CRC112

FAULT SIMULATION ON REFRIGERATION SYSTEM

Experimental capabilities

- **Simulation of 18 conventional refrigeration failures**
- **Study of the basic concept of a refrigeration installation with R134A, with double evaporator.**
- **Study of the thermodynamic cycle of enthalpy diagram and display in real time on PC.**
- **Calculation of cooling capacity to the condenser and evaporators.**
- **Overall efficiency of the unit.**

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version : FT-CRC112-STD-B

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Operating principle

The CRC112 bench allows the study of a low-pressure refrigeration cycle with double evaporator.
The system allows you to view the two refrigerated chambers and validate the performance difference between a positive and a negative system. Students will start up the system and do temperature readings with different operating modes.
They will analyze the data and understand what is the influence of the various components on the system.
They can view the refrigeration cycle in real time on the touch screen integrated on the machine.
They can also make troubleshooting thanks to the system that simulates 18 failures.

The robust design of this device makes it suitable for use in schools.
The equipment is set up on an Anodized aluminum frame on casters wheels. This gives it great strength and a flexibility of integration into your premises. The manufacture of this equipment complies with the European standard for machinery manufacturing.

Technical details

1. Semi hermetic reciprocating compressor :
   - Fluid : R134a
   - Power: 1800W (0°C / 32°C)
   - Maximum operating pressure: 28bars
   - Start-up pressure regulating valve (KVL) at suction
   - Load regulation valve (KVC) between the discharge and suction compressor.
   - Safety pressure switch HLP and LP control pressure switch
   - Suction line accumulator at the suction and bottle of oil recovery at discharge
2. Condenser with forced ventilation
   - Air flow rate 1700m3 /h
   - Pressostatic inverter for fan speed
3. Steel liquid tank
   -Volume : 2.4L
4. Dehydrator filter anti acid (X2)
   - With upstream liquid sight glass
   - A filter for normal operation
   - A clogged filter for failure simulation
5. Liquid vapor exchanger (X1)
   - An exchanger for the positive chamber placed upstream of the pressure reducer and on the return of the evaporator
   - Bypass valve
6. Control solenoid valve (x2)
   - For pump down control
   - set up upstream of expansion valve of each chamber
7. Internal equalization thermostatic expansion valve (x2)
   - One for each room
   -+1 failure simulation pressure reducing valve for the positive chamber
8. Positive cold chamber with evaporator
   - Exchange surface: 1.3m²
   - Evaporator with forced ventilation
   - Condensate collection bin on the bottom part
   - Evaporation pressure control valve of KVP type
   - Electronic temperature controller controlling the solenoid valve, the evaporator fan and the defrost
9. Negative cold chamber with evaporator
   - Exchange surface: 1.65m²
   - Evaporator with forced ventilation
   - Condensate collection bin on the bottom part
   - Electric defrost heater
   - Defrosting system by hot gas (injection of outlet gas of the compressor in counter-current in the evaporator and return into the liquid tank with check valve)
   - Electronic temperature controller controlling the solenoid valve, the evaporator fan and the defrost
10. Dual scale manometers (pressure and saturation temperature of the fluid, - 1 to 10 bar and -1 to 30 bar) diameter 80mm.
    - Compressor suction pressure
    - Compressor discharge pressure
    - Liquid tank pressure
    - Positive evaporator pressure
    - Negative evaporator pressure
11. Flowmeter of refrigerant before the pressure reducing valves of each chamber (0-50Kg /h)
12. T type thermocouple temperature probes placed on the circuit and connected to the touch screen :
    - Compressor suction temperature
    - Compressor discharge temperature
    - Condenser outlet temperature
    - Expansion valve inlet temperature 1
    - Expansion valve inlet temperature 2
    - Evaporator temperature outlet 1 (negative)
    - Evaporator temperature outlet 2 (positive)
    - Chamber temperature 1 (negative)
    - Chamber temperature 2 (positive)
13. Touch screen

The bench includes a touch screen that is linked to the acquisition modules and enables the following features:
    - Block diagram with measurement points
    - Display of measured values (pressures and temperatures)
    - Activation of electrical failures
    - Data recording
14. The signals of 7 temperature sensors are shown at the front side on the thermocouples connectors
    - Inlet and outlet of the compressor
    - Condenser outlet
    - Inlet of pressure reducing valves
    - Outlet of evaporators
15. The signals of two pressure sensors are shown at front side of the box on dual sink sockets :
    - Compressor suction (LP)
    - Compressor discharge (HP)
16. The bench is provided with a portable temperature indicator compatible with the signals of the sensors used (thermocouples type T). The connecting cables between the machine and the mobile device are provided.

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Detail of achievable failures on the installation

Failure 1	**Failure on the KVP (evaporator pressure regulator) of the negative evaporator.** The objective is to simulate a leak of the regulator (internal degradation or blocking). The simulation is performed by opening a solenoid valve in parallel with the KVP. (fluid failure-from the touch screen).
Failure 2	**Failure on the KVC (hot gas bypass regulator) of the compressor.** The objective is to simulate a leak of the regulator (internal degradation or blocking). The simulation is performed by opening a solenoid valve in parallel. (fluid failure-from the touch screen).
Failure 3	**Dehydrator clogged.** The objective is to show students the effect produced by a clogged dehydrator on a refrigeration system (pump down ...). The machine is equipped with two dehydrators, one normally functioning, and the other being obstructed. The teacher can activate the failure on the Panel PC. A light indicates which dehydrator is used. (fluid failure-from the touch screen).
Failure 4	**Coil of the solenoid valve broken.** The objective is to show the effect of broken solenoid valve on a refrigeration circuit (burnt out coil). The failure is created by cutting the supply of the coil (electric failure-from the touch screen).
Failure 5	**Coil of the hot gas defrost solenoid valve broken.** The objective is to show the effect of broken solenoid valve on a defrost circuit by hot gas (burnt out coil). The failure is created by cutting the supply of the coil (electric failure-from the touch screen).
Failure 6	**Compressor failure.** The objective is to show the effect of a compressor failure on a refrigeration circuit. The failure is created by cutting the supply of the compressor (electric failure-from the touch screen).
Failure 7	**Failure of evaporator fan.** The objective is to show the effect of the evaporator malfunction on a refrigeration circuit. The failure is simulated by cutting off the fan's power (electric failure-from the touch screen).
Failure 8	**Failure of the condenser fan.** The objective is to show the effect of condenser malfunction on a refrigeration circuit. The failure is simulated by switching off the fan's power (electric failure-from the touch screen).
Failure 9	**Failure of an expansion valve (bulb pierced or sectioned capillary).** The objective is to show the effect of a failure on one of the expansion valve. One of the chambers is equipped with two expansion valve. One is functional, the other has downgraded its bulb (leakage of gas refrigerator of the bulb). The teacher chooses the expansion valve used via solenoid valves. (fluid failure-from the touch screen).
Failure 10	**Failure on the control pressure switch LP**. The objective is to show the effect of a failure on the low-pressure control switch. The failure is simulated by-passing the pressure switch (control). The pressure will continue to go down in the installation when the control solenoid valves will be closed. (electrical failure-from the touch screen).
Failure 11	**Failure on the temperature controller- relay broken.** Failure on the controller. The failure 11 is intended to simulate the defect of the electronic temperature controller of the positive chamber. It simulates the fact that the outputs is burn out by cutting the supply of the power of the controller. (Electrical failure-from the touch screen).
Failure 12	**Failure on the temperature controller- temperature probe broken.** Failure on the control. The failure 12 is intended to simulate the defect of the main control probe. The electrical connection between the probe and the controller is broken, thereby placing the controller in default. (electrical failure-from the touch screen).
Failure 13	**Failure on the refrigerant circuit-lacking load.** Default by lack of load, a set of manual valves allows to store the fluid in the bottle and then isolate it. This creates a lack of load in the rest of the installation. (by manual valves)
Failure 14	**Failure on the refrigeration circuit-excess load.** Default by excess of charge, a set of manual valves allows emptying the fluid contained in the bottle and then isolates it. This creates an excess charge in the rest of the installation. (by manual valves)
Failure 15	**Failure on the compressor-live disconnected.** Live loss of the compressor. This is a power failure, a relay cuts one of the compressor phases. This is actuated by the teacher for a short time in order to show students the change in sound of the compressor. (electrical failure-from the touch screen).
Failure16	**Failure of the solenoid valve of control-seat leakage.** The objective is to show the effect of a leak in the control solenoid valve. A solenoid valve (hidden) is placed in bypass of the latter with a capillary tube to create a micro leak. (fluid failure-from the touch screen).
Failure 17	**Failure on the condenser- fouled exchanger.** The objective is to show the effect of condenser fouling. We bypass it in order to reduce the exchange. The bypass is equipped with a solenoid valve controlled from the screen. (fluid failure-from the touch screen).
Failure 18	**Failure on the evaporator- fouled exchanger.** The objective is to show the effect of fouling of the evaporator. We bypass it to reduce the exchange. The bypass is equipped with a solenoid valve controlled from the screen. (fluid failure-from the touch screen).

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Details of the acquisition software (on the touch screen)

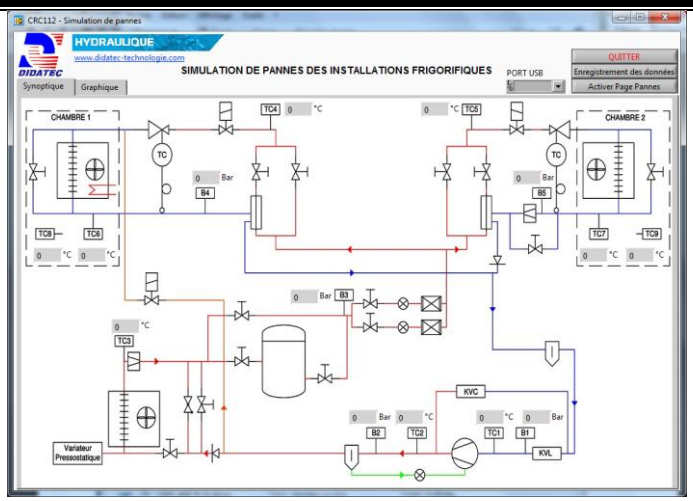
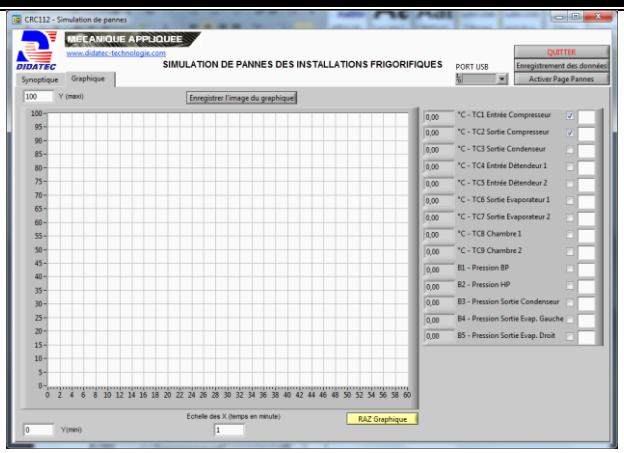
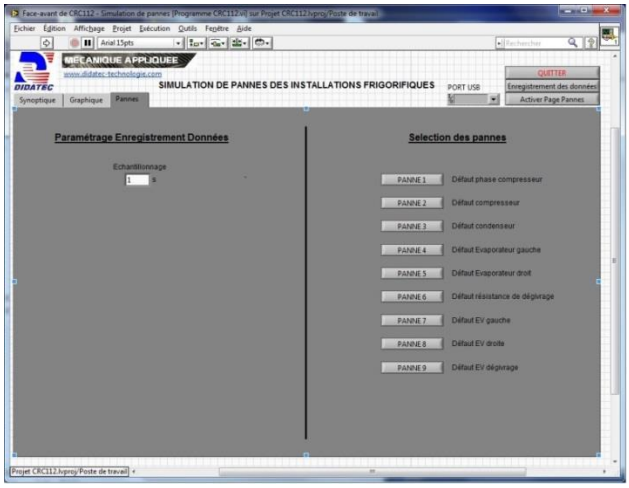


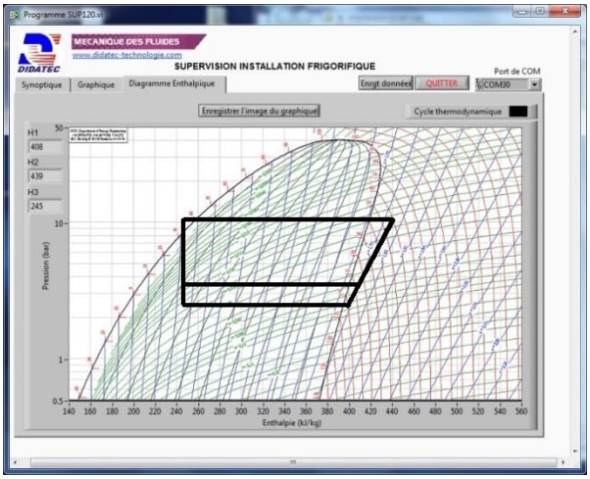
Diagram of the installation and real-time data



Real-time graphs



Activation of power failures and sampling time setting



Enthalpy diagram in real time

Services required

- Electrical supply : 400 Vac – 50 Hz – 10 A
- Electrical network : 3 phase(s) + Neutral + Earth.
- Dimensions: (LxWxH mm): 2500 x 800 x 1940
- weight (Kg): 290

Note : if the equipment installation is operated by our staff, all supplies and exhaust connections required must stand at less than 2m from the machine

Documentation

- User's manual
- Pedagogical manual
- Technical documentation of the components
- Lab exercises
- Software :
- Certificate of conformity CE

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