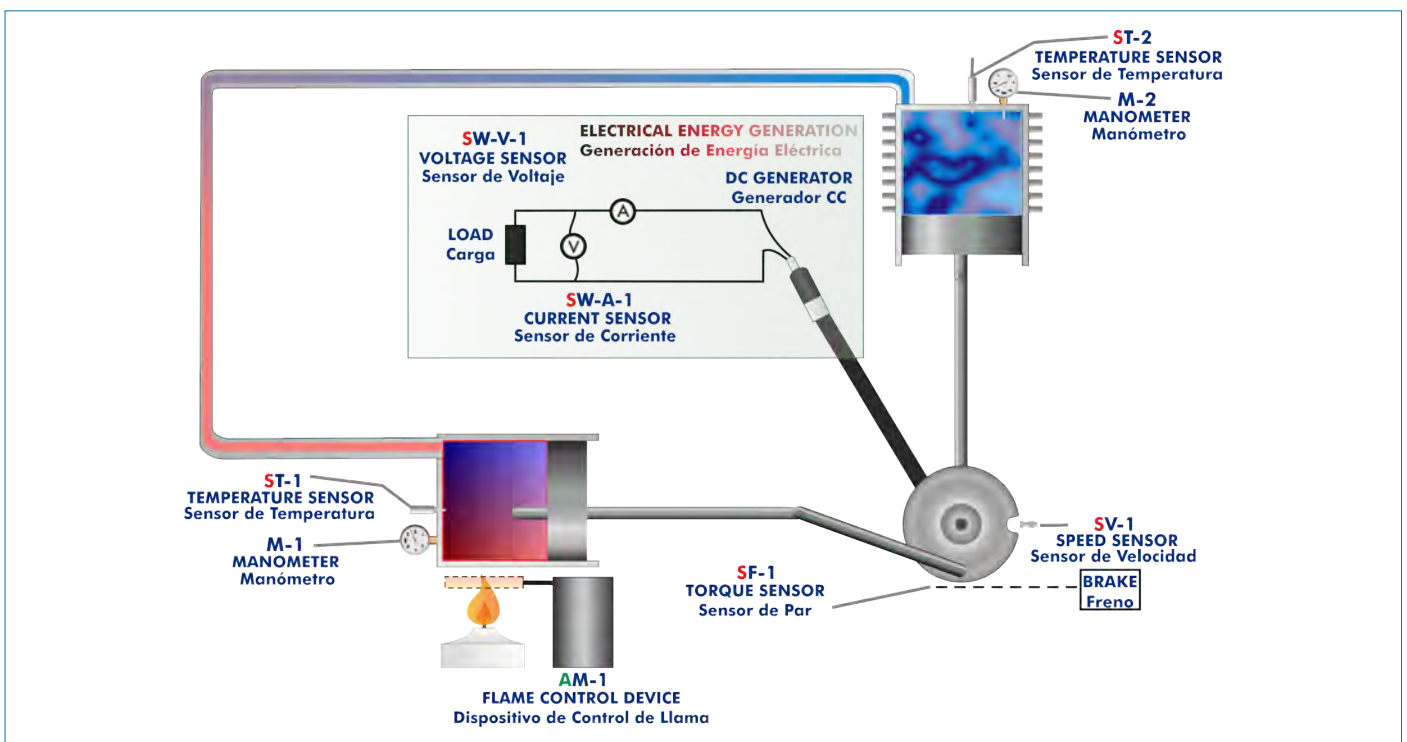




Electronic console

### PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)



European Union Certificate (total safety)



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



"Worlddidac Quality Charter" and Platinum Member of Worlddidac

## INTRODUCTION

A Stirling motor is a heat engine that operates by cyclic compression and expansion of air or other gas, the working fluid, at different temperature levels such that there is a net conversion of heat energy to mechanical work.

The motor is an external combustion unit like a steam engine in that all heat transfer takes place through the engine wall and the heat source is outside the engine. But unlike the steam engine, the working fluid used by the Stirling motor is a fixed quantity of gas either air or other type.

Similarly to other heat engines, the general cycle consists of compressing cool gas, heating the gas, expanding the hot gas, and finally cooling the gas again before repeating the cycle.

The Stirling Motor "TMSB" is noted for its high efficiency, quiet operation, and can be used with any type of heat source, such as renewable ones.

## GENERAL DESCRIPTION

The Stirling Motor, "TMSB", is used to demonstrate the operation of a thermodynamic machine for the conversion of energy. It converts thermal energy into mechanical energy and operates as a motor (heat engine). Additionally it can operate an electrical generator and load.

An ideal Stirling cycle has four phases:

- Phase 1- Constant volume heating of the gas in the hot cylinder.
- Phase 2- Isothermal expansion at constant temperature in the hot cylinder.
- Phase 3- Constant volume working in the cold cylinder.
- Phase 4- Isothermal compression of the gas in the cold cylinder.

The Stirling Motor "TMSB" unit designed by EDIBON is an Alfa type engine. It consists of two power pistons located in separate cylinders (one for the cold source and another for the hot one). They are connected to a tube where the regenerator is located, which stores and transfers the heat, that enables the engine to reach a higher efficiency.

Gas moves between both cylinders in a close circuit. The external source provides energy to the hot cylinder, generating the expansion of the gas, and the subsequent motion of the piston, 90° out of phase from the other, and connected to it by a crankshaft.

The hot gas passes to the cold cylinder. During this time the cold cylinder piston compresses the cooled gas and forces it to move to the hot cylinder, where it receives the heat from the hot source and the cycle starts again.

The unit also includes a braking system with force sensor and an electrical generator with pulley to convert the mechanical energy into electrical energy, equipped with an electrical load and current and voltage measurement system.

This unit is supplied with the suitable sensors and instrumentation for the control and measurement of the most representative parameters, as:

- Flame control, temperatures measurement in the cylinders, pressures measurement in the cylinders, speed measurement (rpm), torque measurement (force) and current and voltage measurement.



TMSB detail

## SPECIFICATIONS

Bench-top unit.

Anodized aluminum structure and panels of painted steel.

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

Alfa type Stirling motor: hot and cold cylinders made of stainless steel and pistons made of bronze.

Device to control the flame of the heating element, to cover it and to release it.

Alcohol lamp as heating element.

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.

Instrumentation:

- Two temperature sensors "J" type, one in the hot cylinder and the other in the cold cylinder.

- Two pressure meters (manometers), one in the hot cylinder and the other in the cold cylinder, range: from -1 to 0.6 bar

- Speed sensor (rpm), range: from 0 to 3000 rpm.

- Dynamometer to measure the force, range: from 0 to 1N.

- Current and voltage sensors.

Electronic console:

- Metallic box.

- Temperature sensors connectors. Digital display for the temperature sensors. Selector for the temperature sensors.

- Voltage sensor connector. Digital display for the voltage sensor.

- Current sensor connector. Digital display for the current sensor.

- Speed sensor connector. Digital display for the speed sensor.

- Switches to open and close the flame device.

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

- 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 generates 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.- Speed measurement (rpm).
- 9.- Torque measurement.
- 10.- Measurement of the generated electrical power.
- 11.- Temperature measurements.
- 12.- Pressure measurements.

### REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.

### DIMENSIONS AND WEIGHTS

#### TMSB:

##### Unit:

- Dimensions: 450 x 450 x 600 mm approx.  
(17.71 x 17.71 x 23.62 inches approx.)
- Weight: 35 Kg approx.  
(77.16 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.).

### REQUIRED CONSUMABLES (Not included)

- Alcohol or paraffin.

### SIMILAR UNITS AVAILABLE

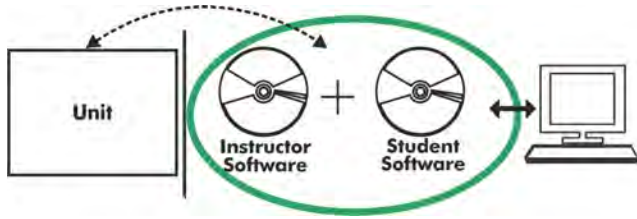
- TMSB. Stirling Motor.

Offered in this catalogue:

Offered in other catalogue:

- TMSC. Computer Controlled Stirling Motor.

**TMSB/ICAI. Interactive Computer Aided Instruction Software:**



With no physical connection between unit and computer, 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.

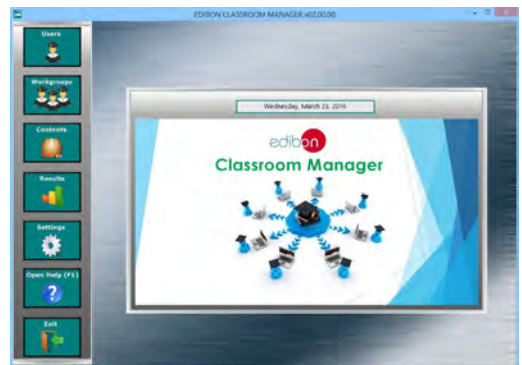
Instructor Software

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

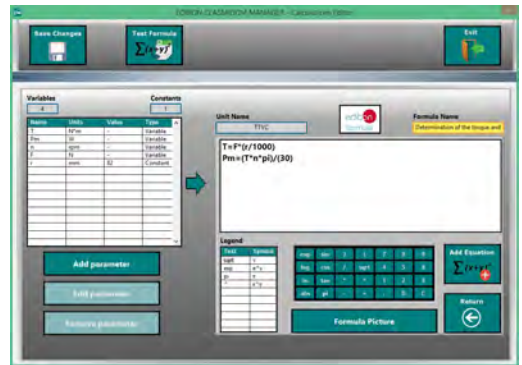
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual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

Innovative features:

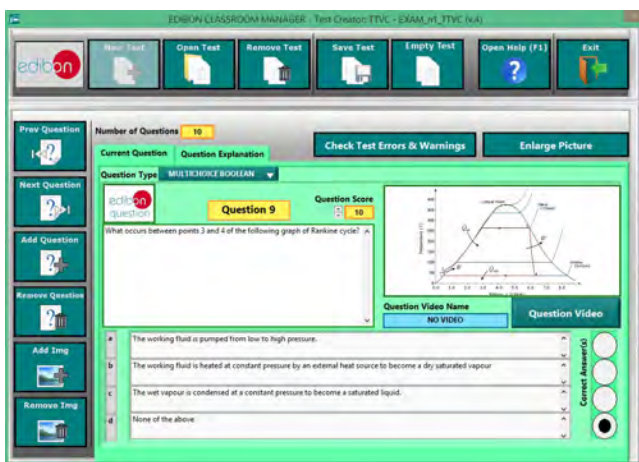
- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- 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:

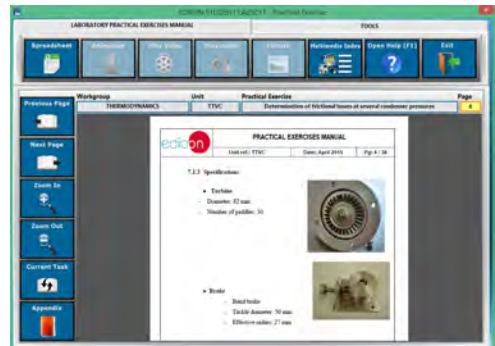
- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- 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:

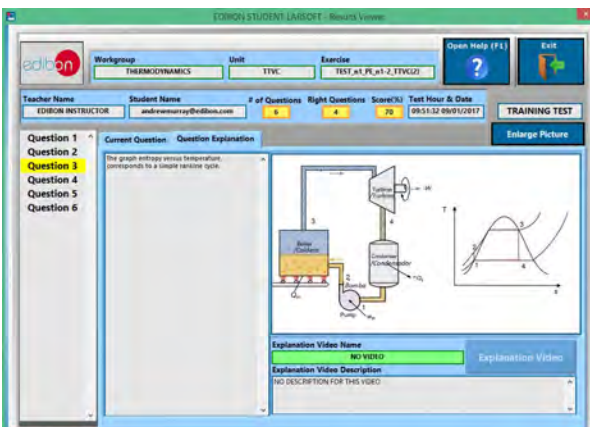
[www.edibon.com/en/files/expansion/ICAI/catalog](http://www.edibon.com/en/files/expansion/ICAI/catalog)



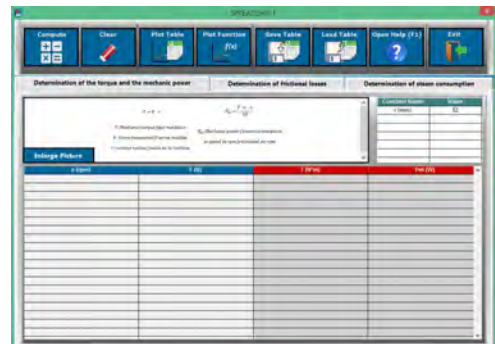
ESL-SOF. EDIBON Student LabSoft (Student Software)  
Application Main Screen



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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