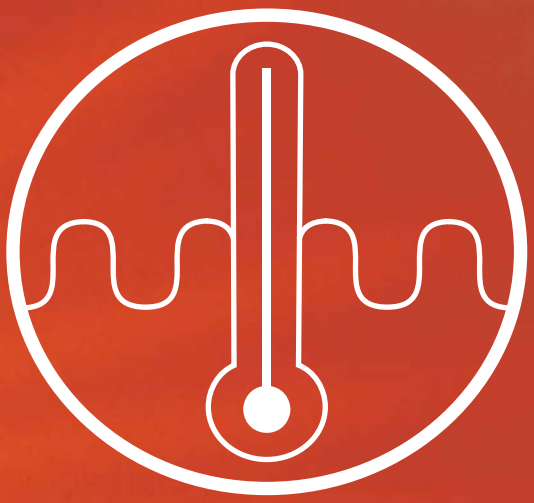
Summarized
Catalogue

four (4)



9. Thermodynamics & Thermotechnics

edibon

www.edibon.com

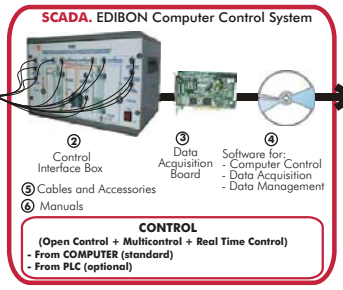
9.- Thermodynamics & Thermotechnics

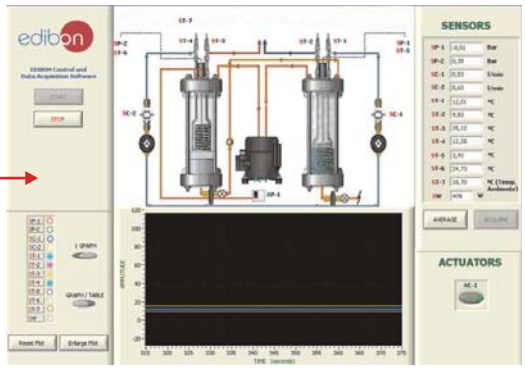
Equipment list

➤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

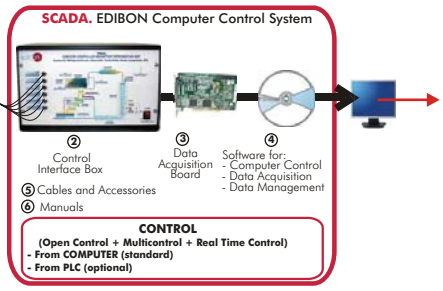
PRACTICAL POSSIBILITIES

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

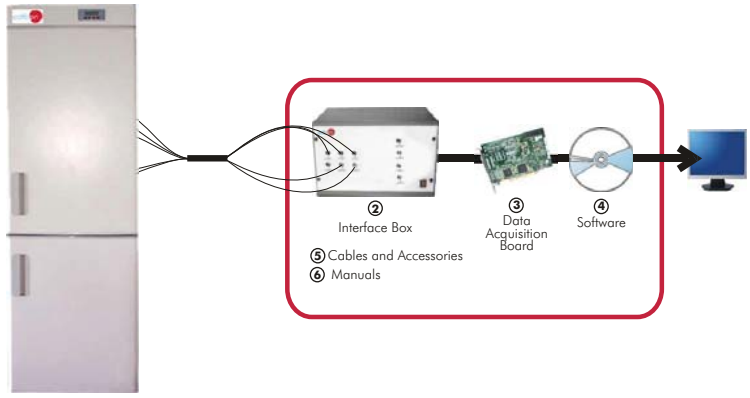
1.- Study of a absorption refrigeration system.
2.- Familiarisation with the individual components of the absorption refrigeration unit.
3.- Operation of a gas absorption refrigeration unit using either electricity or LPG as the heat source.
4.- Demonstration of the refrigeration process.
5.- Measurement 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.

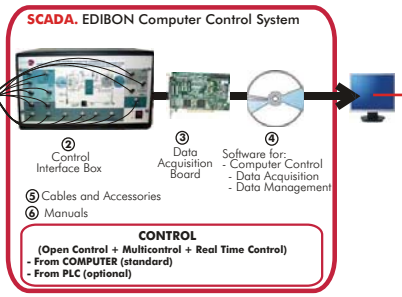
2.- Observation of the household refrigerator.

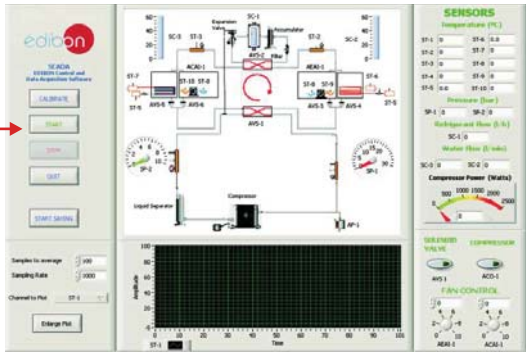
TRCVC. Computer Controlled **Vapour-Compression Refrigeration Unit**

➤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.

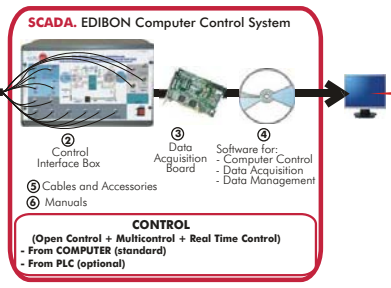
Other possible practices:

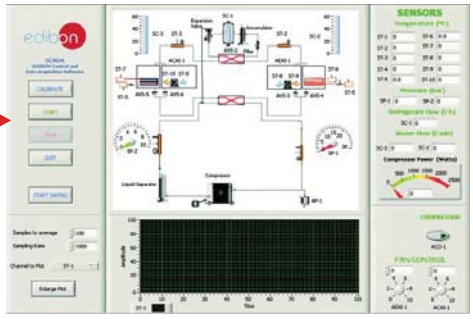
18.- Temperature sensors calibration.
19.- Flow sensors calibration.
20.- Refrigerant flow sensor.
21.- Pressure sensors calibration.
22-40.- Practices with PLC.

✱ Non computer controlled version available too.

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

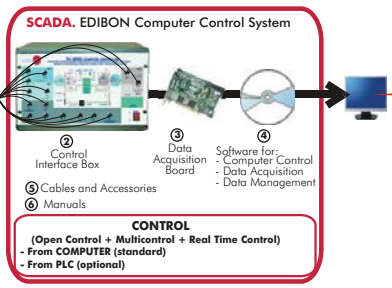
PRACTICAL POSSIBILITIES

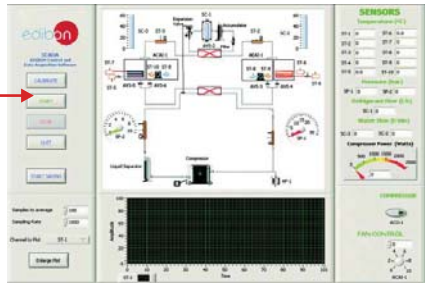
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air).
3.- Determination of the inlet power, produced heat and performance coefficient. 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

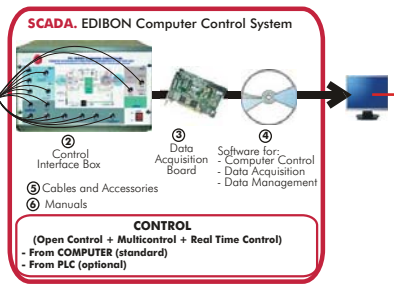
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with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

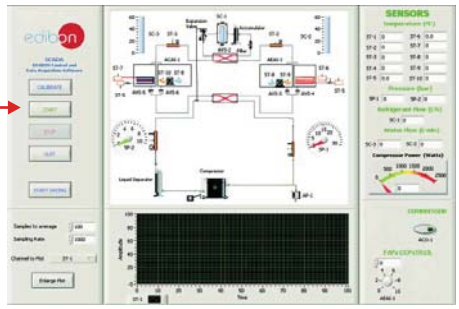
Other possible practices:
5.- Temperature sensors calibration.
6.- Flow sensors calibration.
7.- Pressure sensors calibration.
8-26.- Practices with PLC.

✱ 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.

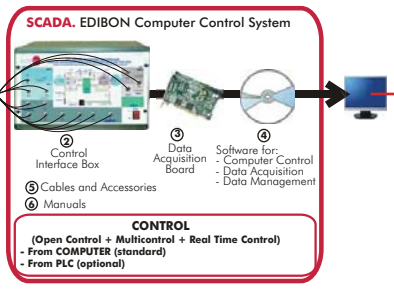
Dimensions (approx.) =Unit: 900 x 600 x 500 mm. Weight: 85 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

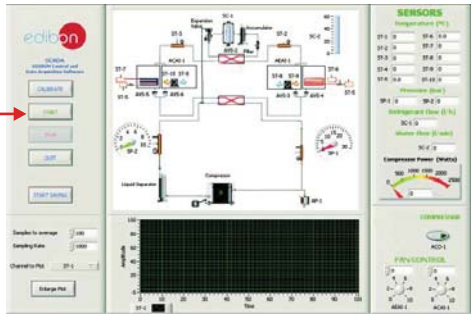
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARL2C.pdf

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))*

①Unit: 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

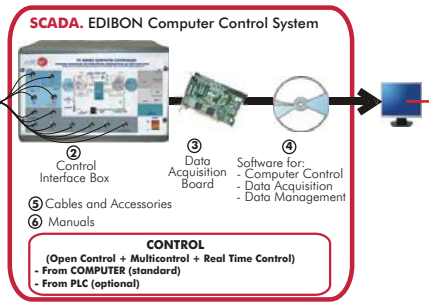
PRACTICAL POSSIBILITIES
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
3.- Preparation of performance curves of the unit with different inlet and 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.

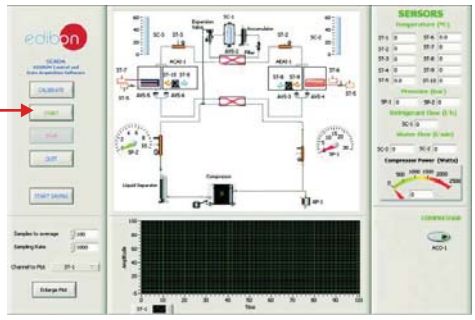
* Non computer controlled version available too.

➤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

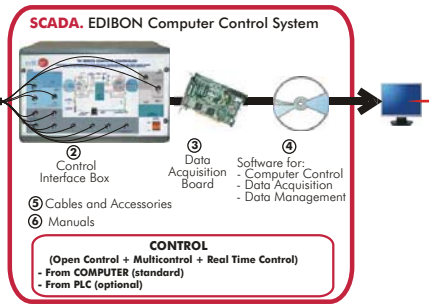
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with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

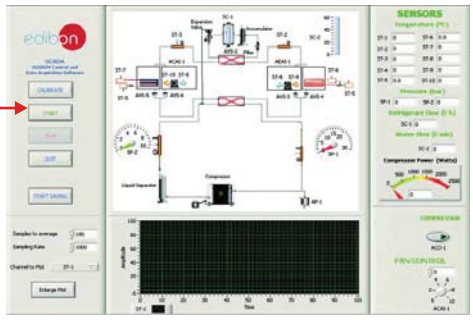
Other possible practices:

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

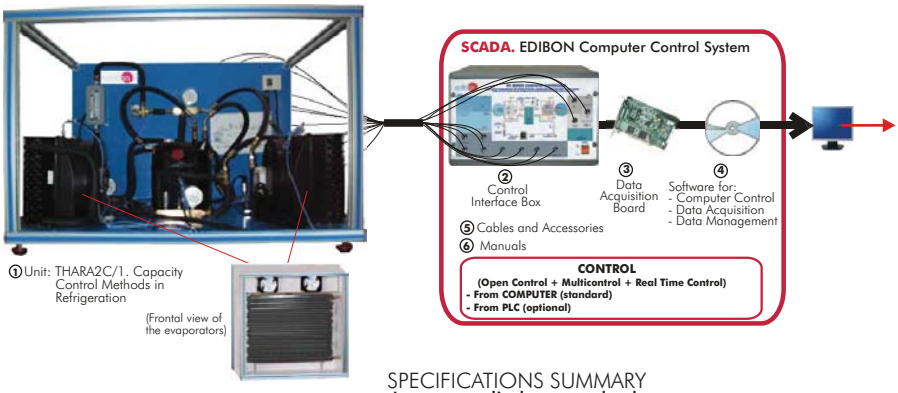
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source.
3.- Lay out of the steam compression cycle in a diagram P-H and comparison with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

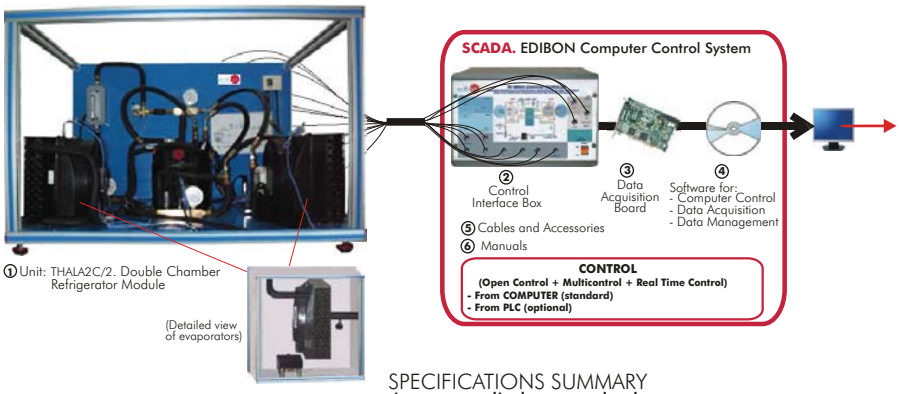
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/THARA2C-1.pdf

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

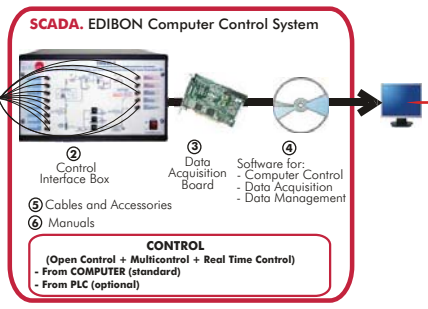
PRACTICAL POSSIBILITIES

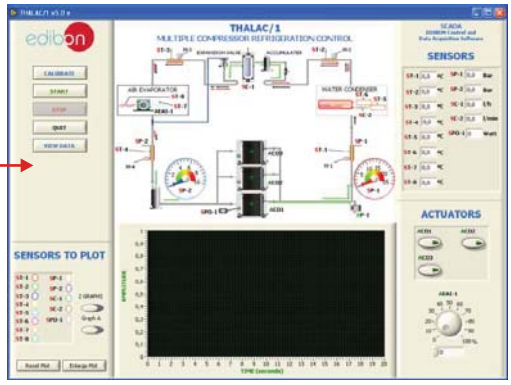
1.- Familiarisation with a cooling system and its main components.
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source.
3.- Series and parallel operation of an evaporator.
4.- Cyclic process on the p-h state diagram.
5.- Preparation of performances curves 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.

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.

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

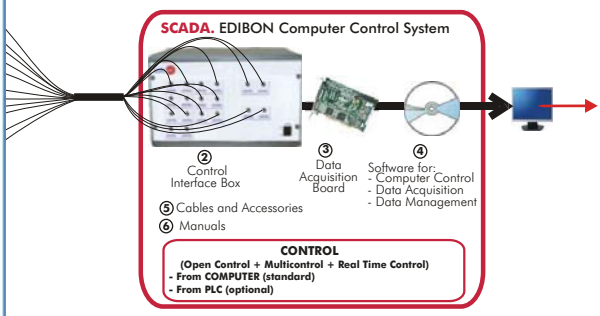
PRACTICAL POSSIBILITIES

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.

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.

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

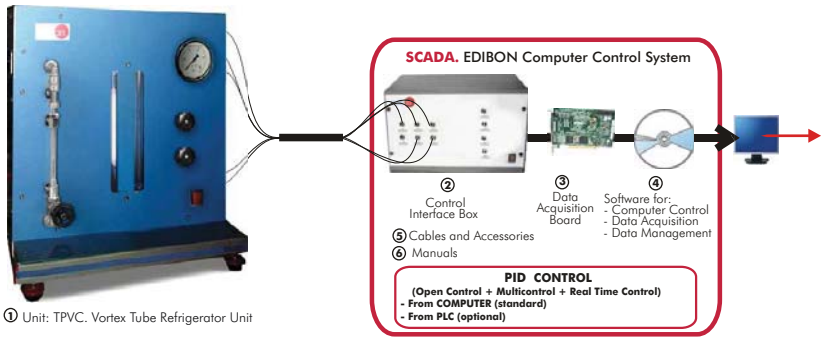
PRACTICAL POSSIBILITIES

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.

➤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.

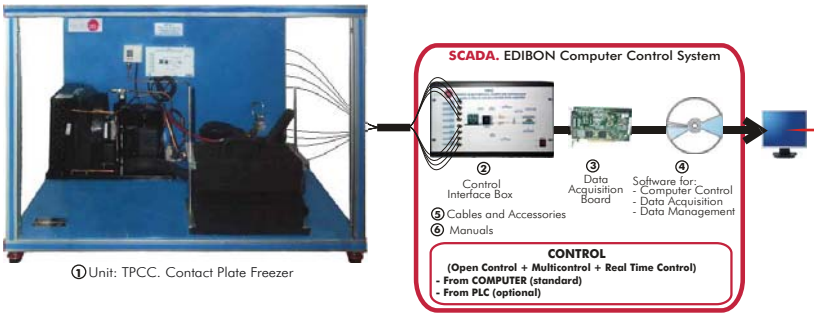
Dimensions (approx.) = Unit: 700 x 400 x 800 mm. Weight: 50 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

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

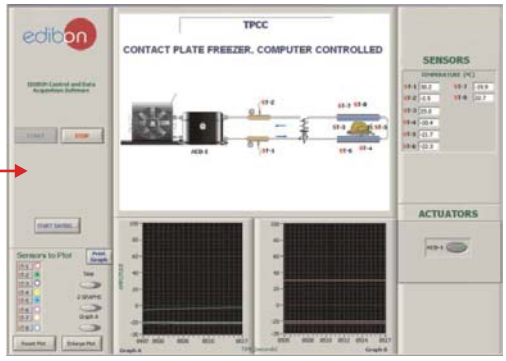
PRACTICAL POSSIBILITIES

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): <-35°C.

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).

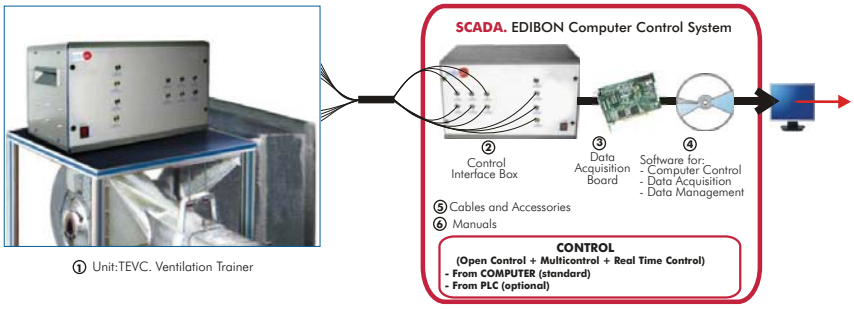
Other possible practices:

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.

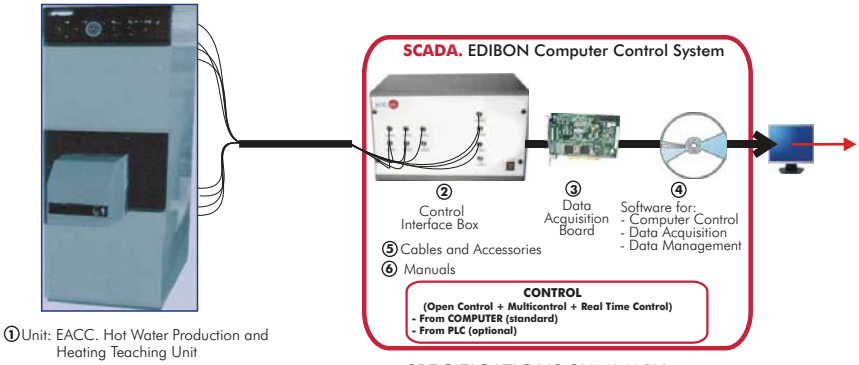
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/refrigeration/TEVC.pdf

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**



① Unit: 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

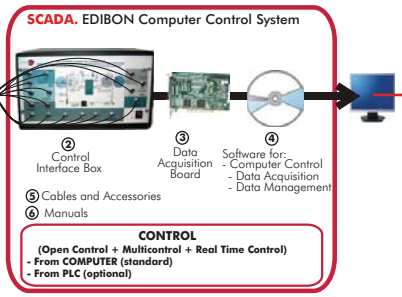
1.- Determination of the flow and fuel consumption.
2.- Determination of the boiler's temperature.
3.- Determination of the heating water exit temperature.
4.- Determination of the sanitary water exit temperature.
5.- Determination of the net water exit temperature.
6.- Determination of the burner aspiration 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.

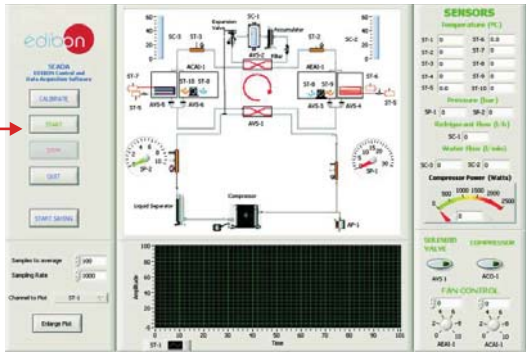
Other possible practices:
11.- Sensors calibration.
12-30.- Practices with PLC.

➤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:

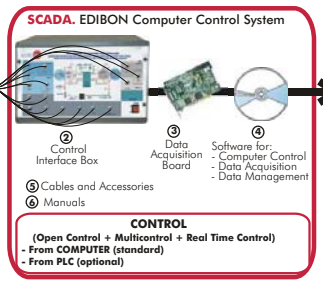
THIBAR44C. Computer Controlled **Heat Pump + Air Conditioning + Refrigeration Unit, with Cycle Inversion Valve** (four condensers (two of water and two of air) and four evaporators (two of water and two of air))✱

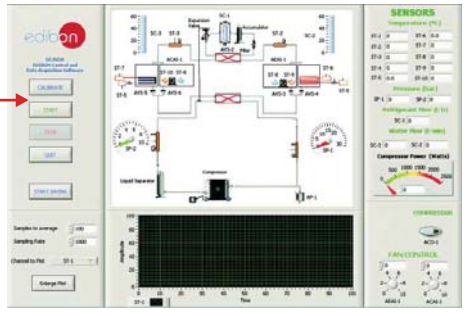
✱ Non computer controlled version available too.

➤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.

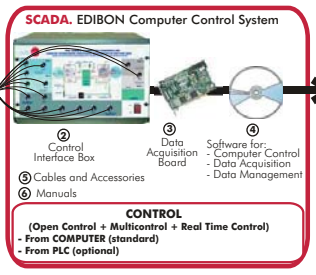
Dimensions (approx.) = Unit: 900 x 600 x 500 mm. Weight: 100 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

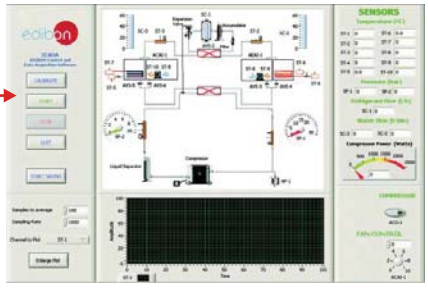
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THB22C.pdf

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.

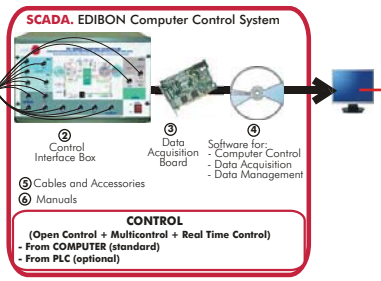
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THB2LC.pdf

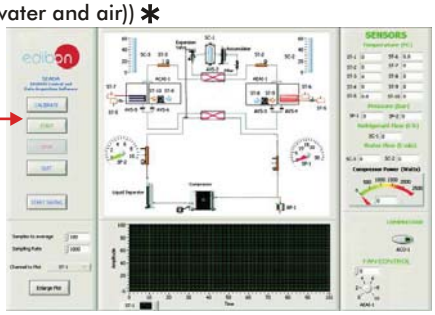
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air-water heat pump).
3.- Preparation of performance curves of the heat 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.

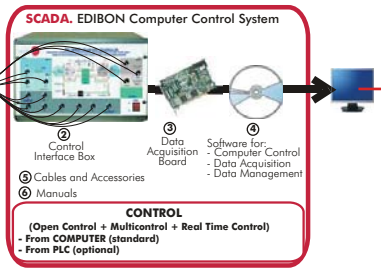
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heatpumps/THBL2C.pdf

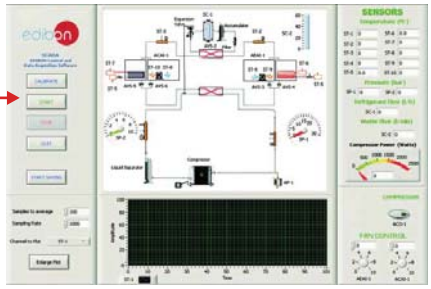
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source.
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source.
3.- Preparation of performance curves of the heat pump with different inlet and outlet temperatures. 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.

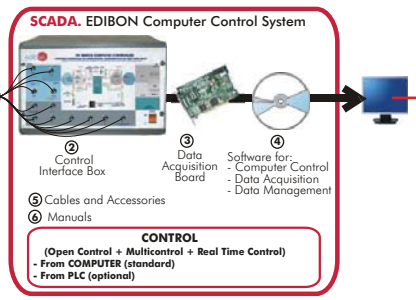
Other possible practices:
9.- Temperature sensors calibration.
10.- Flow sensors calibration.
11.- Pressure sensors calibration.
12-30.- Practices with PLC.

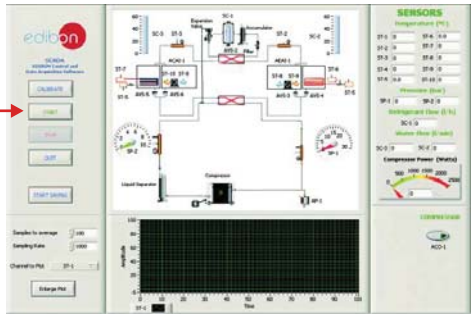
✱ Non computer controlled version available too.

➤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.

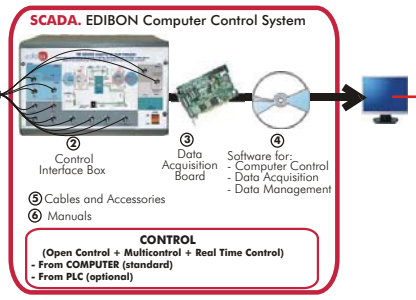
6.- Flow sensors calibration.

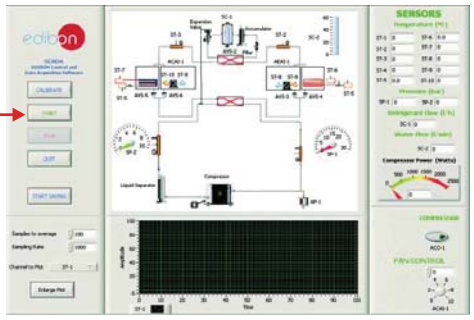
7.- Pressure sensors calibration.

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.

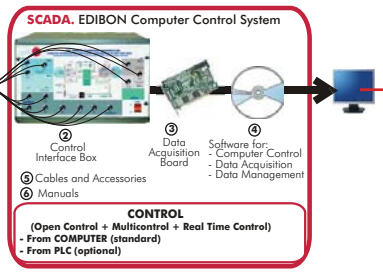
9-27.- Practices with PLC.

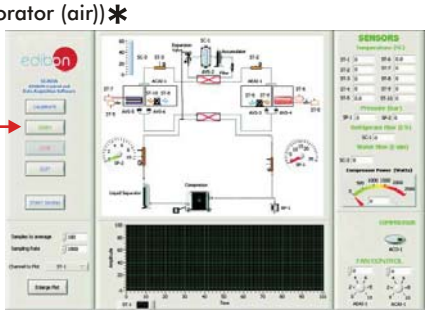
✱ Non computer controlled version available too.

➤General Heat Pumps

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

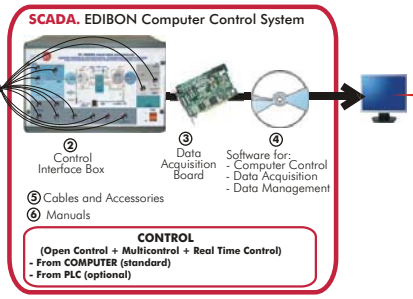
1.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source. (Water-air heat pump).
2.- Determination of the inlet power, heat produced and performance coefficient. Air as heat source. (Air-air heat pump).
3.- Preparation of performance curves of the heat pump 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).

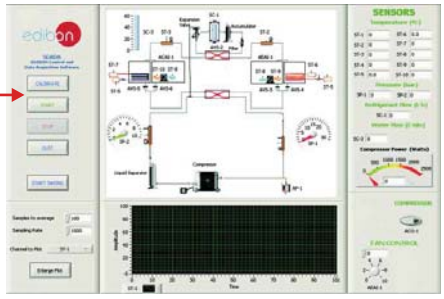
Other possible practices:

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:

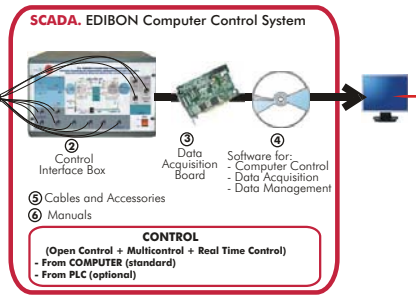
6.- Temperature sensors calibration.
7.- Flow sensors calibration.
8.- Pressure sensors calibration.
9-27.- Practices with PLC.

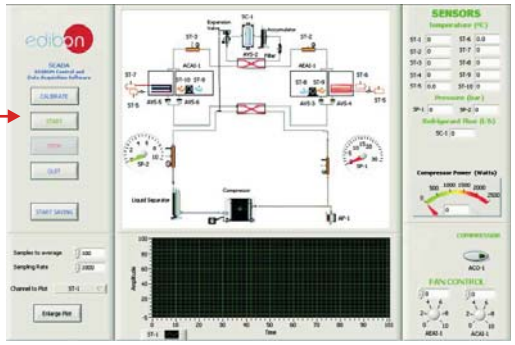
*Non computer controlled version available too.

➤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.

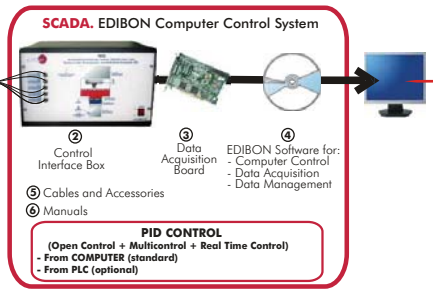
Other possible practices:

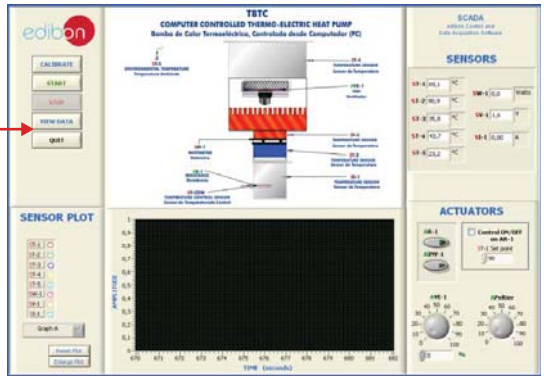
5.- Temperature sensors calibration.
6.- Flow sensor calibration.
7.- Pressure sensors calibration.
8-26.- Practices with PLC.

➤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.

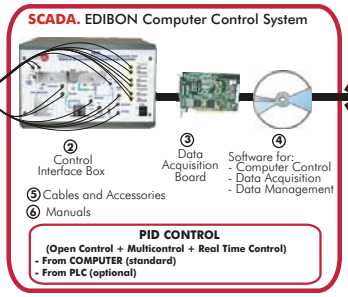
4.- To calculate internal energies of reactions from bomb calorimeter experiments.

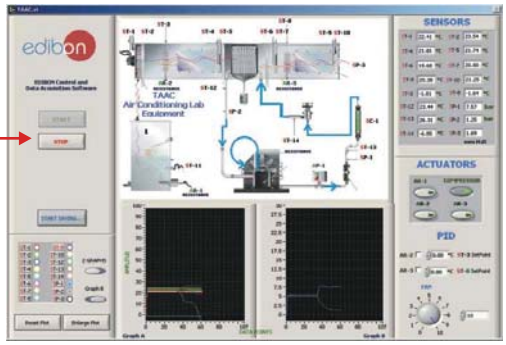
5.- To calculate enthalpies of reactions from bomb calorimetry experiments.

➤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

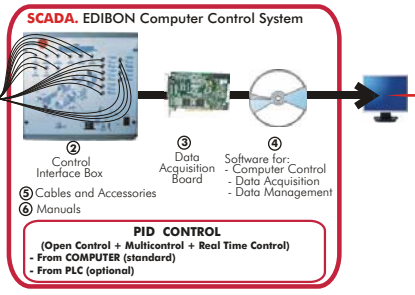
PRACTICAL POSSIBILITIES

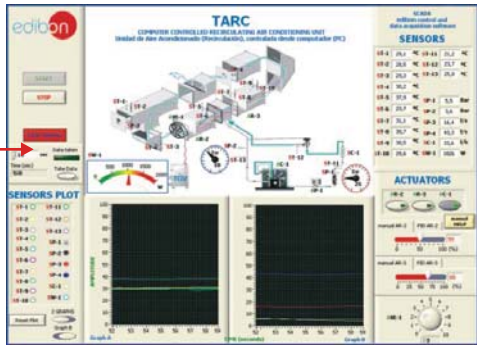
1.- Demonstration of the processes and components used in heating, cooling, humidification, de-humidification of an airstream.
2.- Obtaining of the steam generator efficiency curve.
3.- Energy balance in the steam generator.
4.- Efficiency determination of the preheating resistance.
5.- Preheating effect 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.

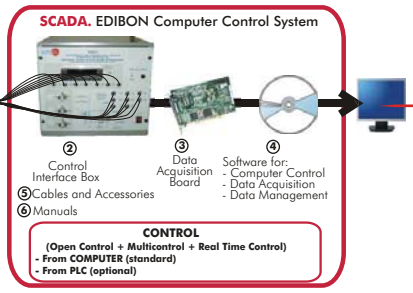
Other possible practices:
15.- Sensors calibration.
16.- Psychrometric chart.
17.- Determingtion of the airflow.
18.- Example of the air properties determination.
19.- Usage of psychrometric chart.
20.- Properties of the Refrigerant R134a.
21.- Enthalpy-Pressure diagram for the refrigerant R134a.
22-40.- Practice with PLC.

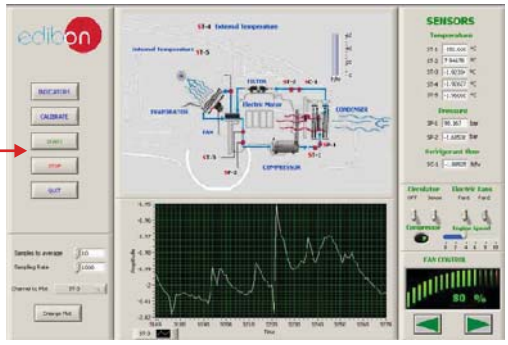
✱ Non computer controlled version available too.

➤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

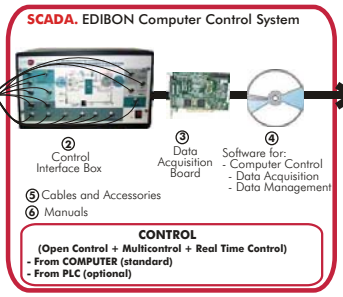
PRACTICAL POSSIBILITIES

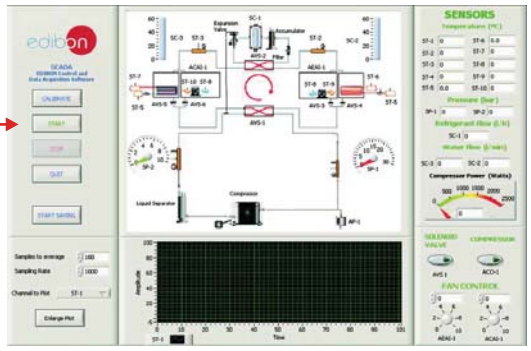
1.- General use of the air conditioning: Manual/Auto modes.
2.- Cooling with and without internal circulation.
3.- Speed of the automobile engine.
4.- Cooling in function of the radiator fans.
5.- Cooling in function of the automobile inlet fan.
6.- Energy balance in the evaporator.
7.- Matter balance 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.

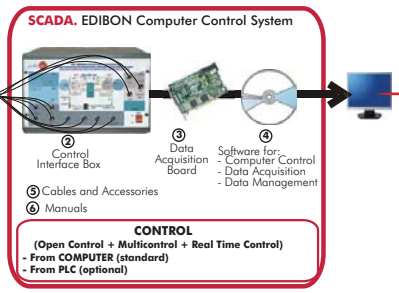
PRACTICAL POSSIBILITIES

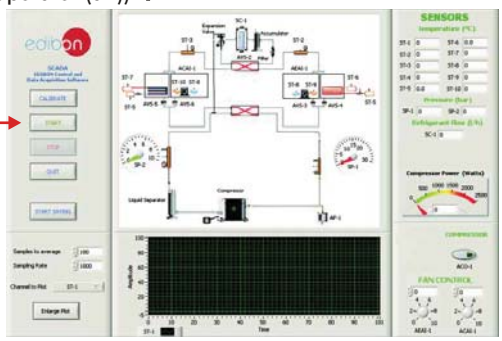
1.- Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water heat pump).
2.- Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air heat pump).
3.- Determination of the inlet power, produced heat 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.

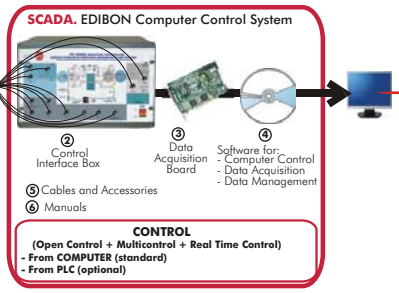
6.- Flow sensor calibration.

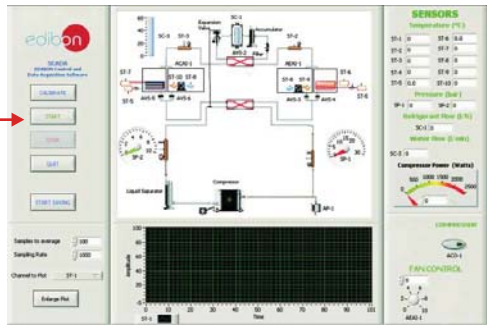
7.- Pressure sensors calibration.

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.

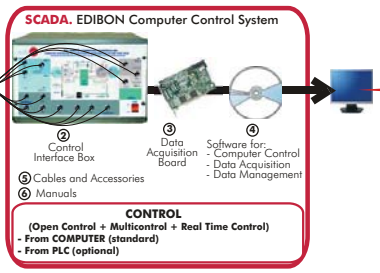
9-27.- Practices with PLC.

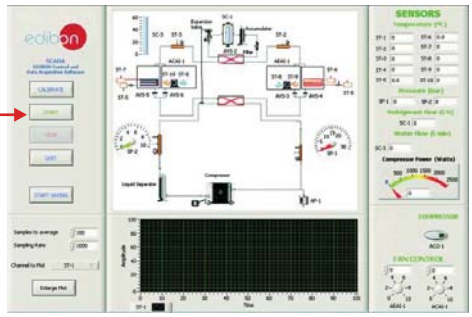
✱ Non computer controlled version available too.

➤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

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

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

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

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

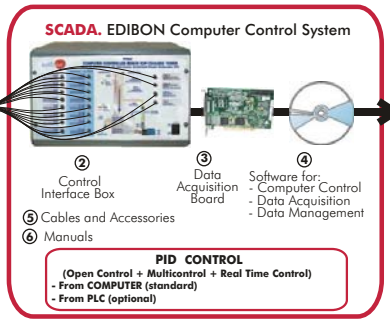
THARALC. Computer Controlled **Refrigeration and Air Conditioning Unit** (one condenser (air) and one evaporator (water))✱

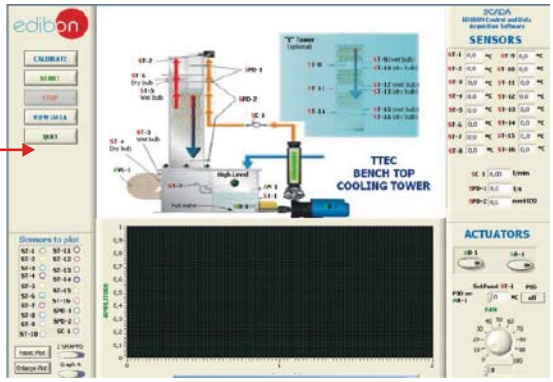
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/airconditioning/THARALC.pdf

✱ 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_2O.

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.

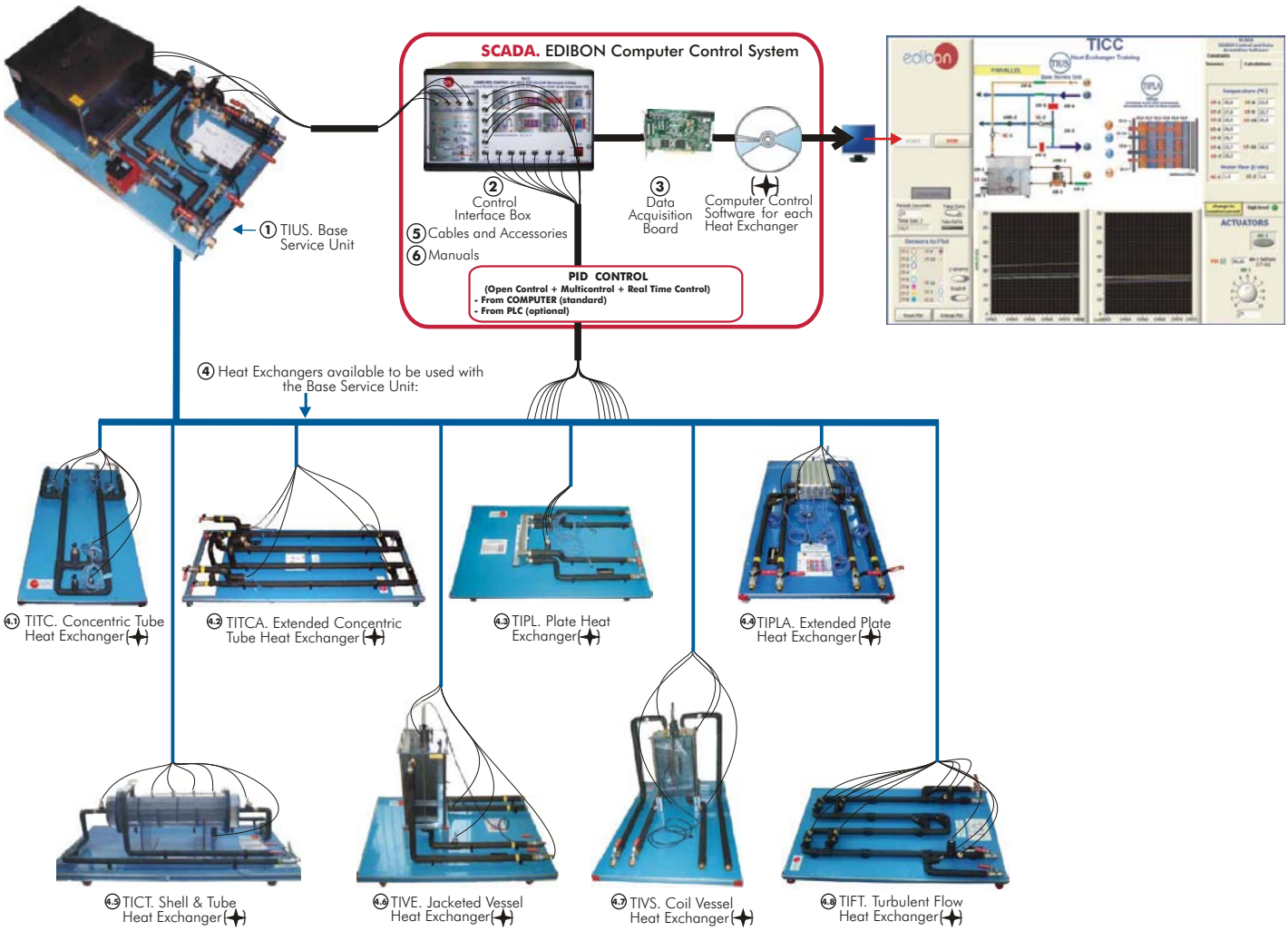
20.- Use of a psychometric map.

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"

① TIUS. 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.

② TICC/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.

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.

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...

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: $D_{int} = 8 \cdot 10^{-3}$ m. External diameter: $D_{ext} = 10 \cdot 10^{-3}$ 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 = $6 \cdot 10^{-3}$ 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: $D_{int} = 8 \cdot 10^{-3}$ m. External diameter: $D_{ext} = 10 \cdot 10^{-3}$ 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.

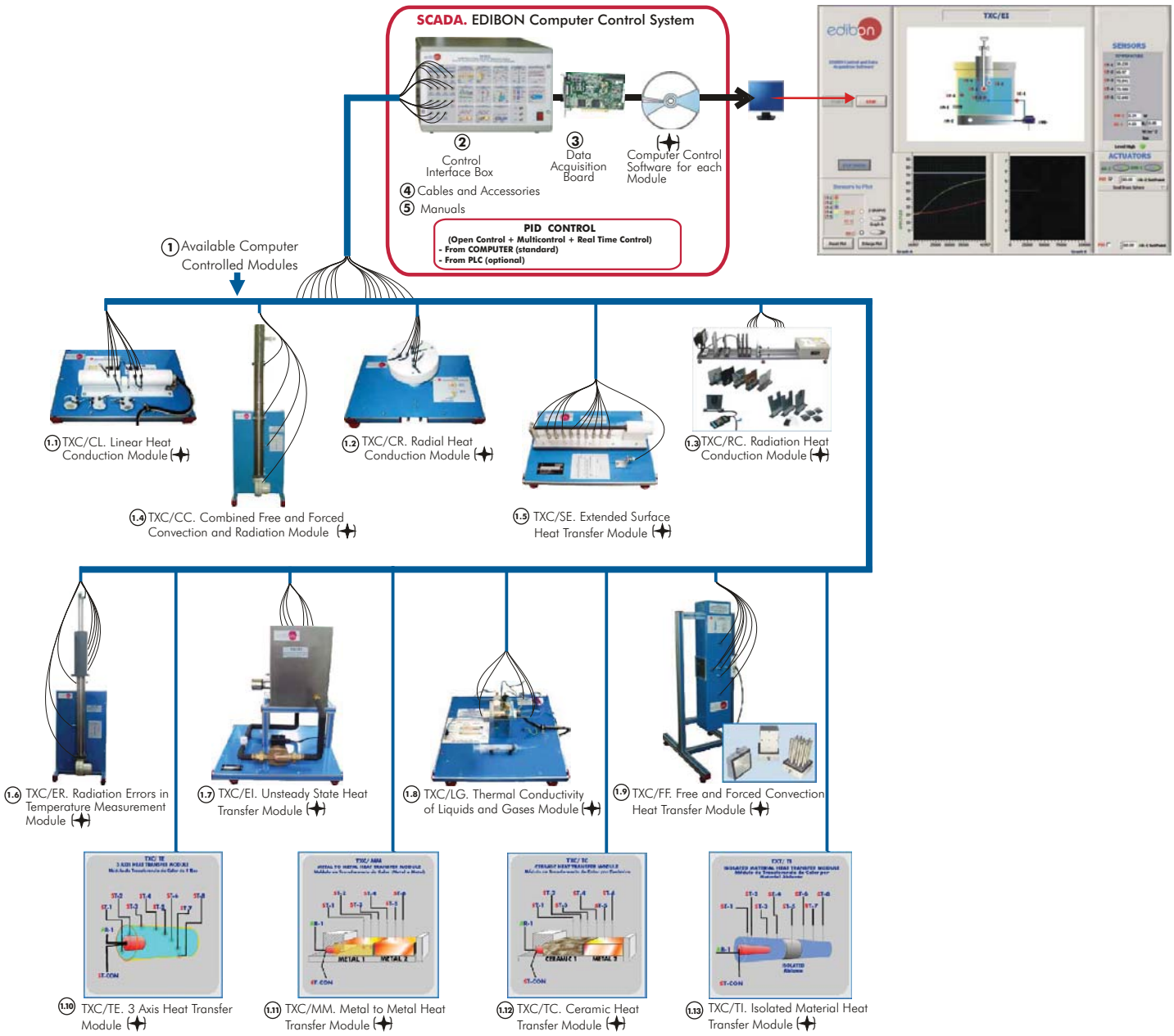
Practices to be done with the Coil Vessel Heat Exchanger (TIVS):

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

⑫TXC/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).

⑬TXC/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 1Grey 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).

⑭TXC/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).

⑮TXC/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):

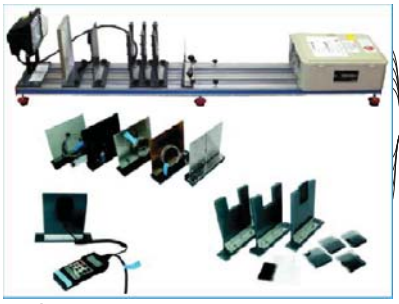
286.- Calibration processes.
287.- Temperature sensors calibration.
288.- Determination of the thermal conductivity "k".
289.- Calculation of the heat transfer properties of specimens.
290-308.- Practices with PLC.

Practices to be done with the Isolated Material Heat Transfer Module (TXC/TI):

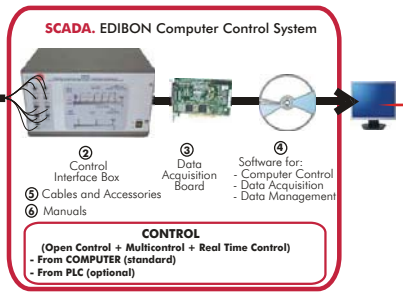
309.- Calibration processes.
310.- Temperature sensors calibration.
311.- Determination of the thermal conductivity "k".
312.- Calculation of the heat transfer properties of specimens.
313-331.- Practices with PLC.

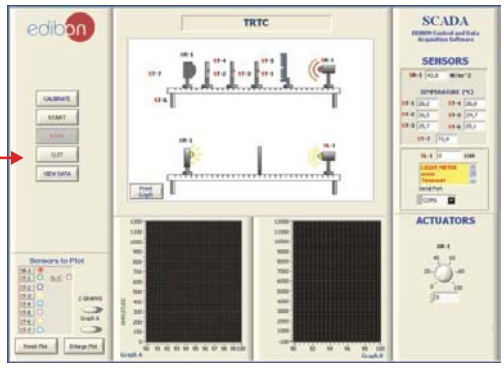
* Non computer controlled version available too.

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

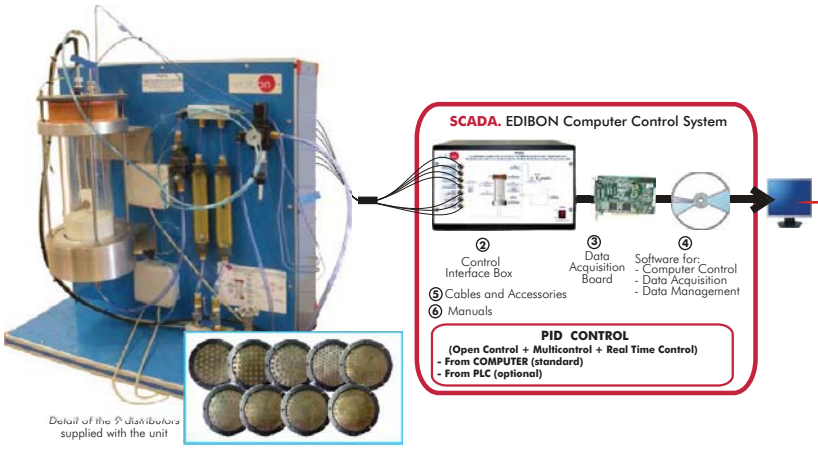
TMCP. Pressure Measurement and Calibration Unit is designed to study pressure and how different methods and tehcniques can be used to measure this variable.
This unit introduces students to pressure, pressure scales and common devices available to measure pressure.
Bench-top unit mounted on an anodized 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.

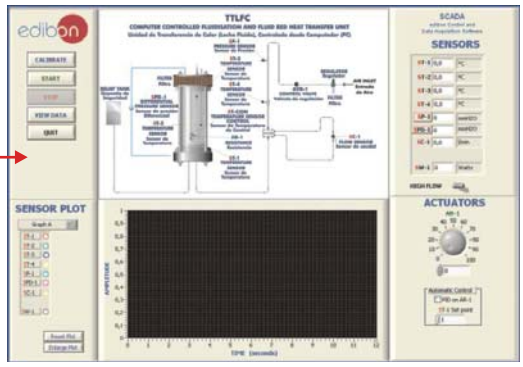
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TMCP.pdf

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.

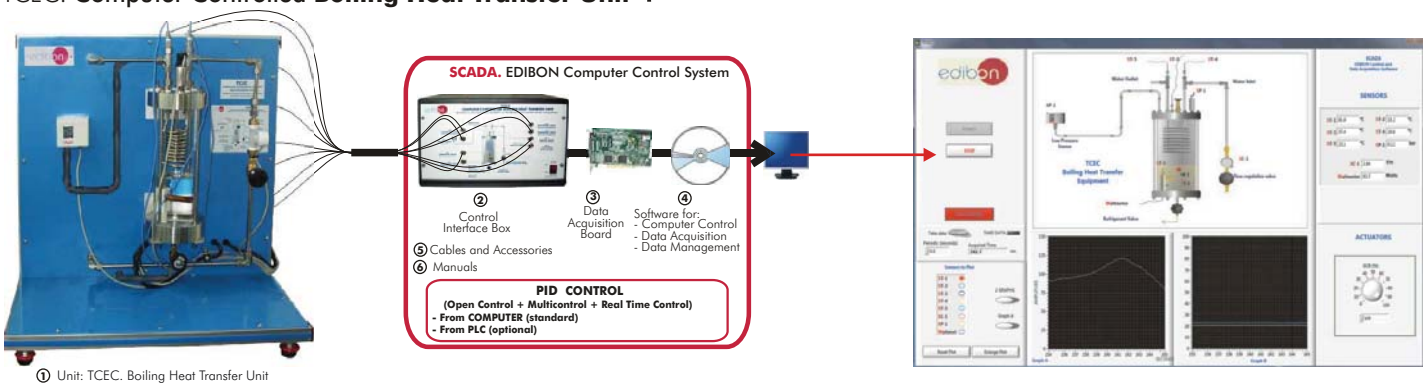
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TTLFC.pdf

✱ 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

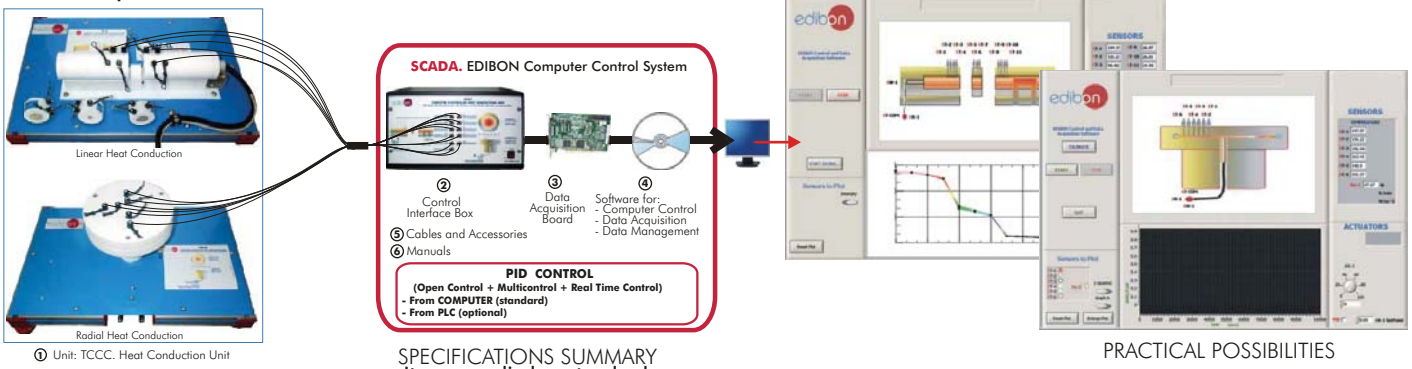
PRACTICAL POSSIBILITIES

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.

④TCCC/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

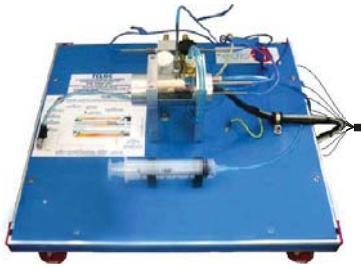
1.- Conduction through a simple bar.
2.- Conduction through a compound bar.
3.- Determination of the thermal conductivity "k" of different materials (conductors and insulators).
4.- The thermal conductivity properties of insulators may be found by inserting paper or other elements between the heating 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:

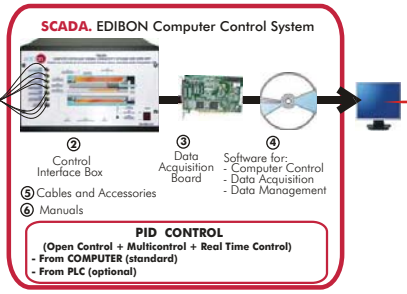
11.-Calibration processes.
12.-Calibration of the temperature sensors.
13-31.- Practices with PLC.

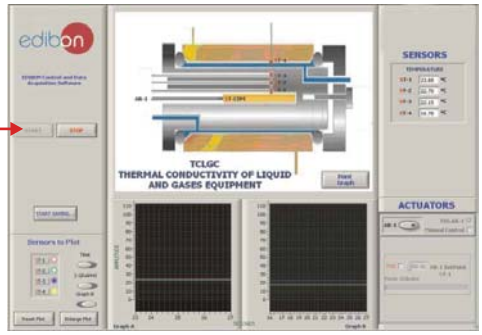
✱ Non computer controlled version available too.

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.

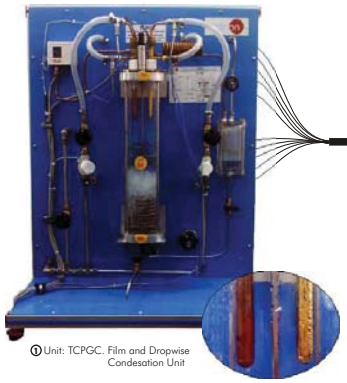
6.- Control system: Calibration of the sensors.

Other possible practices:

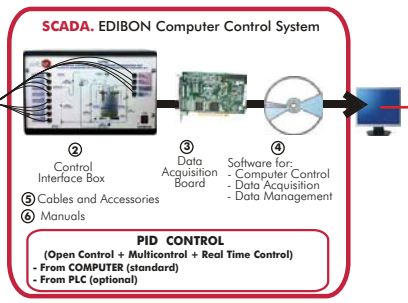
7.- Dry air thermal conductivity under atmospheric pressure.

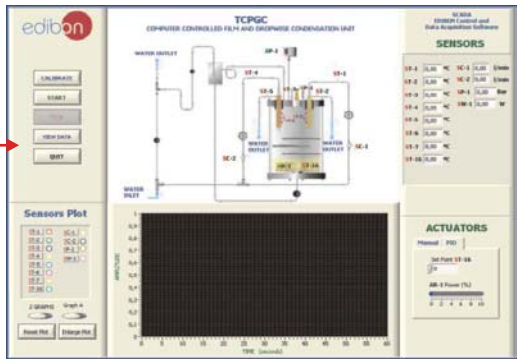
8-26 .- Practices with PLC.

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.

⑤Cables and Accessories, for normal operation.

⑥Manuals: 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:

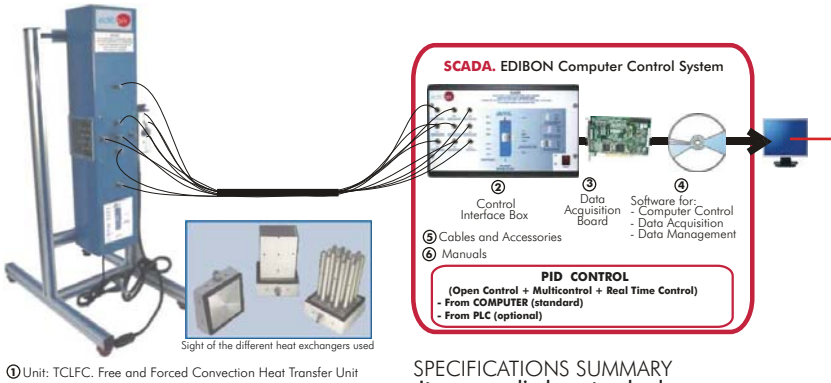
6.- Sensors calibration.

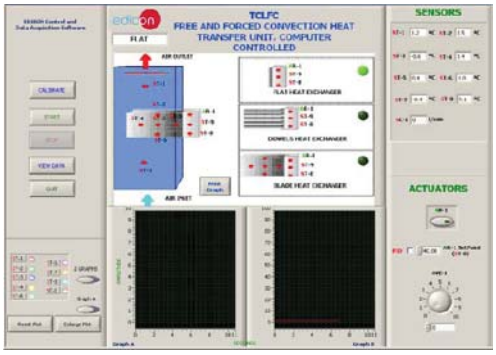
7-25 .- Practices with PLC.

✱ Non computer controlled version available too.

9.9- Heat Transfer (General)

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.

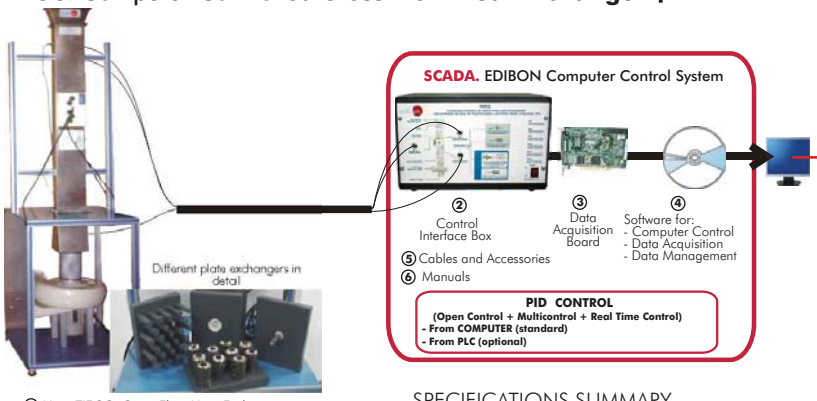
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/heattransfergeneral/TCLFC.pdf

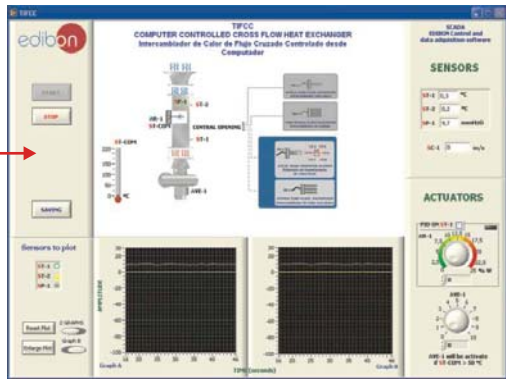
PRACTICAL POSSIBILITIES

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

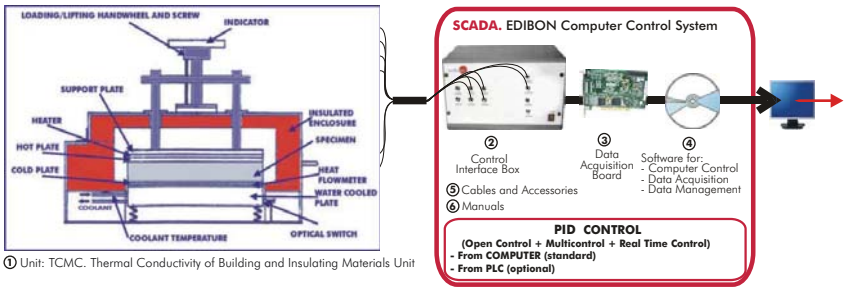
PRACTICAL POSSIBILITIES

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.

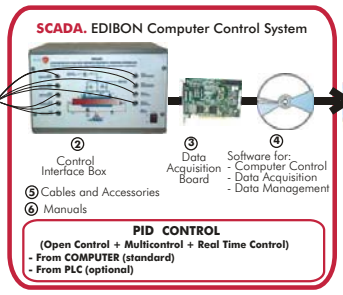
Other possible practices:

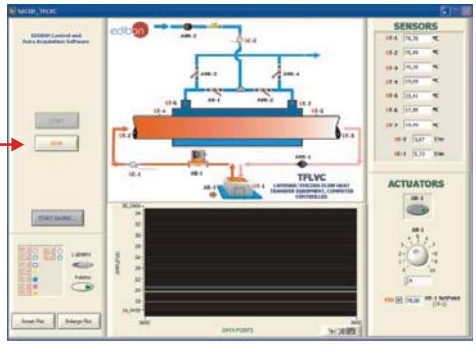
5.- Sensors calibration.

6-24.- Practices with PLC.

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.

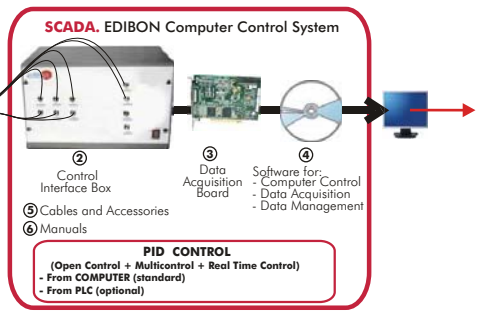
4.- Relationship between Nusselt Number and Graetz Number for Reynolds Numbers up to 1400.

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.

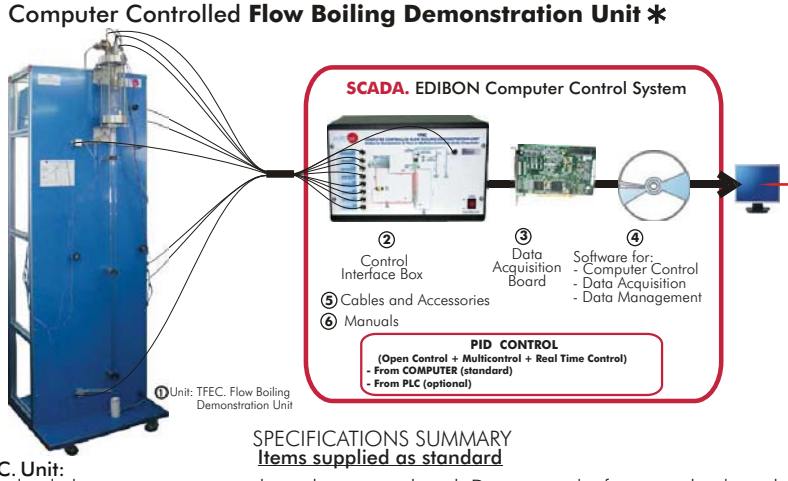
Other possible practices:

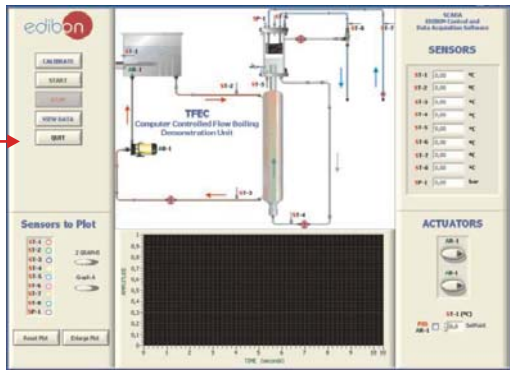
6.- Sensors calibration.

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

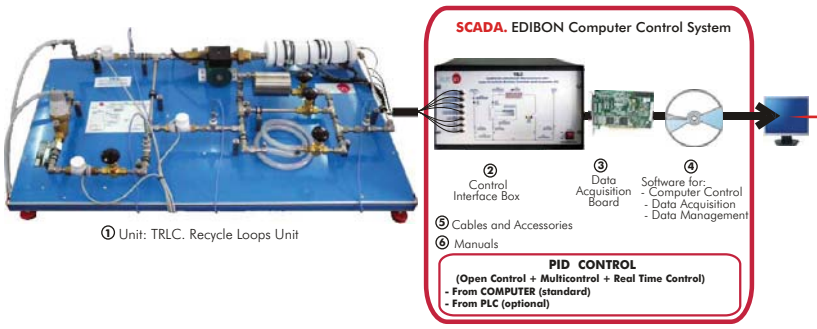
PRACTICAL POSSIBILITIES

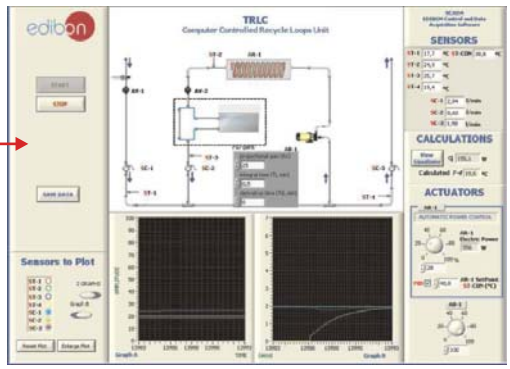
1.- Observation of:
- Single-phase liquid flow.
- Sub-cooled boiling.
- Bubbly flow.
- Slug regime.
- Annular flow.
- Film boiling.
- Drop flow (mist).
- Single-phase vapour flow.

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

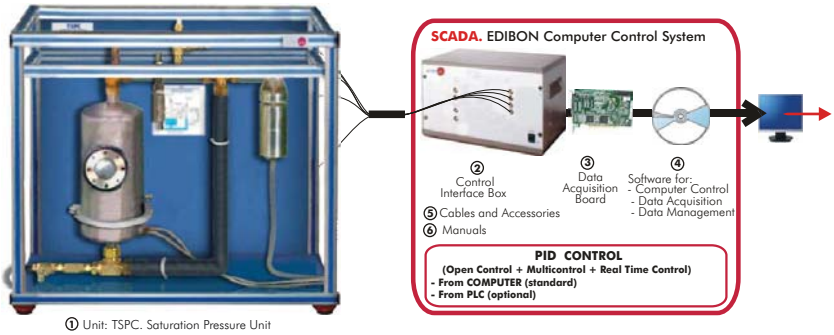
PRACTICAL POSSIBILITIES

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.

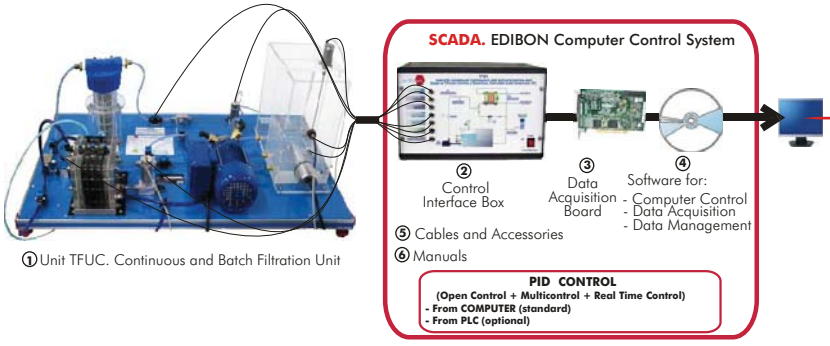
Throttling Calorimeter:(14 to 18)

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.

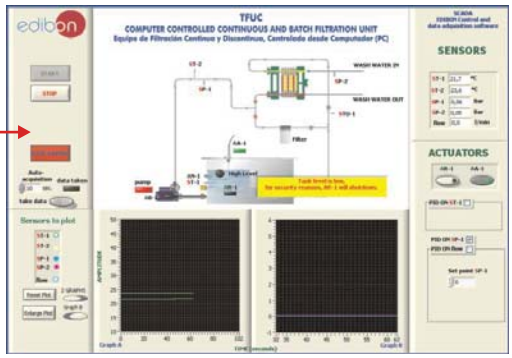
Other possible practices:

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

TFUC. Computer Controlled **Continuous and Batch Filtration Unit** ✱



① Unit 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.

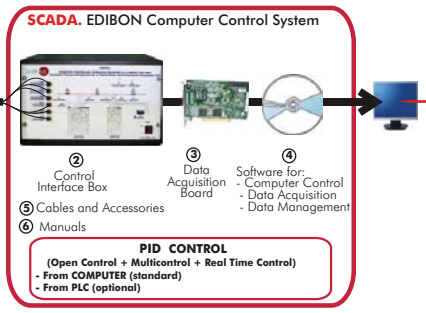
Other possible practices:

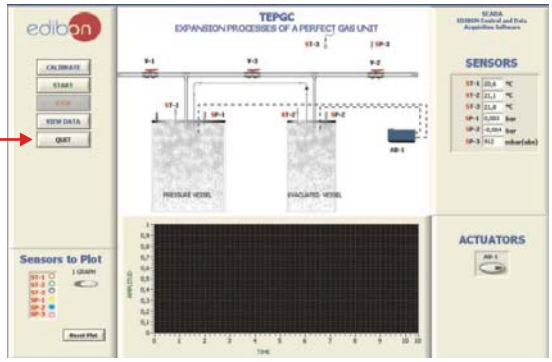
16.- Sensors calibration.
17-35.- Practices with PLC.

✱ 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

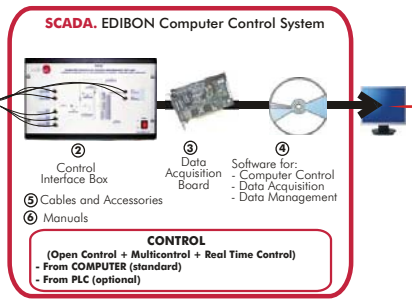
1.- To study of the pressure changes in the processes involves the 1st Law of Thermodynamics.
2.- Understanding of the 2nd Law of Thermodynamics and its corollaries.
3.- Different responses resulting from fast or slow changes in a process can be observed.
4.- Relationship between volume, pressure and 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.

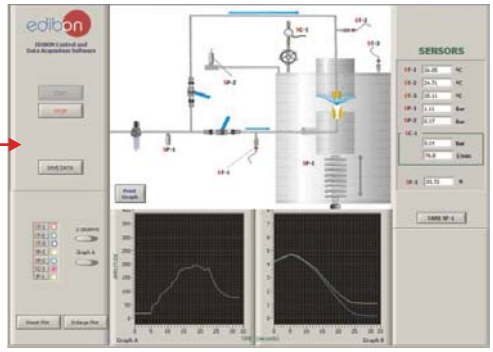
Other possible practices:

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: 0-120° 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: 0-120° 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

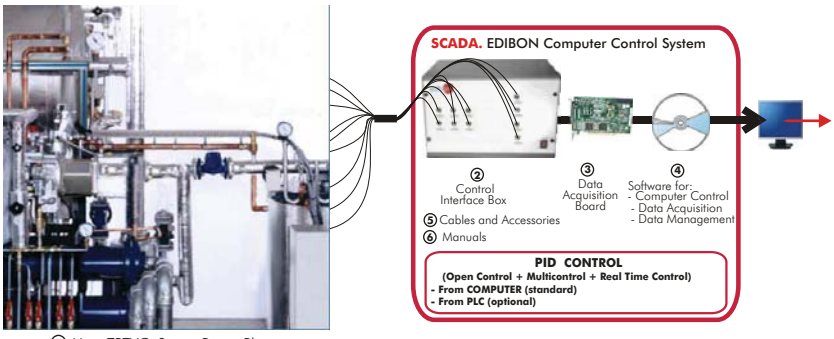
TGV-6KWA. **Steam Generator (6 kW)** (for high pressures and high temperatures)

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: 0-160° 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

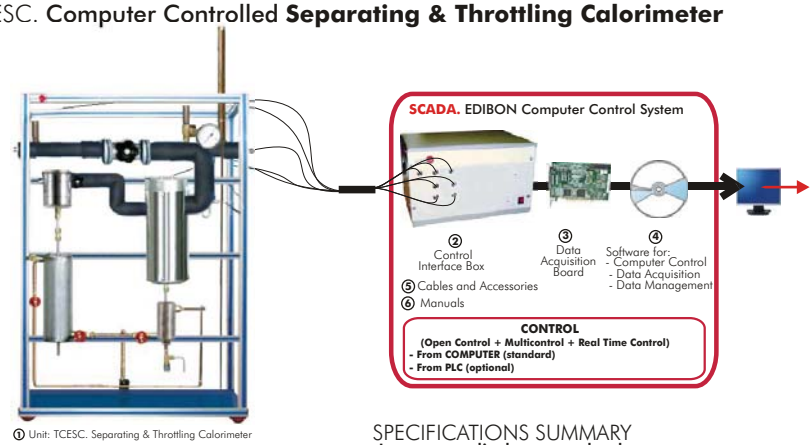
PRACTICAL POSSIBILITIES

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

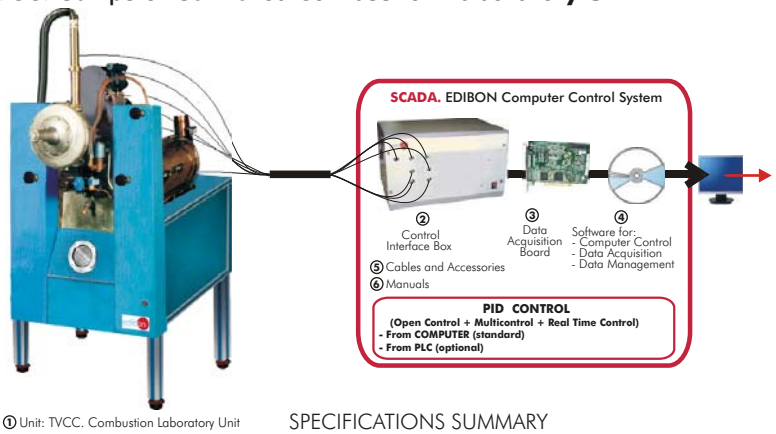
PRACTICAL POSSIBILITIES

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

①TVCC. 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.

②TVCC/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.

④TVCC/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.

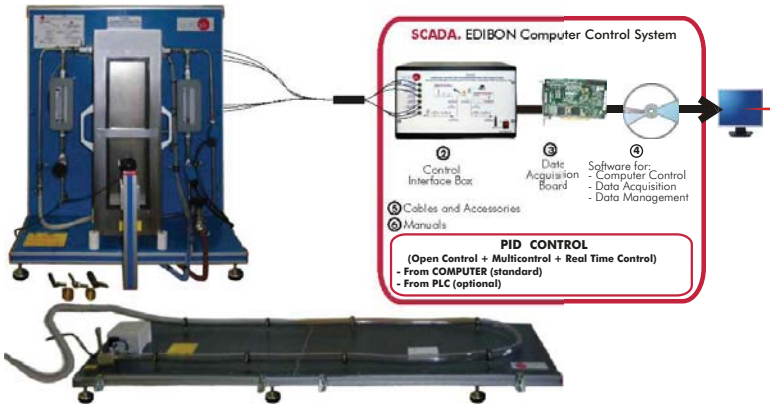
Dimensions (approx.) = Unit: 2200 x 1000 x 1700 mm. Weight: 200 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

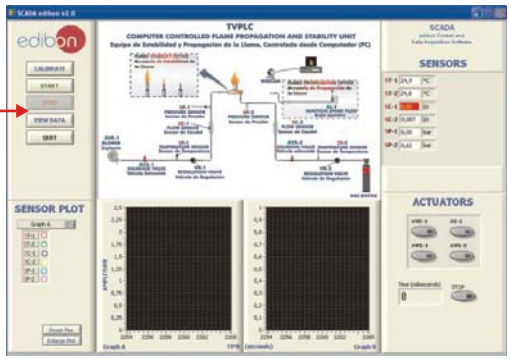
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/combustion/TVCC.pdf

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

①TVPLC. 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.

②TVPLC/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.

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.

④TVPLC/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.

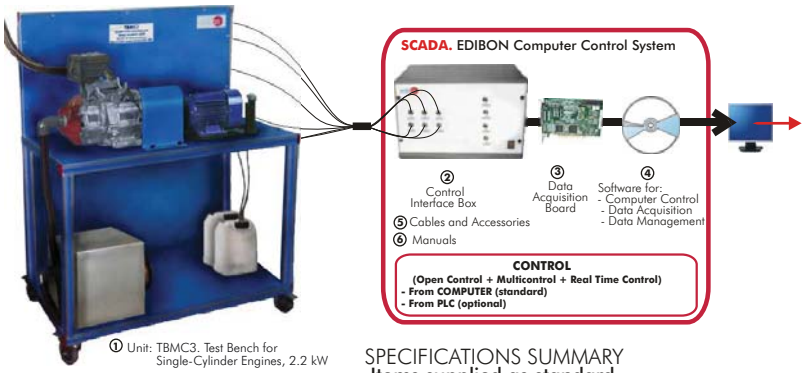
Dimensions (approx.) = Unit: 700 x 500 x 800 mm. Weight: 80 Kg.
Flame Propagation Accessory: 2000 x 500 x 150 mm. Weight: 30 Kg.
Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

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.

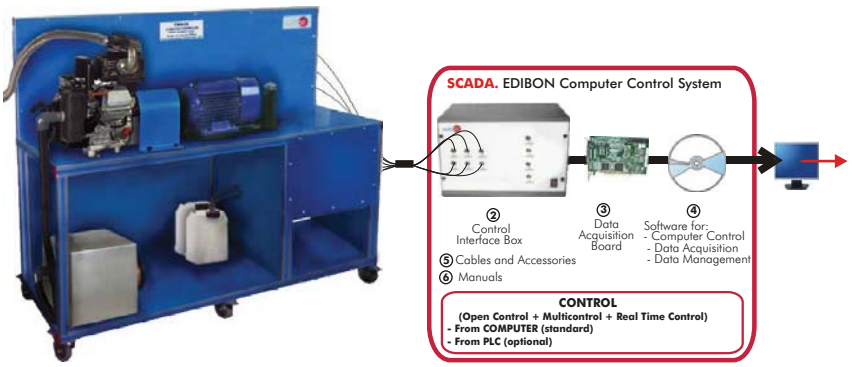
Dimensions (approx.)= Unit: 1230 x 1000 x 1500 mm. Weight: 125 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

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.

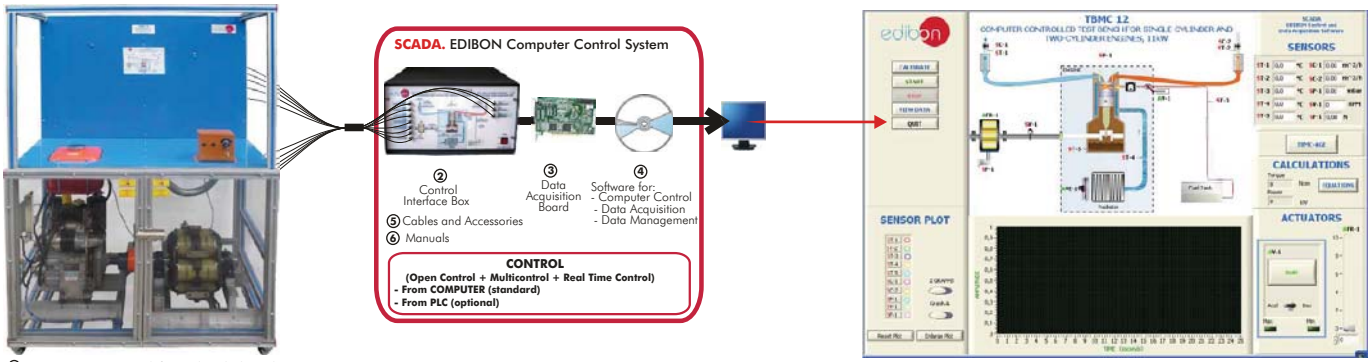
Dimensions (approx.)= Unit: 1600 x 1000 x 1500 mm. Weight: 200 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

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

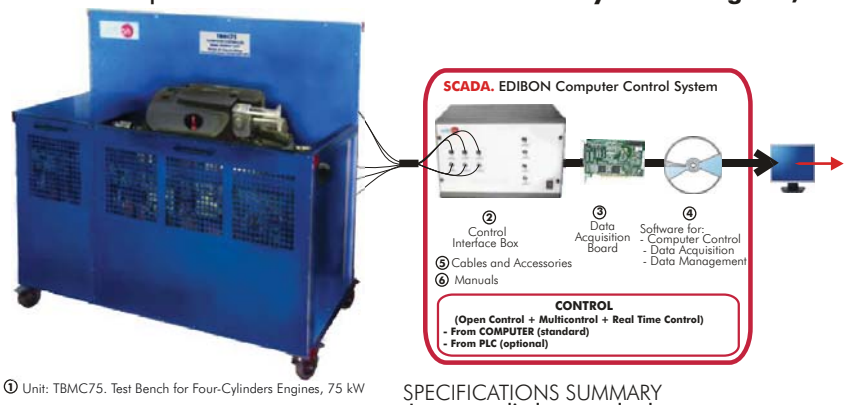
PRACTICAL POSSIBILITIES

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.

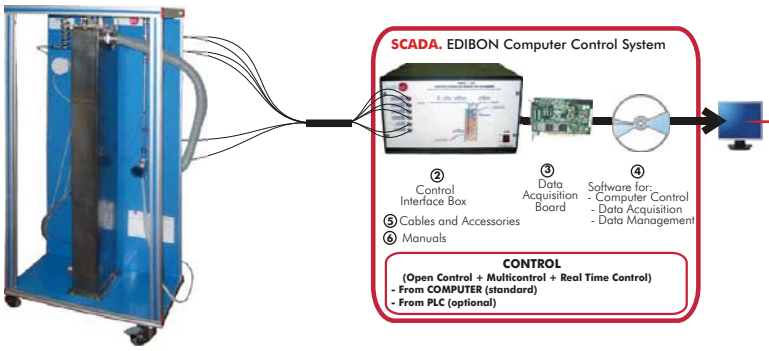
Dimensions (approx.)= Unit: 1900 x 1200 x 1600 mm. Weight: 300 Kg. Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.

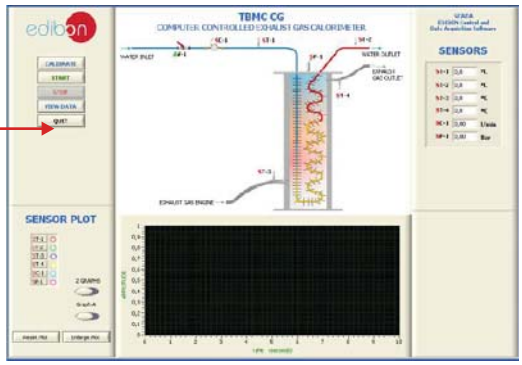
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC75.pdf

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.

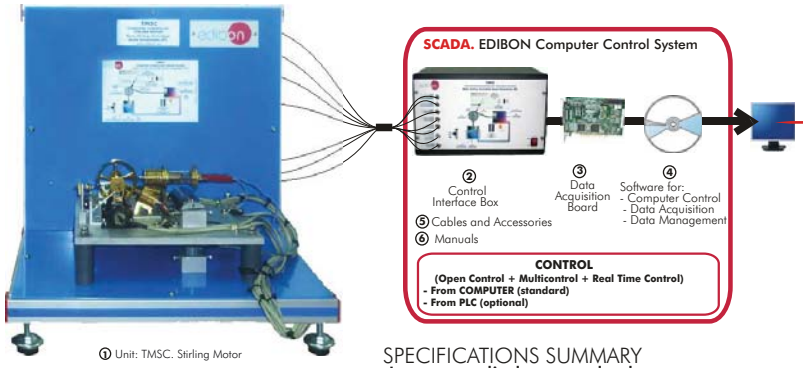
Measurements:

Carbon monoxide CO (%).
Carbon dioxide CO_2 (%).
HC gasoline, propano, methane (ppm).
Oxygen O_2 (%).
Carbon monoxide CO adjusted (%).
Lambda calculation.
Oil temperature.

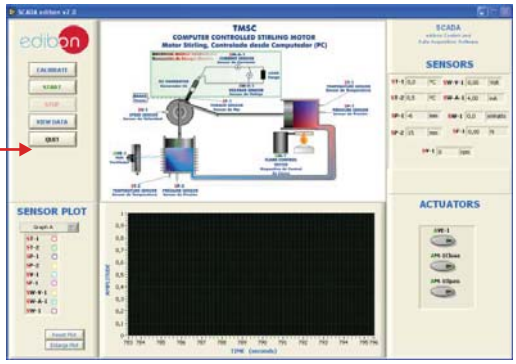
Dimensions (approx.): 600 x 200 x 300 mm. Weight: 5 Kg.

More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TBMC-AGE.pdf

TMSC. Computer Controlled **Stirling Motor**



① Unit: TMSC. Stirling Motor



SPECIFICATIONS SUMMARY

Items supplied as standard

①TMSC. 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.

②TMSC/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

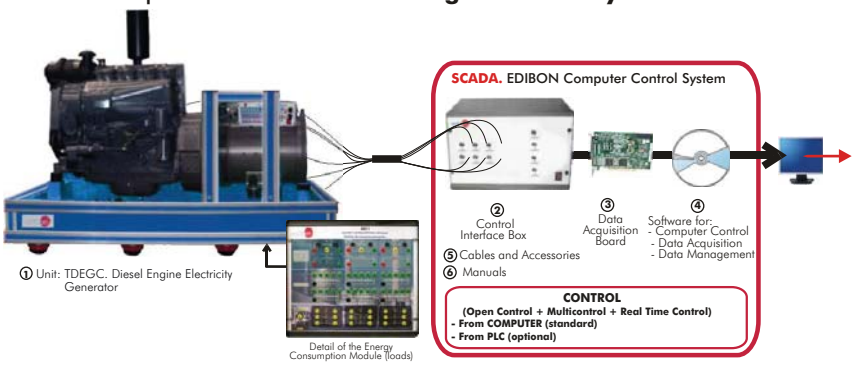
PRACTICAL POSSIBILITIES

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**



① Unit: TDEGC. Diesel Engine Electricity Generator

Detail of the Energy Consumption Module (loads)

SPECIFICATIONS SUMMARY

Items supplied as standard

①TDEGC. 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.

②TDEGC/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.

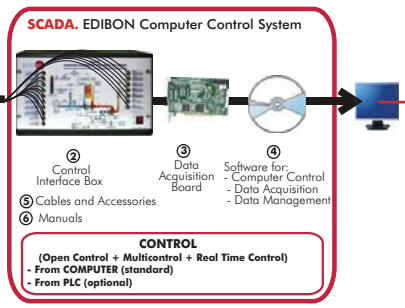
⑥ Manuals: This unit is supplied with 8 manuals.

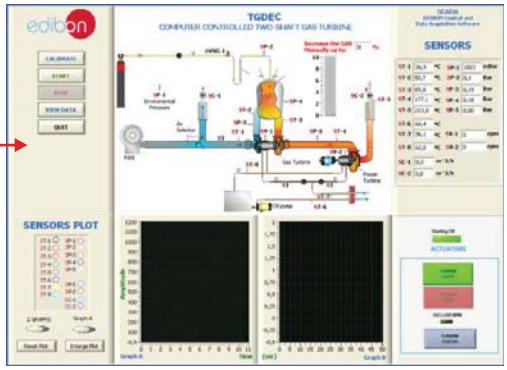
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/enginestestbenches/TDEGC.pdf

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.

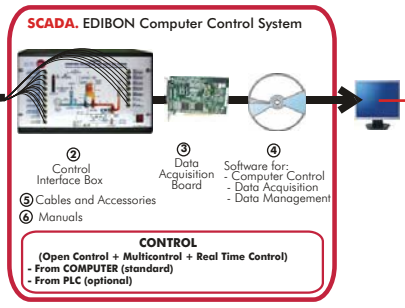
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/TGDEC.pdf

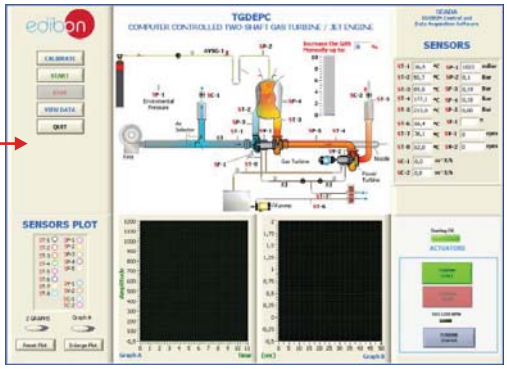
PRACTICAL POSSIBILITIES

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.

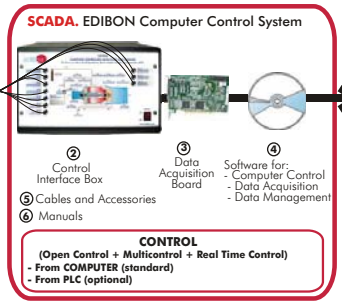
More information in: www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/turbines/TGDEPC.pdf

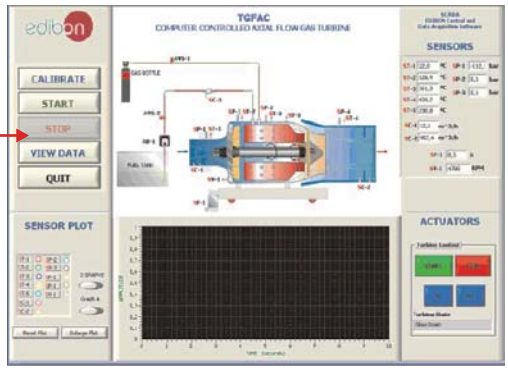
PRACTICAL POSSIBILITIES

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

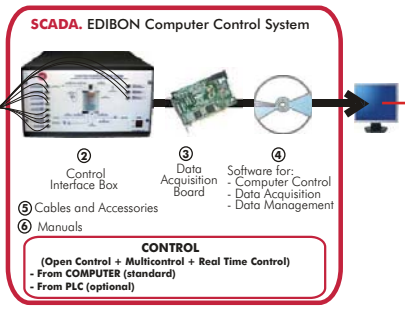
1.- Study of a gas turbine.
2.- Function and operation of a gas turbine as jet engine.
3.- Determination of fuel consumption.
4.- Air and fuel ratio.
5.- Recording the turbine characteristic.
6.- Determination of the efficiency of the compressor.
7.- Determination of the specific thrust.
8.- Determination of the efficiency of the turbine.
9.- Temperature measurements.
10.- Safety systems in the operation of a gas turbine.
11.- Energy global balance.

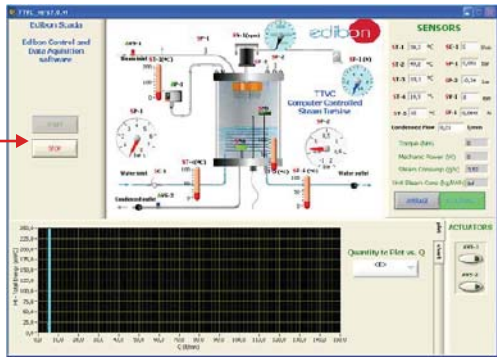
Other possible practices:

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

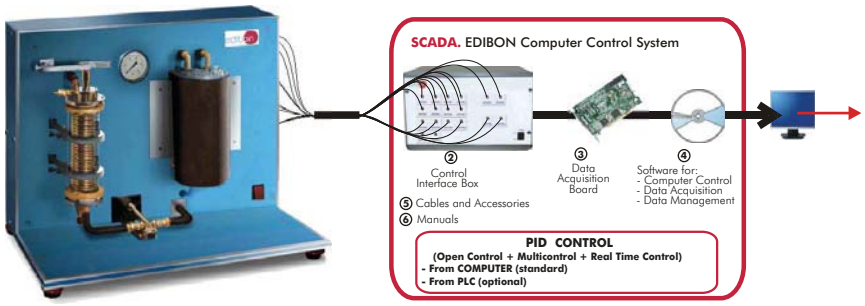
PRACTICAL POSSIBILITIES

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.