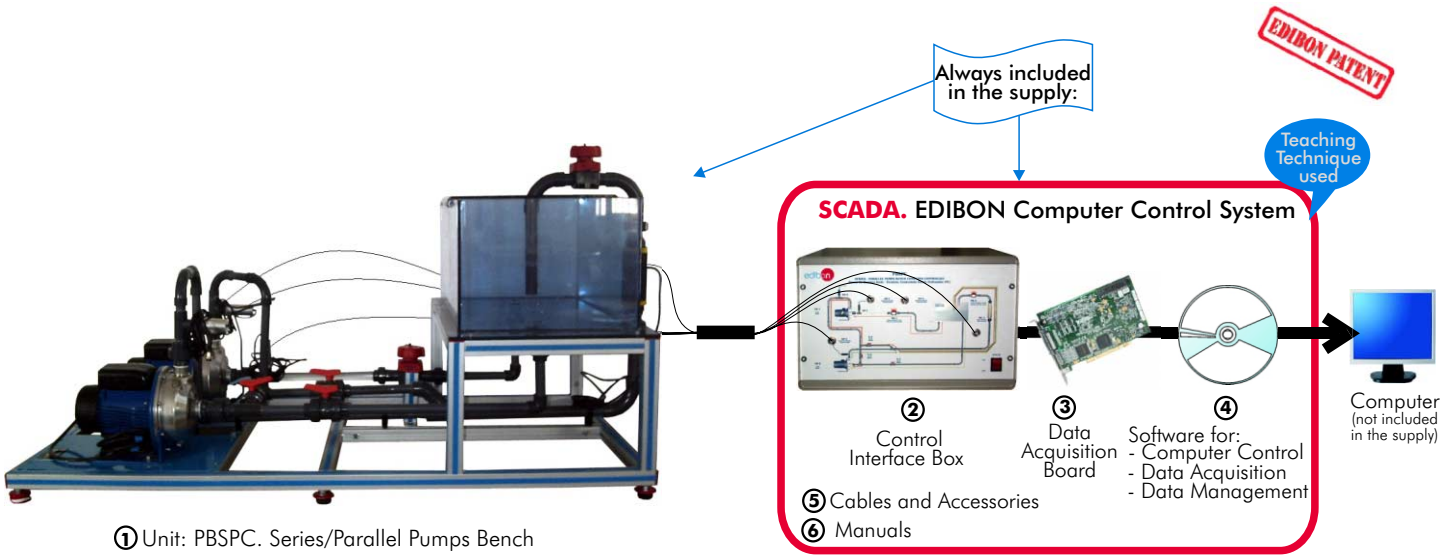
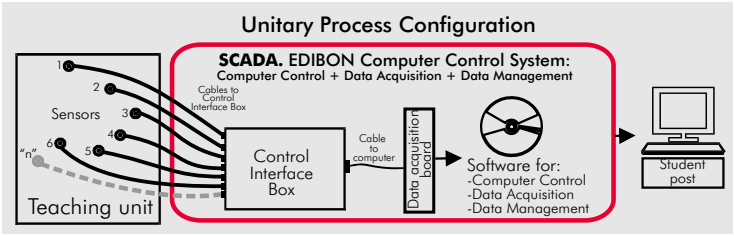
edibon
Technical Teaching Equipment

Computer Controlled
Series/Parallel Pumps Bench

PBSPC



① Unit: PBSPC. Series/Parallel Pumps Bench



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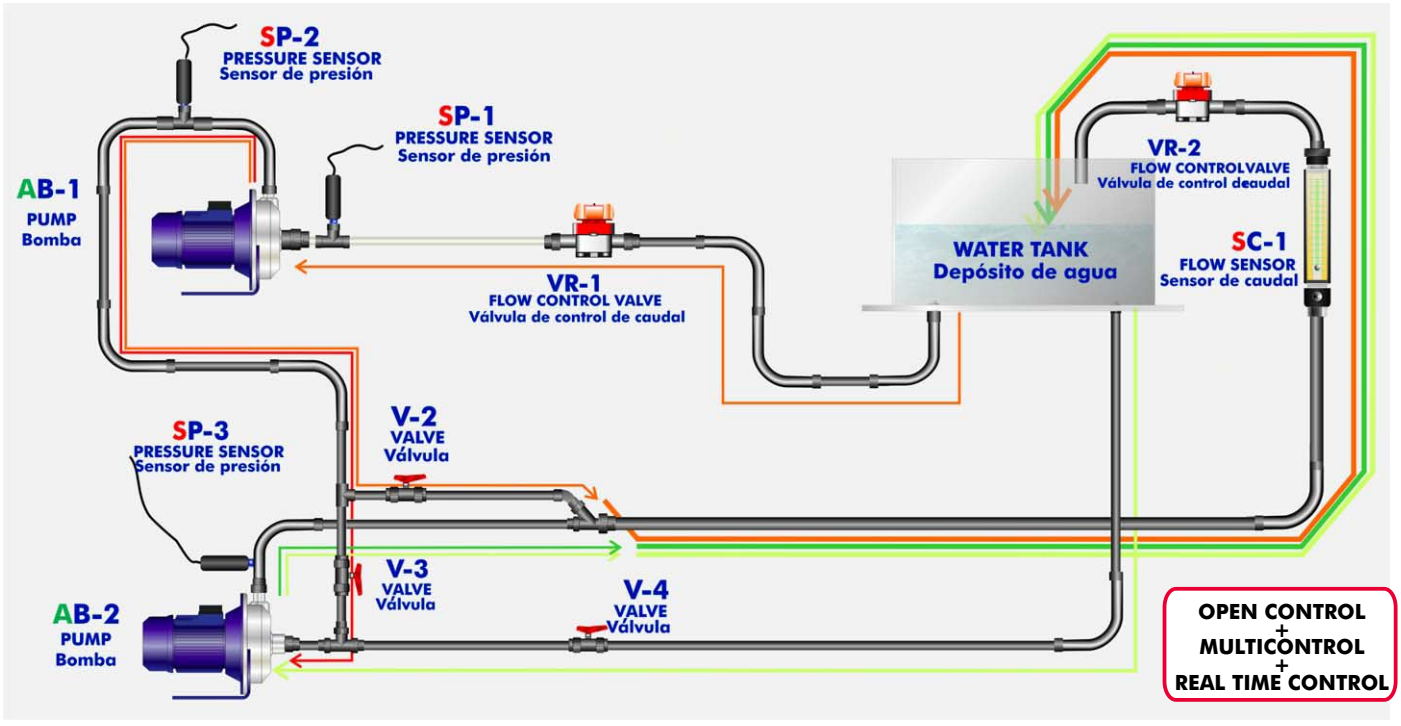
PROCESS DIAGRAM AND ELEMENTS ALLOCATION



ISO:9001-2000 Certificate of Approval. Reg. No. E204034

European Union Certificate

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

Worlddidac Quality Charter Certificate
Worlddidac Member

DESCRIPTION

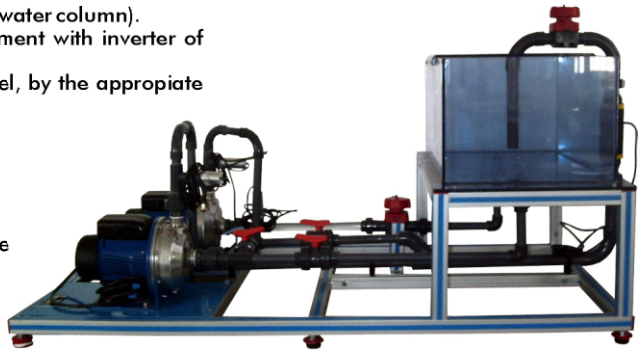
Unit designed to demonstrate the operational advantages of parallel or series operation, depending on the required duty.
This unit consists of two centrifugal pumps, a water tank and circulation pipes with valves at the inlet and outlet of the pumps, three pressure sensors and a flow sensor.
This unit 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.
The centrifugal pumps can operate: alone, coupled in series or in parallel. A three-phase motor activates a pump with possibility of adjustment and measurement of the turn speed as well as of the transmitted mechanic torque.
The pumps are installed in a pipes system, which, as it is a closed circuit, avoids the permanent waste of water during the operation.
By the appropiate positioning of the valves it is possible to connect the pumps individually, in series or in parallel, depending on which test is going to be performed.

SPECIFICATIONS

Items supplied as standard

① PBSPC. Unit:

Anodized aluminium structure.
Panels and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution that the elements in the real unit.
2 Centrifugal pumps :
Maximum flow: 120 l./min. Maximum height (approx.): 25 mwc (meter of water column).
One is a three-phase pump of 0.37 KW with continuous speed adjustment with inverter of frequency/voltage and the other one is single-phase.
3 valves that allow connecting the pumps separately, in series or in parallel, by the appropiate positioning of the valves and 2 regulating valves.
Torque measurement and speed measurement.
Discharge pressure sensor (0 to 2.5 bar).
Discharge pressure sensor (0 to 6 bar).
Admission pressure sensor (-1to 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: 60 l.



PBSPC. Unit

② PBSPC/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 for -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 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.

PBSPC/CIB

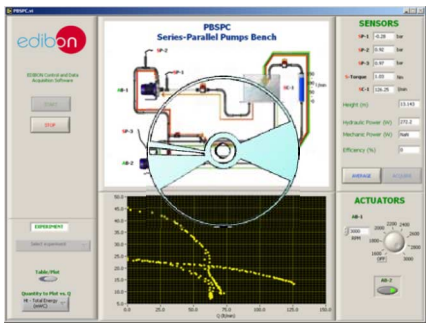
③ DAB. Data Acquisition Board:

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. Number of DMA channels=6.
Analog output:
Number of **channels=2. Resolution=16 bits,** 1 in 65536. Max. output rate up to: 833 KS/s.
Output range(V)=±10 V. Data transfers=DMA, interrupts, programmed I/O.
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.

DAB

④ PBSPC/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. Student calibration system for all 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 to 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.



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

Continue...

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 V DC).
Relay output: 14 (250 V A 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).

PLC-PI

⑧ PBSPC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

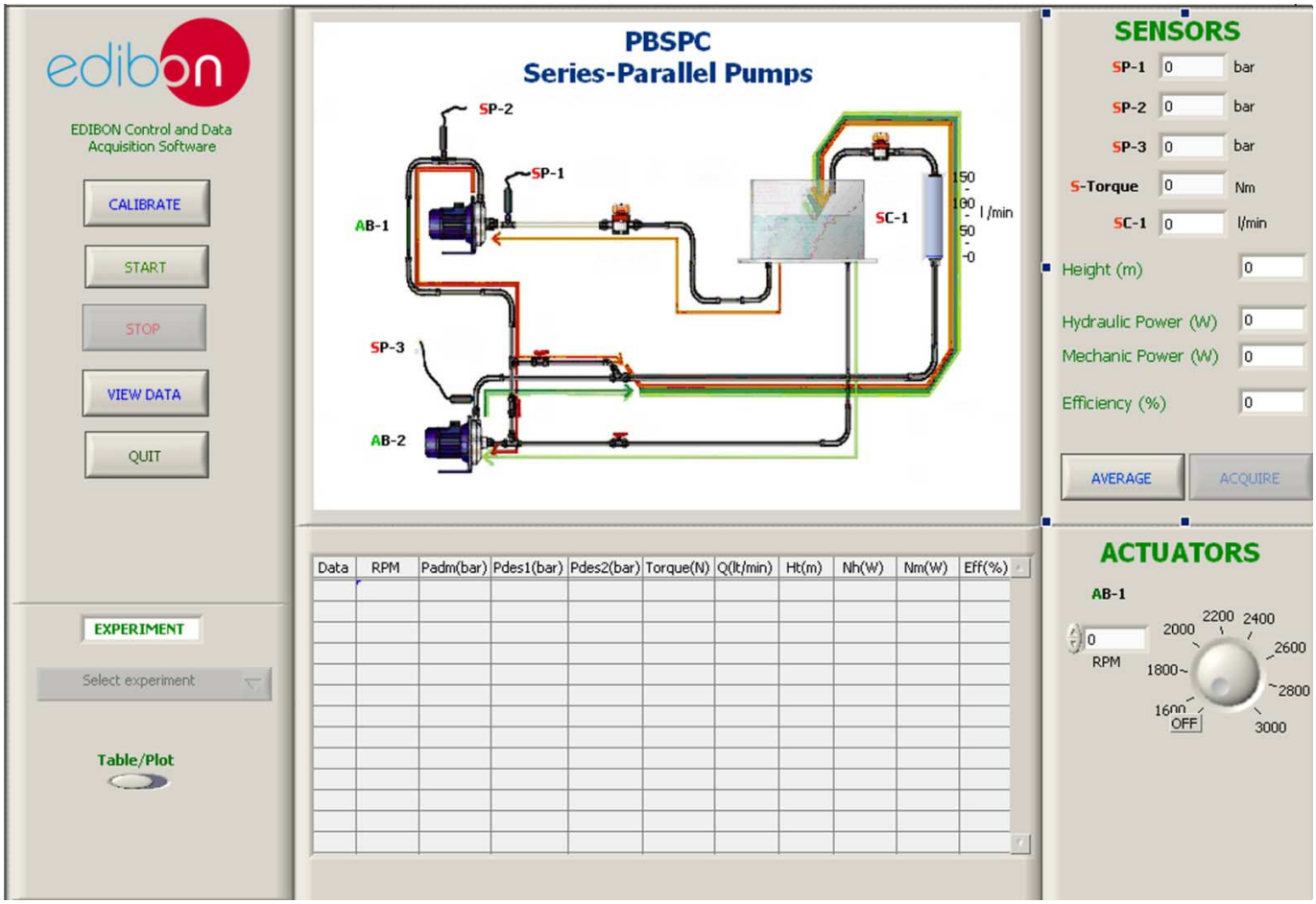
Items available on request

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

⑩ PBSPC/FSS. Faults Simulation System.

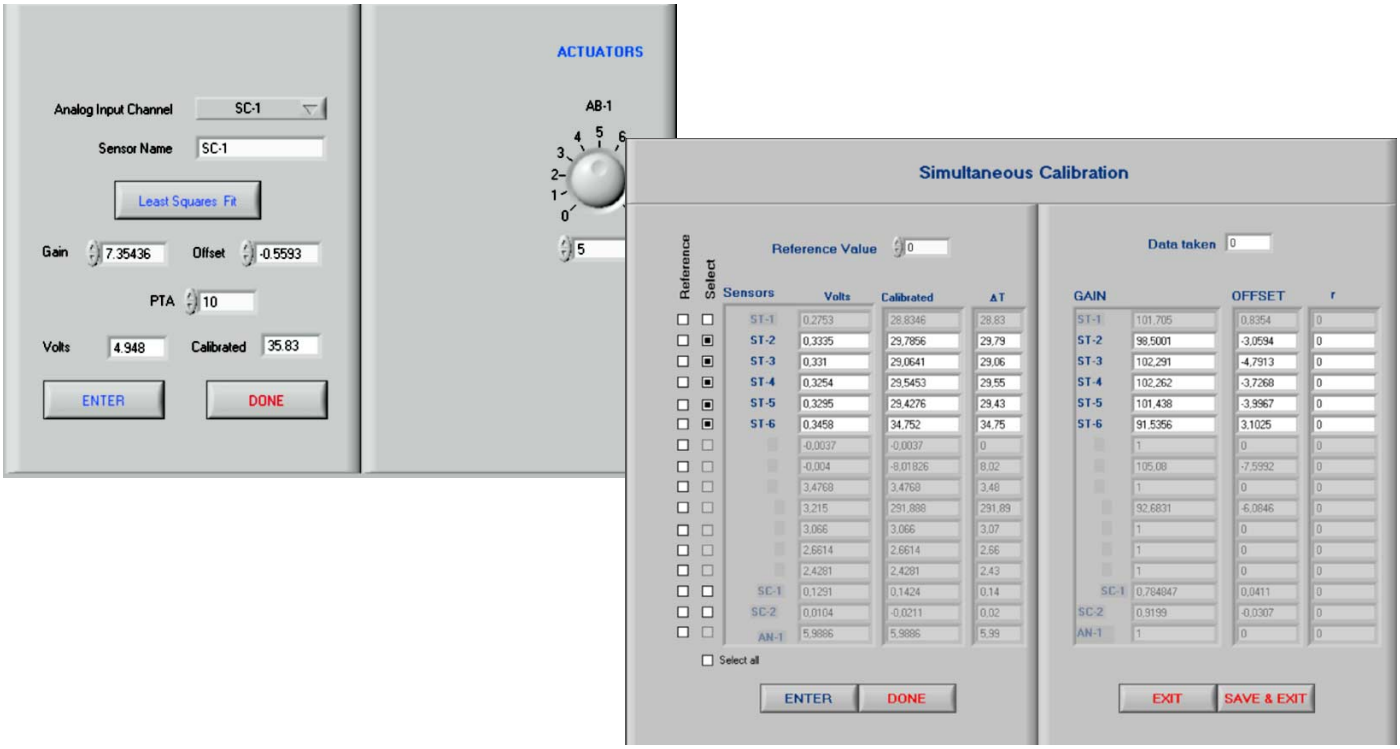
Software Main Screens

Main screen



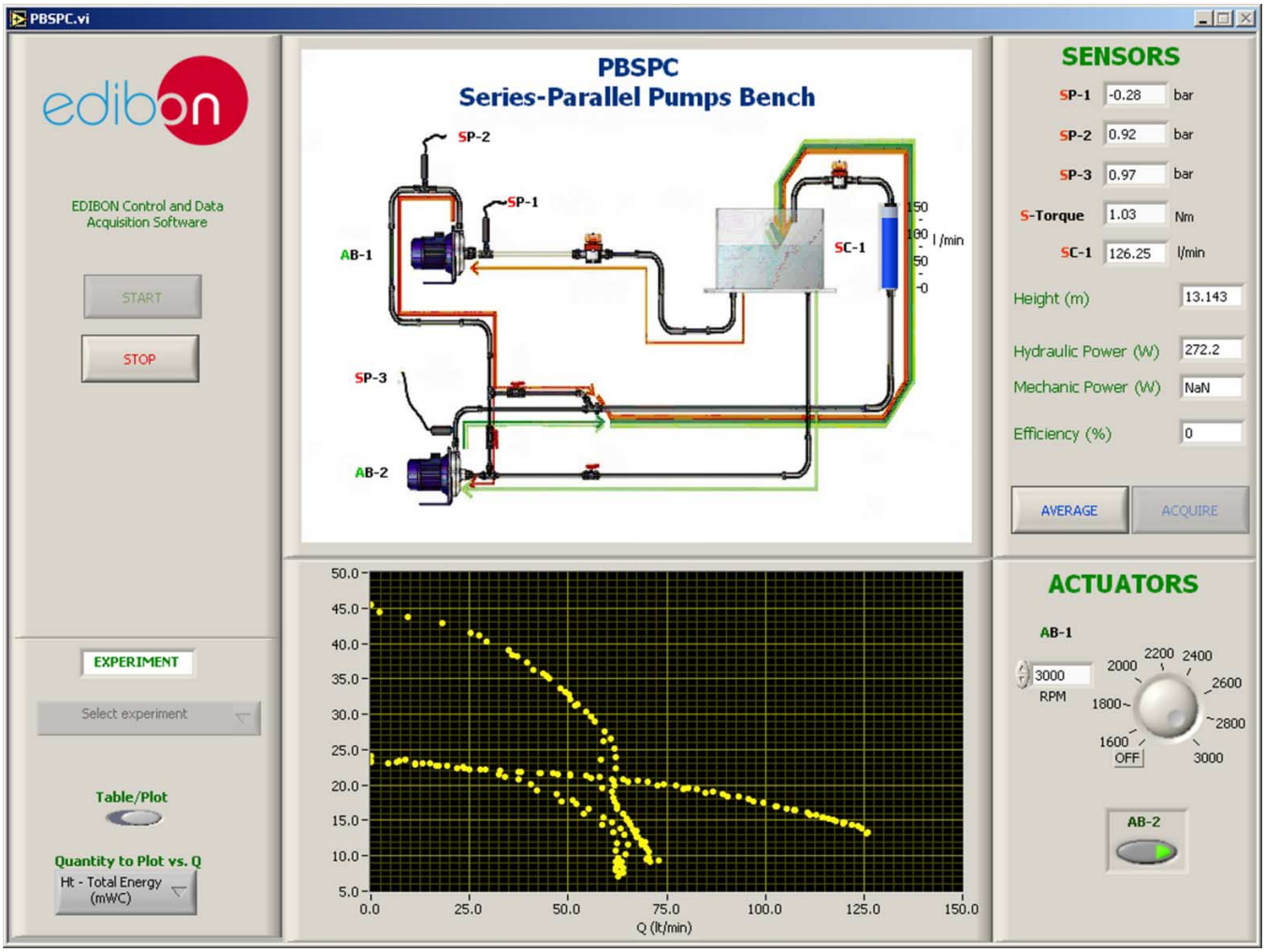
Note: SP= Pressure sensor. SC= Flow sensor. AB= Pump.

Examples of Sensors Calibration screens

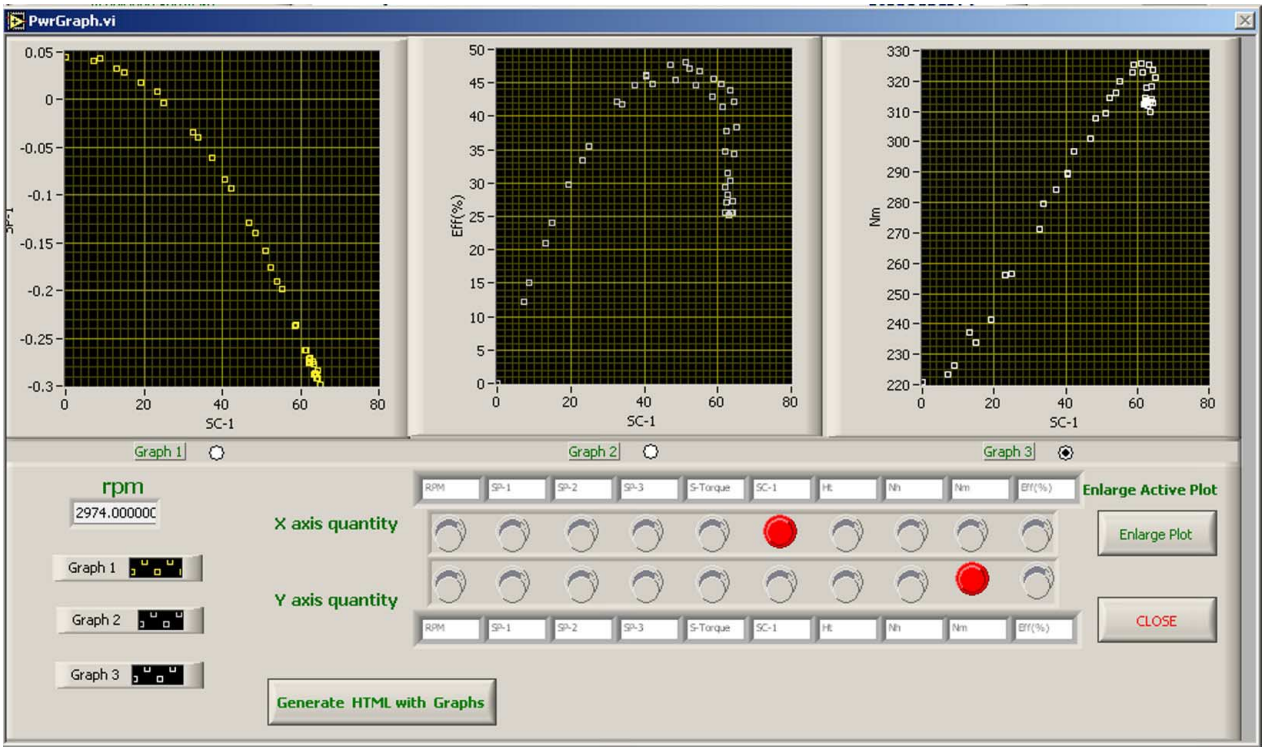


Continue...

Some typical exercises results



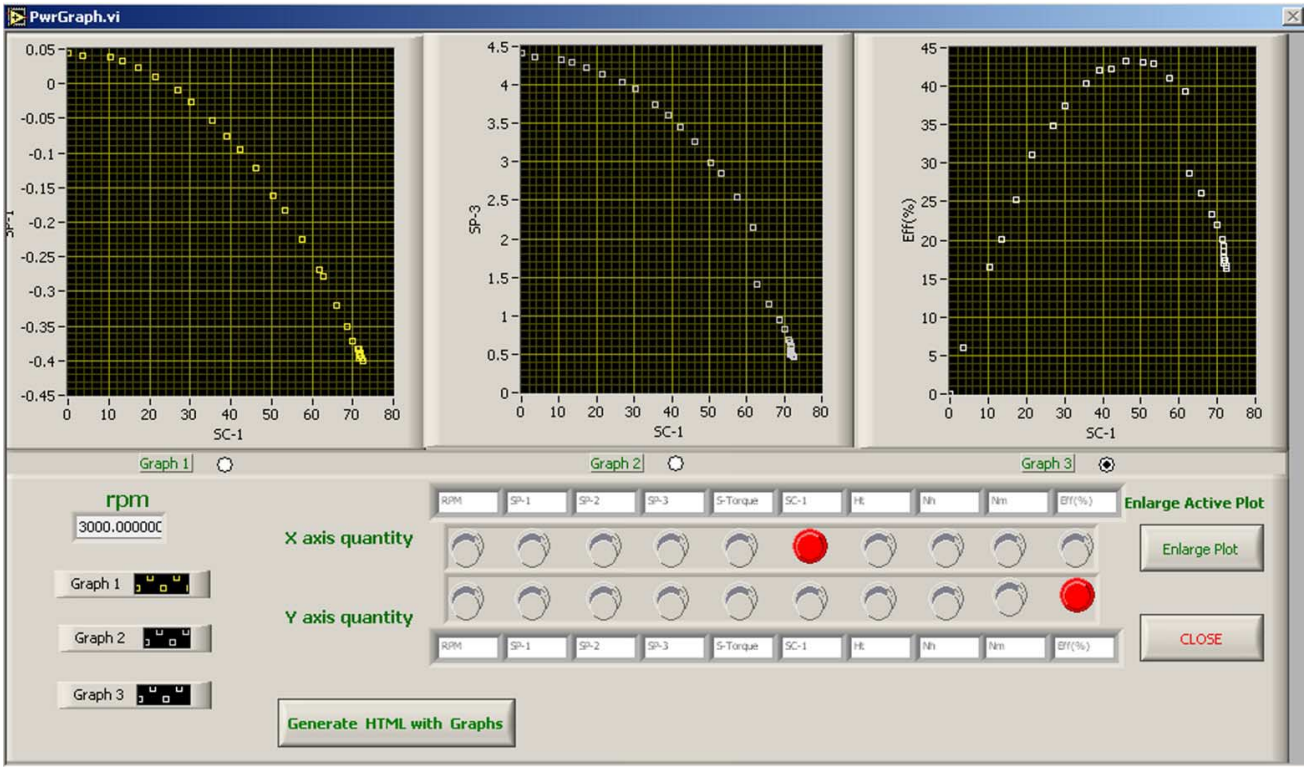
On this screen it is shown the repretentation of the pump characteristics and of the paralell and series configurations.
As we can see, when we have two paralell pumps a bigger flow can be pumped (in theory, two times greater than in the one pump case) at the same height (with the same energy).
If what we want is to pump a higher height, we should use two serial pumps, what let us to reach higher energies with a constant flow.

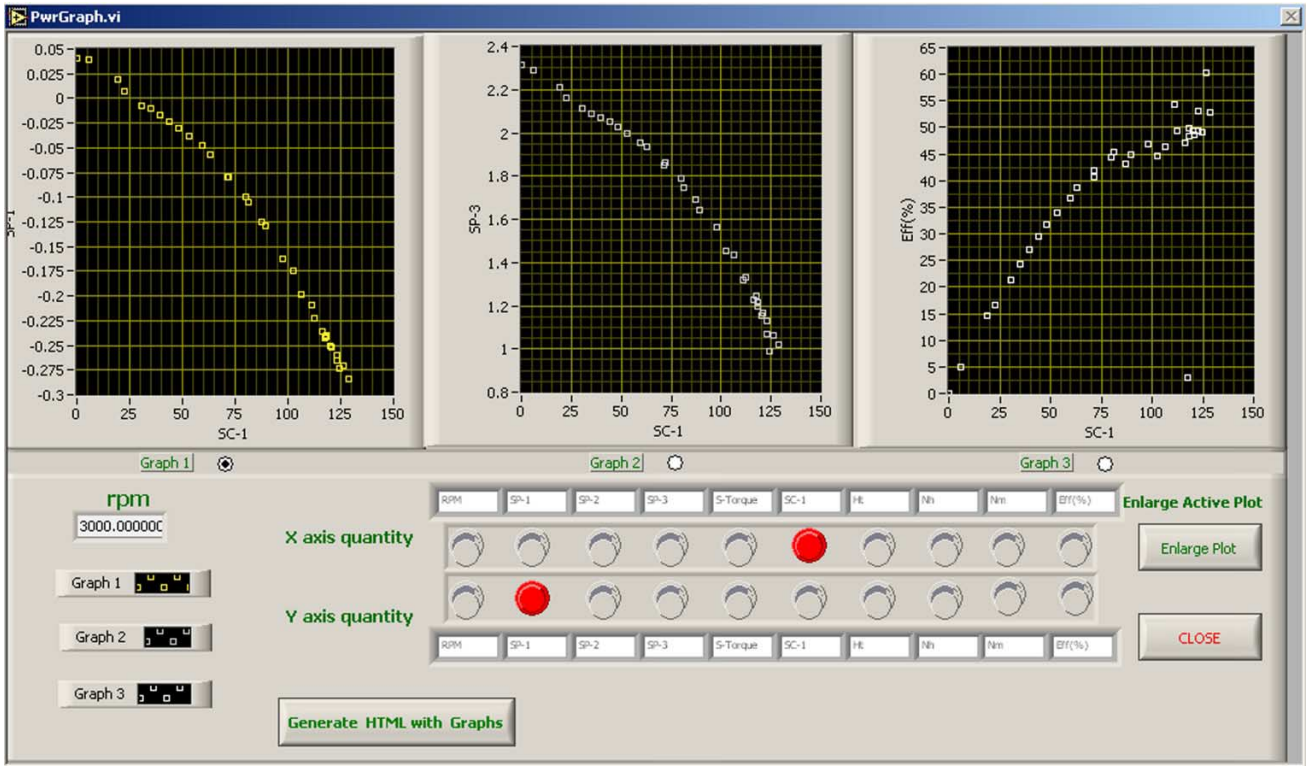


We can see on this three screens the main pump characteristics as function of the flow pumped. We see as the mechanic power (and then, the mechanic efficiency) increases the flow increases, until a moment in which flow is so high, theat the mechanic power starts to decrease.

Continue...

Some typical exercises results





In these two examples we can compare the maximum flow and the outlet pressure (SP-3) when the valve is closed (no flow). As we see, the outlet pressure is greater in the paralell pumps case than in the serial and one pump cases, which are similar between them. In the other way, the maximum flow is higher in the serial case than in the partalell and one pump cases (which are similar between them).

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Obtaining of curves H (Q), N (Q), Eff% (Q).
2.- Three simultaneous representatios 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 NPSHr.
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.

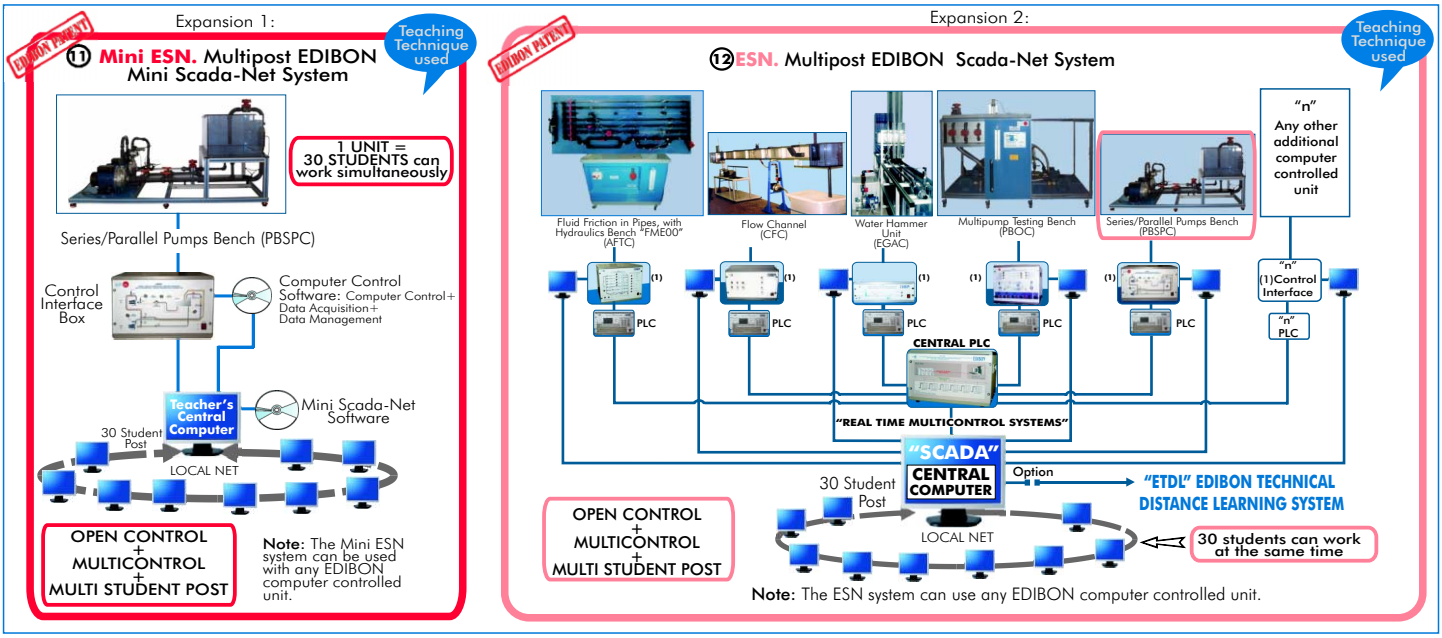
Other possible practices:

10.- Sensors calibration.

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

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

***IMPORTANT: Under PBSPC 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 PBSPC/PLC-SOF. PLC Control Software.
⑨ PBSPC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
⑩ PBSPC/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: 220V./50Hz or 110V./60Hz.

-Water supply and drainage.

-Computer (PC).

DIMENSIONS & WEIGHTS

PBSPC Unit: -Dimensions: 1530 x 770 x 1000 mm. approx.
-Weight: 105 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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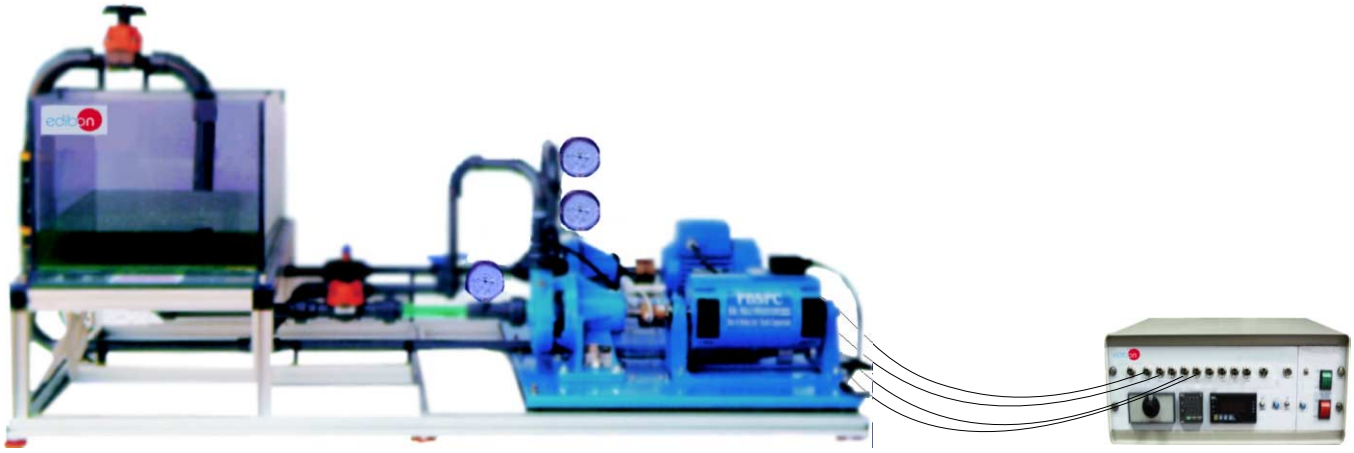
Technical Teaching Equipment

Series/Parallel Pumps Bench

(Manual version)

PBSPB



① Unit: PBSPB. Series/Parallel Pumps Bench

② Electronic Console

DESCRIPTION

Unit designed to demonstrate the operational advantages of parallel or series operation, depending on the required duty.

This unit consists of two centrifugal pumps, a water tank and circulation pipes with valves at the inlet and outlet of the pumps, three pressure meters and a flow meter.

The centrifugal pumps can operate: alone, coupled in series or in parallel. A three-phase motor activates a pump with possibility of adjustment and measurement of the turn speed as well as of the transmitted mechanic torque.

The pumps are installed in a pipes system, which, as it is a closed circuit, avoids the permanent waste of water during the operation.

By the appropiate positioning of the valves it is possible to connect the pumps individually, in series or in parallel, depending on which test is going to be performed.

SPECIFICATIONS

① PBSPB. Unit:

- Anodized aluminium structure.
- Panels and main metallic elements in stainless steel.
- Diagram in the front panel with similar distribution that the elements in the real unit.
- 2 Centrifugal pumps:
  - Maximum flow: 120 l./min.
  - Maximum height (approx.): 25 mwc (meter of water column).
  - One is a three-phase pump of 0.37 KW with continuous speed adjustment with inverter of frequency/voltage and the other one is single-phase.
- 3 valves that allow connecting the pumps separately in series or in parallel by the appropiate positioning of the valves and 2 regulating valves.
- Discharge pressure meter (0 to 2.5 bar).
- Discharge pressure meter (0 to 6 bar).
- Admission pressure meter (-1 to 0 bar).
- Flow meter, range:0 - 150 l./min.
- Torque measurement.
- Speed measurement.
- The speed of one pump is adjustable from speed controller.
- Water tank, capacity: 60 l.

② Electronic Console:

- Metallic box.
- Speed controller.
- Display for speed, torque and power.
- Pumps switches.

③ Cables and accessories, for normal operation.

④ Manuals:

This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Obtaining of curves H (Q), N (Q), Eff% (Q).
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5.- Series coupling of two pumps with same characteristics.
6.- Series coupling of two pumps of different characteristics.
7.- Parallel coupling of two pumps with same characteristics.
8.- Parallel coupling of two pumps of different characteristics.

ORDER INFORMATION

The supply **always includes:**

① **Unit: PBSPB. Series/Parallel Pumps Bench.**
② **Electronic Console.**
③ **Cables and Accessories,** for normal operation.
④ **Manuals.**

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

REQUIRED SERVICES

-Electrical supply: 220V./50Hz or 110V./60Hz.

-Water supply and drainage.

DIMENSIONS & WEIGHTS

Unit: -Dimensions: 1530 x 770 x 1000 mm. approx.
-Weight: 105 Kg. approx.
Electronic Console: -Dimensions: 490 x 330 x 310mm. approx.
-Weight: 10 Kg. approx.

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