

# CONDITIONING AND REFRIGERATION

## T108/2D/C - Computerized Refrigeration Study Unit with Mass/Energy Balance - Code 953812



### 1. General

The T108/2D/C is an extremely easy-to-use and functional unit able to permit the study of a compression frigorific cycle and the evaluation of the cycle efficiency and the energy balance at the evaporator and at the condenser. The unit allow the study of the main thermodynamics quantities as a function of the thermal load at the evaporator and the calculation of the power required at the compressor shaft.

A front panel with mimic diagram and instrumentation allows to keep the most significant thermodynamic quantities under control, so facilitating the students' understanding and the teacher's task. Moreover, the transducers and the dedicated software allows the data acquisition of the main thermodynamic quantities and to obtain or as a table or as a graph, the acquired values and the thermodynamic calculated quantities.

The unit is supplied with manuals which describe the components, the installation and utilization procedures as well as many exercises with experimental results.

### 2. Composition

The unit includes:

- open type two cylinder compressor, driven by a swinging frame electric motor
- water/R134a condenser
- ethylene glycol - water/R134a evaporator
- adjustable 0-1200W electrical resistance to change the evaporator thermal load
- manual isenthalpic expansion valve
- sub cooling heat exchanger
- liquid trap
- dehydrator filter

- load cell for torque measurement
- proximity sensor to measure engine revolutions
- flow meter with control valve of the H<sub>2</sub>O delivery at the condenser
- pressure gauge for condensation pressure
- pressure gauge for evaporation pressure
- maximum pressure switch
- maximum temperature switch
- cooling fluid sight glass
- N. 2 temperature digital indicators
- N. 2 temperature selectors
- N. 9 temperature probes type Pt100
- N. 9 temperature signal transducers with analog outlet for PC data acquisition
- N° 1 digital power indicator with electric resistance regulator with analog outlet for PC data acquisition
- N° 1 digital rpm indicator with analog outlet for PC data acquisition
- N° 1 digital torque indicator with analog outlet for PC data acquisition
- N° 1 energy meter
- N. 1 flow meter signal transducer with analog outlet for PC data acquisition
- N. 2 pressure signal transducers with analog outlet for PC data acquisition
- N. 1 A/D conversion card with USB interface
- magnetothermic differential switch, manual controls, signaling lamps and protection fuses.
- data acquisition and analysis software

### 3. Description

The main characteristic of the unit is to enable the student to evaluate mass and energy flows, so that to verify the frigorific cycles theory and the differences between the ideal and real cycles.

An open type two cylinders compressor guarantees the compression work. The evaporator consists of a copper coil, through which the cooling fluid R134a flows, immersed in a tank full of antifreeze liquid (mixture of ethylene glycol and water) heated by an electric resistance. The resistance is adjustable and allows to study the frigorific cycle when the evaporator thermal load changes. The condenser is a coil type and the condensing fluid is water. The manual expansion valve realizes the isenthalpic expansion and the manual regulation allows the student to verify the influence of the expansion on the thermal balance of the cycle. The unit is also supplied with a double pipe exchanger; in the internal pipes it flows the cooling fluid R134a in the fluid state, sub cooled, while in the external pipes it flows the cooling fluid R134a in the gaseous state, super heated. A set of valves allows to cut out the exchanger from the cycle.

The instrumentation is inserted into the actual cycle and allows to constantly check all the main parameters: two digital instantaneous thermometers with switches visualize one the inlet temperatures and the other the outlet temperatures, one flow meter visualizes the condensation water flow rates and two pressure gauges visualize the condensation and evaporation pressures. The instrumentation comes with a complete synoptic panel allowing the immediate understanding of the frigorific cycle.

The data acquisition and analysis software works in MS-Windows environment and acquires real time data, elaborates them and stores them. It can display and print the data acquired and the quantities obtained by calculation and processes graphics which describe the trend of the calculated quantities. Moreover, instead of acquiring data from transducers, it is possible to insert data from the keyboard, allowing an independent use of the software.

### 4. Technical specifications

- Compressor power 2.2 kW at 1500rpm
- Water consumption 80 l/h approx

### 5. Experiments

- Frigorific cycle thermodynamic study
- Efficiency calculation (COP).
- Internal heat exchange effect
- Efficiency calculation when the evaporation temperature changes.
- Evaporator thermal balance.
- Condenser thermal balance.
- Compression efficiency calculation.

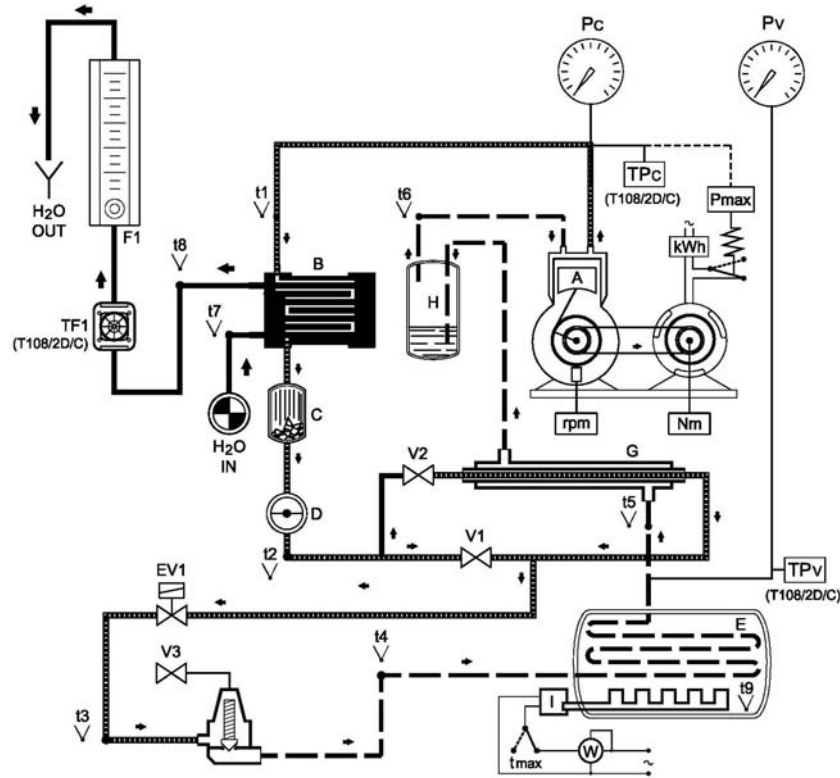
### 6. Required services

- Electric supply: 220 V single-phase, 50/60 Hz
- Water supply: net water, maximum pressure 3 bar
- PC minimum Pentium with HD >10Gb, CD drive, SVGA graphic card minimum, mouse, 32MB RAM, USB port
- Windows XP or following
- Graphic printer

### 7. Weight and Dimensions

- Dimensions: 600 x 600 x 1530 h mm
- Net weight: 160Kg

## 8. Synoptic



### Keys:

- A. open type two cylinder compressor, driven by a swinging frame electric motor
- B. water/R134a condenser
- C. dehydrator filter
- D. cooling fluid sight glass
- E. ethylene glycol - water/R134a evaporator
- F. sub cooling heat exchanger
- G. liquid trap
- V1-V2. sub cooling heat exchanger cut out valves
- V3. manual isenthalpic expansion valve
- EV1. safety solenoid valve
- t1. temperature sensor: condenser coolant inlet
- t2. temperature sensor: condenser coolant outlet
- t3. temperature sensor: manual isenthalpic expansion valve inlet
- t4. temperature sensor: evaporator coolant inlet
- t5. temperature sensor: evaporator coolant outlet/ heat exchanger coolant inlet
- t6. temperature sensor: heat exchanger coolant outlet
- t7. temperature sensor: condenser water inlet
- t8. temperature sensor: condenser water outlet
- t8. temperature sensor: inside evaporator (adjustable through the electric resistance)
- F1. flowmeter with control valve of the condenser H<sub>2</sub>O flow rate
- TF1. flow transducer for the condenser H<sub>2</sub>O flow rate (on T108/2D/C only)
- Pc. pressure gauge for condensation pressure
- TPc. pressure transducer for condensation pressure (on T108/2D/C only)
- Pv. pressure gauge for condensation pressure
- TPv. pressure transducer for evaporation pressure (on T108/2D/C only)
- Pmax. maximum pressure switch
- Tmax. maximum temperature switch
- rpm. rpm digital counter with analog outlet for PC data acquisition
- Nm. torque digital counter with analog outlet for PC data acquisition
- KWh. electric energy counter with analog outlet for PC data acquisition
- W. power digital counter with regulation card with analog outlet for PC data acquisition

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