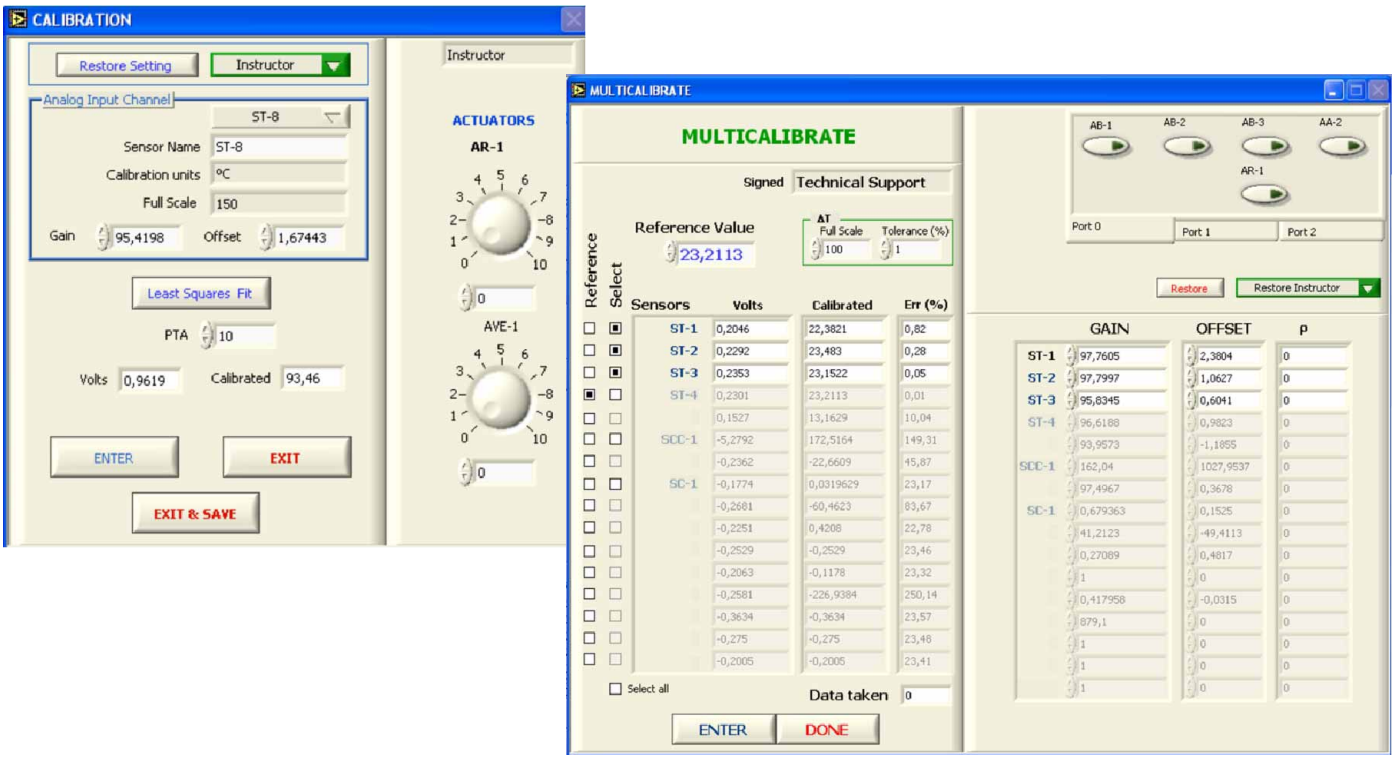
Software Main Screens

Main screen



Note: SP=Pressure sensor SC=Flow sensor AB=Pump

Examples of Sensors Calibration screens



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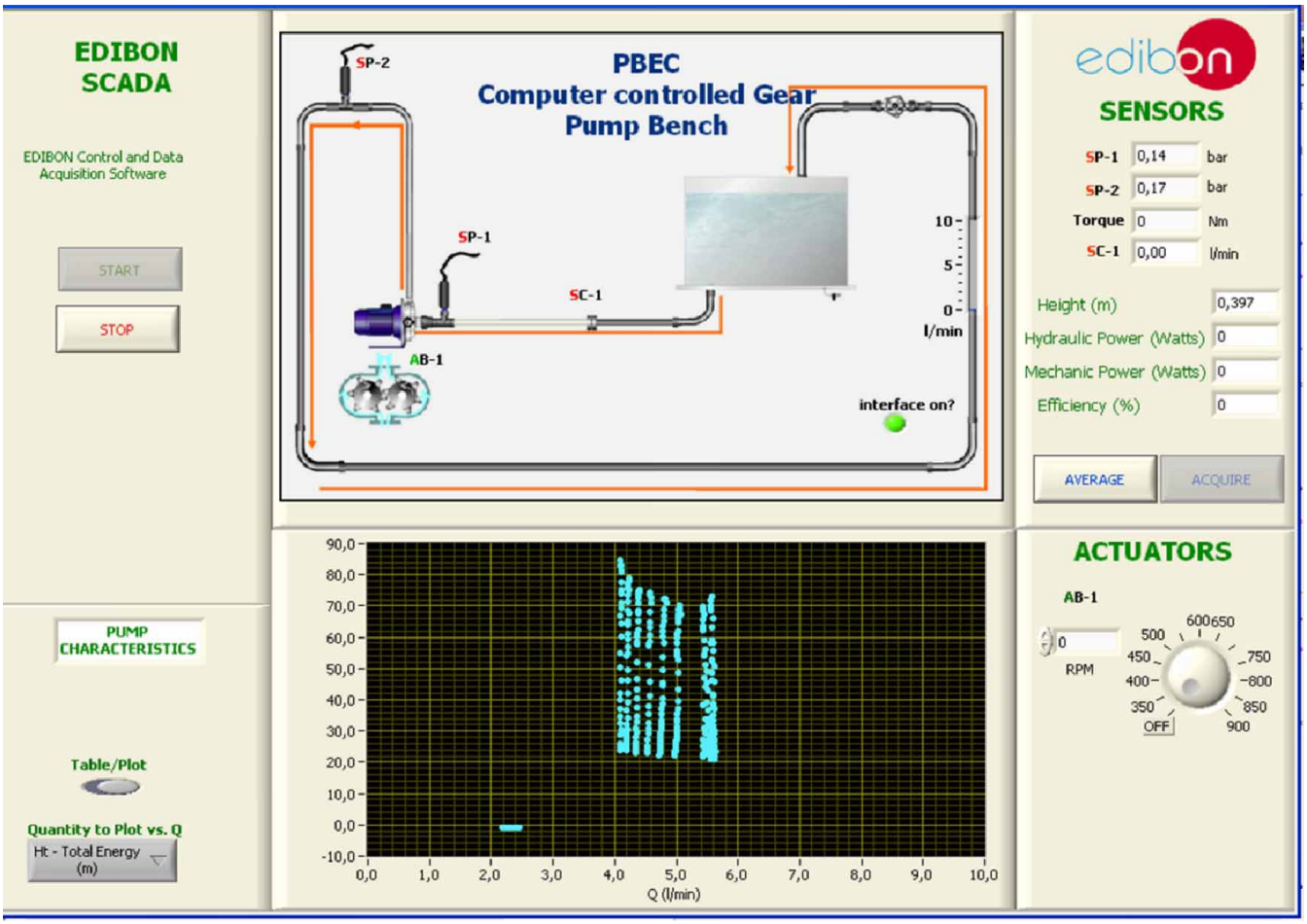
Some typical exercises results

Representation of Ht (Total Height) vs Flow, at different rpm.

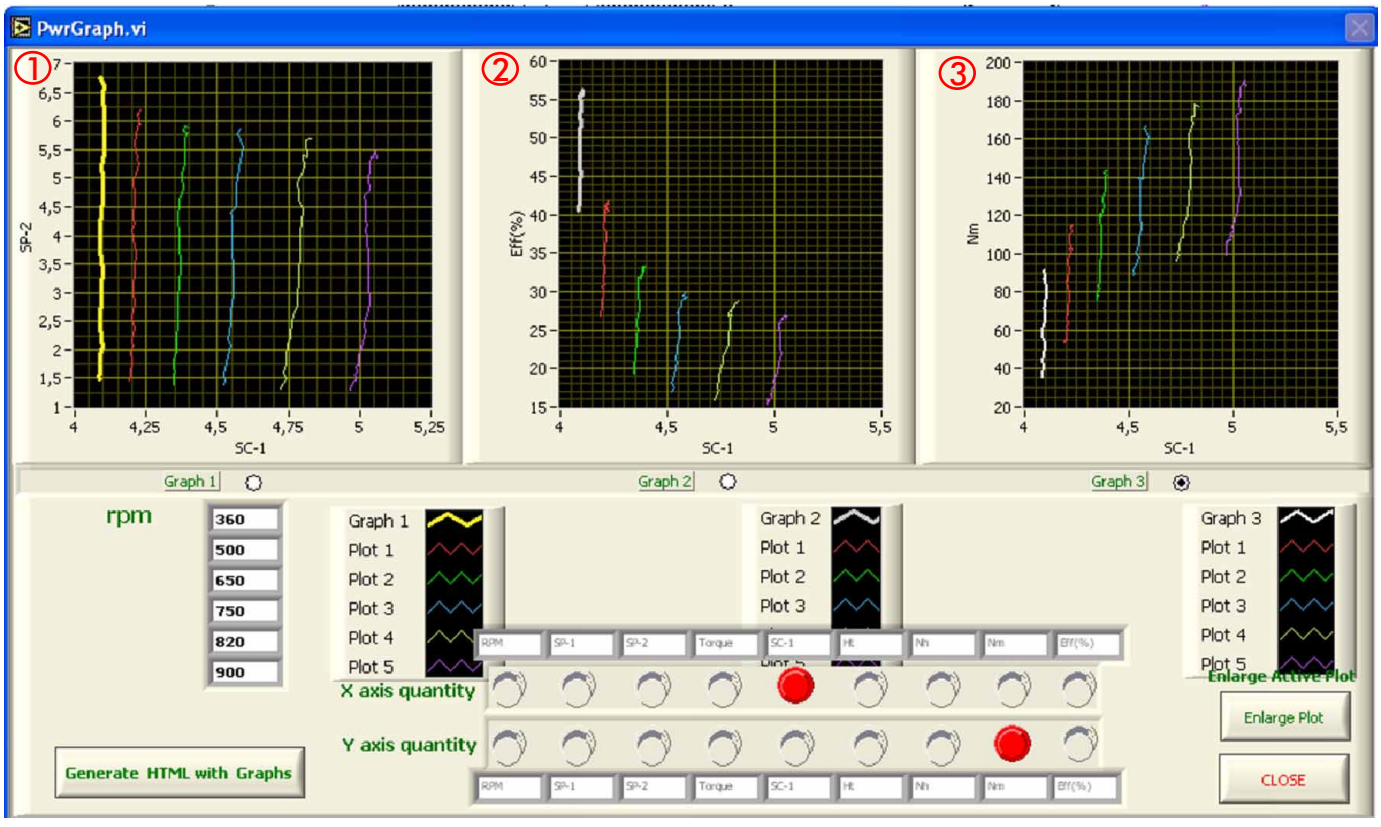


Graphical Representations:

1.- Graphical Representation of Pressure vs Flow, at different rpm.

2.- Graphical Representation of Efficiency vs Flow, at different rpm.

3.- Graphical Representation of Torque vs Flow, at different rpm.



EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

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.

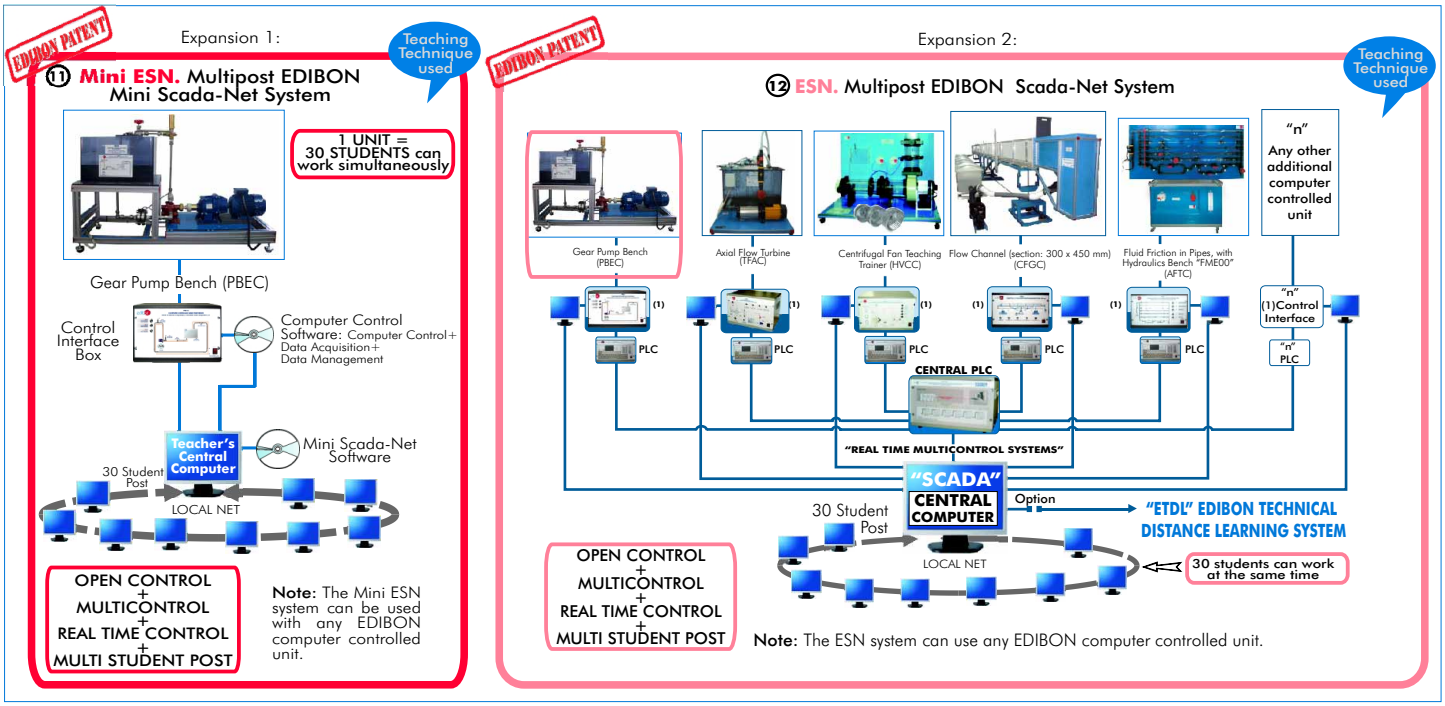
Other possible practices:

9.- Sensors Calibration.

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

10.- Control of the PBEC unit process through the control interface box without the computer.
11.- Visualization of all the sensors values used in the PBEC unit process.
12.- Calibration of all sensors included in the PBEC unit process.
13.- Hand on of all the actuators involved in the PBEC unit process.
14.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
15.- 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).
16.- PLC hardware general use and manipulation.
17.- PLC process application for PBEC unit.
18.- PLC structure.
19.- PLC inputs and outputs configuration.
20.- PLC configuration possibilities.
21.- PLC program languages.
22.- PLC different programming standard languages.
23.- New configuration and development of new process.
24.- Hand on an established process.
25.- To visualize and see the results and to make comparisons with the PBEC unit process.
26.- Possibility of creating new process in relation with the PBEC unit.
27.- PLC Programming Exercises.
28.- 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: PBEC. Gear Pump Bench.**
② **PBEC/CIB.Control Interface Box.**
③ **DAB.Data Acquisition Board.**
④ **PBEC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
⑤ **Cables and Accessories,** for normal operation.
⑥ **Manuals.**

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

Additional and optional items to the standard supply

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

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

-Water supply and drainage.

-Computer (PC).

DIMENSIONS & WEIGHTS

PBEC Unit:	-Dimensions: 1100 x 450 x 800 mm. approx. -Weight: 60 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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