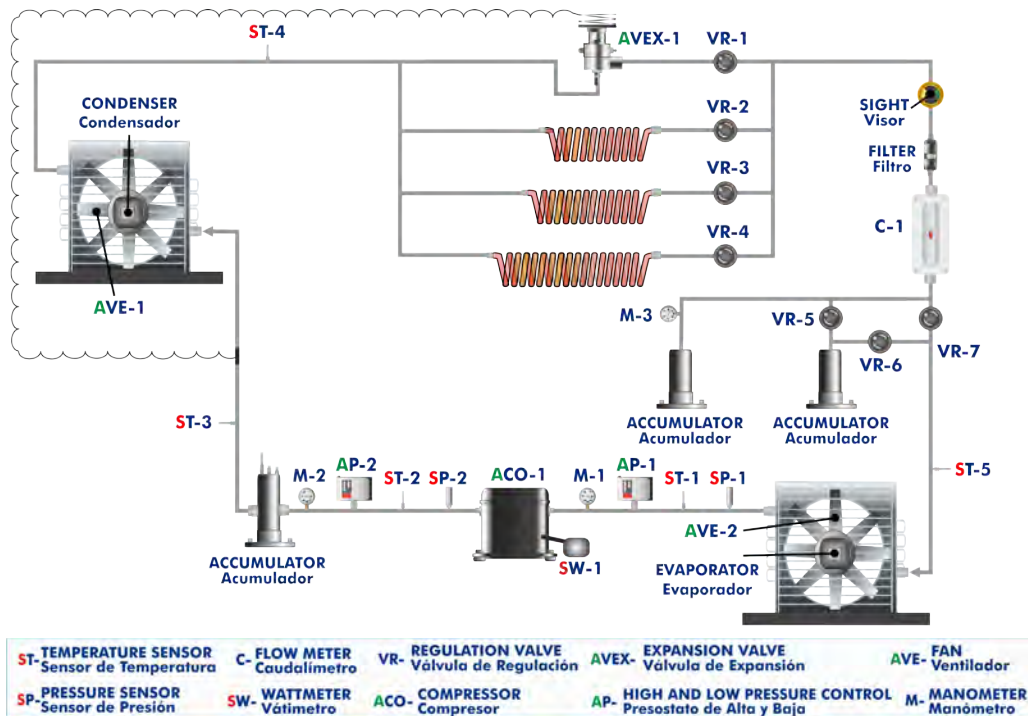


Electronic console

### PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



## INTRODUCTION

Cooling is the process of reducing and maintaining the temperature of an object or space. A very common refrigeration system is the so-called compression refrigeration system, in which the flowing of a fluid is mechanically forced inside a closed circuit, creating high and low pressure areas so that the fluid can absorb heat in one place and dissipate it in the other place. In this system, the refrigerant flows through four main elements: compressor, condenser, expansion element and evaporator. It is an advantage in a cooling system the fact that the refrigerant has a low boiling temperature at low pressure. For that reason, evaporation takes place at the low pressure side. During the refrigerant evaporation, heat is removed from the environment, that is to say, it is cooled. Condensation takes place at the high pressure side after the evaporator. In this case heat is discharged into the environment. If not the cooling effect but the discharged heat is used, then it is called a heat pump.

The vapor compression refrigeration and the heat pump cycle are very important in food and drug preservation, air conditioning and heat pumps, as well as for other industrial and commercial process.

The Compression Refrigeration Unit with Different Capillary Tubes, "TCRCT", allows a clear visualization of all the processes of a compression refrigeration system with transparent evaporator and condenser and allows compare different expansion elements, Expansion valve and capillary tubes of different lengths.

## GENERAL DESCRIPTION

The "TCRCT" unit, designed by EDIBON, is clearly arranged and represents a typical compression refrigeration system with compressor. The main components of the unit are the hermetic compressor, condenser, evaporator, expansion elements, reservoir and a receiver for refrigerant where, refrigerant can be added to or removed from the refrigeration circuit.

The unit includes three capillary tubes of different lengths and a thermostatic expansion valve can be compared as expansion elements.

For the variables process measurement:

- The flow rate of the refrigerant is read from a flow meter.

- Temperature is recorded by sensors and can be read on digital display.

- Pressure is recorded by sensors and can be read on digital display.

- The electrical power consumption of the compressor is recorded by sensors and can be read on digital display.

## SPECIFICATIONS

Experimental unit for the training of apprentices in the refrigeration area, which allows the investigation of a refrigeration system with different expansion elements.

Anodized aluminum structure and panels of painted steel.

The unit includes wheels to facilitate its mobility.

Main metallic elements of stainless steel.

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

Refrigeration circuit consisting of:

- Hermetic compressor:

  - Refrigeration capacity: 372W at 7.2°C/32°C.

  - Power consumption: 215W at 7.2°C/32°C.

- Condenser with fan: Finned tube exchanger heat:

  - Max. Volumetric air flow rate: 300 m<sup>3</sup>/h.

- Evaporator with fan: Finned tube exchanger heat:

  - Max. Volumetric air flow rate: 180 m<sup>3</sup>/h.

- Expansion elements:

  - Expansion valve.

  - Three Capillary tubes of different lengths: 1.5 m, 3 m, 6 m.

Filter and drier.

Two pressure switches.

Reservoir of refrigerant, capacity: 2 l.

Receiver for underfilling/overfilling the system with refrigerant, capacity: 2 l.

Refrigerant flow meter, range: 2 to 18 m<sup>3</sup>/h.

Pressure sensors:

- Low pressure pressure sensor in the intake side, range: -1 to 10 Bar.

- High pressure pressure sensor in the delivery side, range: -1 to 24 Bar.

Electrical power consumption. Range: 0 to 1000 W.

Five temperature sensors at relevant points of the system:

- Four temperature sensors of range -40 to 150°C.

- One temperature sensors of range -100 to 100°C.

Three manometers distributed along the circuit to view the pressures in key points.

The unit has been designed to be used with the environmental friendly CFC-free refrigerant R-134a.

Enthalpy diagram of the R134a refrigerant.

Electronic console:

- Metallix box.

- Temperature sensors connectors.

- Pressure sensors connectors.

- Digital display for the temperature sensors.

- Digital display for the pressure sensors.

- Selector for the temperature sensors.

- Switch for the compressor.

- Switch for the fan of the condenser.

- Switch for the fan of the evaporator.

- High pressure control connection.

Cables and accessories, for normal operation.

Manuals:

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

## EXERCISES AND PRACTICAL POSSIBILITIES

- |   |  |
|---|--|
| <p>1.- Function and operational behaviour of the refrigeration circuit components.</p> <p>2.- Identification and study of the main components of a compression refrigeration system:</p> <ul style="list-style-type: none"> <li>Compressor.</li> <li>Evaporator.</li> <li>Condenser.</li> <li>Expansion valve.</li> </ul> <p>3.- Study and comparison of work with different expansion elements:</p> <ul style="list-style-type: none"> <li>Expansion valve.</li> <li>Capillary tubes of different lengths.</li> </ul> <p>4.- Study of effect of underfilling or overfilling of the system with refrigerant.</p> <p>5.- Study of finned tube exchangers heat in use with condenser and evaporator in compression refrigeration circuit.</p> | <p>6.- Representation of the thermodynamic cycle in the log p-h diagram.</p> <p>7.- From the log p-h diagram and in comparison with the measured values:</p> <ul style="list-style-type: none"> <li>Determination of the refrigeration capacity.</li> <li>Determination of the coefficient of performance.</li> <li>Determination of the efficiency of the compressor.</li> </ul> <p>Additional practical possibilities:</p> <p>8.- Properties of the R134a refrigerant.</p> <p>9.- Enthalpy-pressure diagram for the R134a refrigerant.</p> |
|---|--|

## REQUIRED SERVICES

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

## DIMENSIONS AND WEIGHTS

TCRCT:

Unit:

-Dimensions: 1500 x 600 x 1800 mm. approx.  
(59.05 x 23.62 x 70.86 inches approx.)

-Weight: 125 Kg. approx.  
(275.57 pounds approx.).

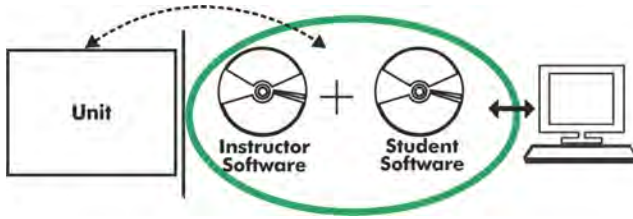
Electronic console:

-Dimensions: 490 x 330 x 310 mm. approx.  
(19.29 x 12.99 x 12.20 inches approx.)

-Weight: 10 Kg. approx.  
(22 pounds approx.).

## Optional

### TCRCT/ICAI. Interactive Computer Aided Instruction Software System:



With no physical connection between unit and computer (PC), this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

#### Instructor Software

### -ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

**User Data Base Management.**

**Administration and assignment of Workgroups, Tasks and Training sessions.**

**Creation and Integration of Practical Exercises and Multimedia Resources.**

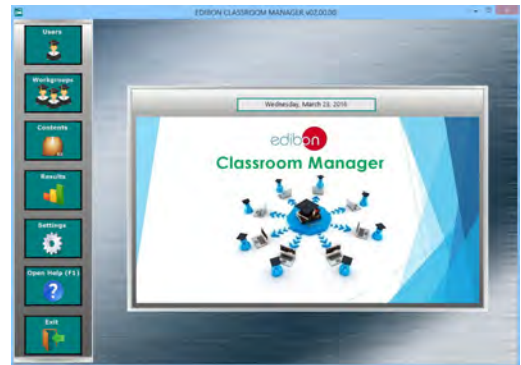
**Custom Design of Evaluation Methods.**

**Creation and assignment of Formulas & Equations.**

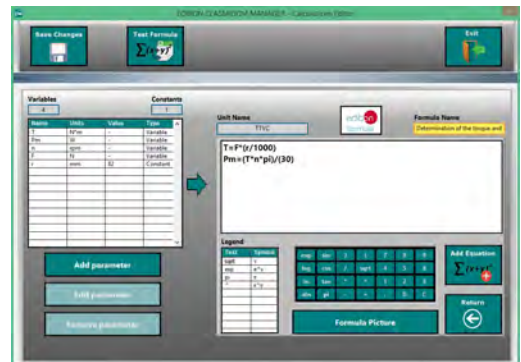
**Equation System Solver Engine.**

**Updatable Contents.**

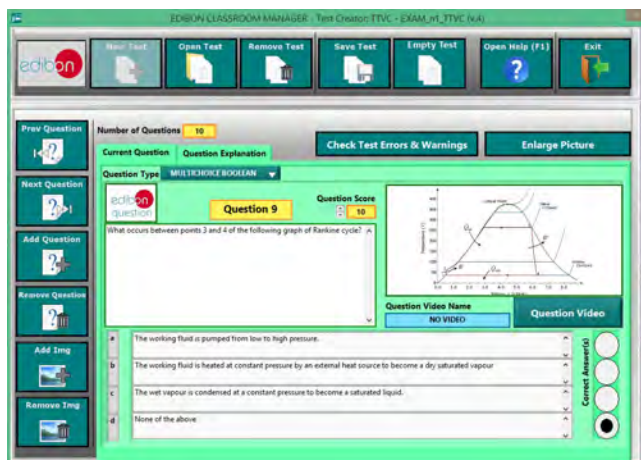
**Report generation, User Progression Monitoring and Statistics.**



ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen



ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question



ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram



**-ESL-SOF. EDIBON Student Labsoft (Student Software).**

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

**Student Log-In & Self-Registration.**

**Existing Tasks checking & Monitoring.**

**Default contents & scheduled tasks available to be used from the first session.**

**Practical Exercises accomplishment by following the Manual provided by EDIBON.**

**Evaluation Methods to prove your knowledge and progression.**

**Test self-correction.**

**Calculations computing and plotting.**

**Equation System Solver Engine.**

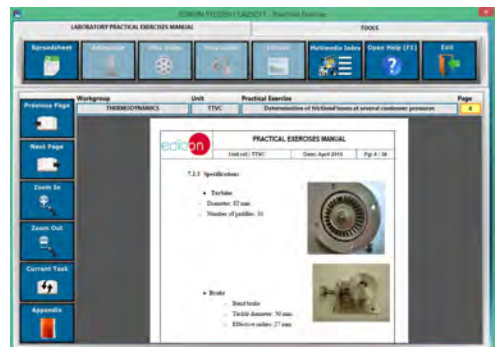
**User Monitoring Learning & Printable Reports.**

**Multimedia-Supported auxiliary resources.**

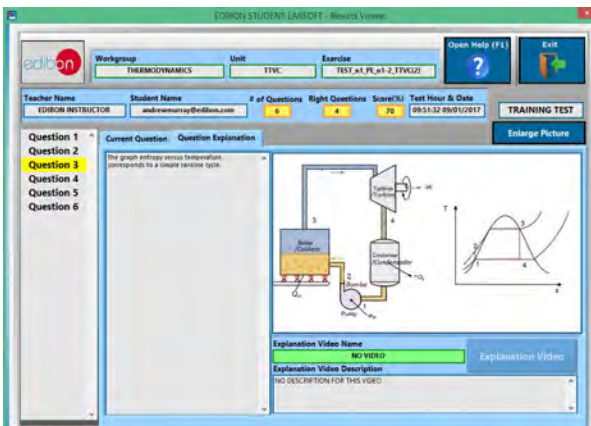
For more information see ICAI catalogue. Click on the following link:  
[www.edibon.com/products/catalogues/en/ICAI.pdf](http://www.edibon.com/products/catalogues/en/ICAI.pdf)



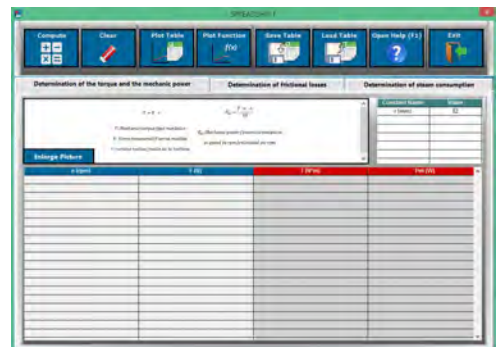
ESL-SOF. EDIBON Student LabSoft (Student Software)  
Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package-Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

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



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REPRESENTATIVE

