CRC112

FAULT SIMULATION ON REFRIGERATION SYSTEM

Experimental capabilities

- **Identifying the components of a commercial refrigeration installation**
- **Commissioning and adjustment**
- **Simulation of 18 conventional refrigeration failures**
- **Study of the basic concept of a refrigeration plant, with double evaporator.**
- **Study of the thermodynamic cycle on enthalpy diagram and real-time visualization on a computer.**
- **Calculation of cooling capacities for condensers and evaporators.**
- **Overall unit performance.**

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Operating principle

The CRC112 bench allows the study of a refrigeration cycle with double evaporator.
The system makes it possible to visualize the two refrigerated rooms and validate the difference in performance between a positive and a negative system. The students will have to commission the system and take temperature readings with different operating modes.
They will have to analyze the data and understand how the different components influence the system.
They will be able to view the refrigeration cycle in real time on the machine's built-in PC (Panel PC).
They will also be able to find faults thanks to the system that simulates 18 faults.

The rugged design of this equipment makes it perfectly suited for use in a school setting.
Its anodized aluminum structure on wheels gives it a very high robustness as well as great flexibility of integration into your premises. The manufacture of this equipment complies with the European Machinery Directive

Technical details

1. Semi hermetic piston compressor:
   -Power: 1800W approx
   -Maximum working pressure: 28bar
   -Starting pressure control valve (KVL) at suction
   -Load control valve (KVC) between the discharge and the compressor suction.
   -Safety HBP pressure switch and BP regulation pressure switch
   -anti-liquid surge bottle at suction and oil recovery bottle at discharge
2. Forced Ventilation Condenser
   -Pressure inverter for fan speed
3. Steel Liquid Tank
   -Volume: 2.4L
4. Anti-acid filter drier (X2)
   -With upstream liquid indicator light
   -a filter for normal operation
   -a clogged filter for failure simulation
5. Liquid Steam Exchanger (X1)
6. An exchanger for the positive chamber placed upstream of the expansion valve and on the return of the evaporator
   -Two-pass valve
7. Solenoid Control Valve (x2)
   -for pump down regulation
   -placed upstream of the regulators of each chamber
8. Thermostatic expansion valve with internal equalization (x2)
   -one for each room
   -+1 fault simulation regulator for the positive chamber
9. Positive cold room with evaporator
   -Forced ventilation evaporator
   -condensate collection tank in the lower part
   -KVP type evaporative pressure control valve
   --Electronic temperature controller controlling the solenoid valve, evaporator fan and defrost
10. Negative cold room with evaporator
    -Forced ventilation evaporator
    -condensate collection tank in the lower part
    -electric defrost resistor
    -hot gas defrosting system (injection of the compressor outlet gases counter-current into the evaporator and return to the liquid tank with valve)
    -Electronic temperature controller controlling the solenoid valve, evaporator fan and defrost
11. Dual Graduation Pressure Gauges (Fluid Saturation Pressure and Temperature)
    -pressure suction compressor
    - pressure discharge compressor
    -Pressure liquid tank
    -positive evaporator pressure
    -negative evaporator pressure
12. Refrigerant flow meter before the expansion valves in each chamber
13. Thermocouple T temperature probes placed on the circuit and connected to the PC:
    -Temperature suction compressor
    -Temperature discharge compressor
    -condenser outlet temperature
    -Temperature inlet regulator 1
    -Temperature inlet regulator 2
    -evaporator outlet temperature 1 (negative)
    -evaporator outlet temperature 2 (positive)
    -temperature room 1 (negative)
    - temperature room 2 (positive)
14. Panel PC
    The bench has a panel PC on the front panel that is linked to the acquisition modules and allows the following functionalities:
    - synoptic with measuring points
    - Display of measured values (pressures and temperatures)
    -activation of electrical failures
    - Data logging
15. Signals from 7 temperature sensors are transferred to the front panel on thermocouple connectors
    - Compressor input and output
    - Condenser output
    - Regulator inlet
    - Evaporator output
16. The signals from two pressure sensors are transferred to the front of the enclosure on double-well bushings:
    -suction compressor (LP)
    -Compressor discharge (HP)
17. The bench is supplied with a portable temperature indicator compatible with the signals of the sensors used (T-type thermocouples). Cables for connecting the machine to the handheld 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)

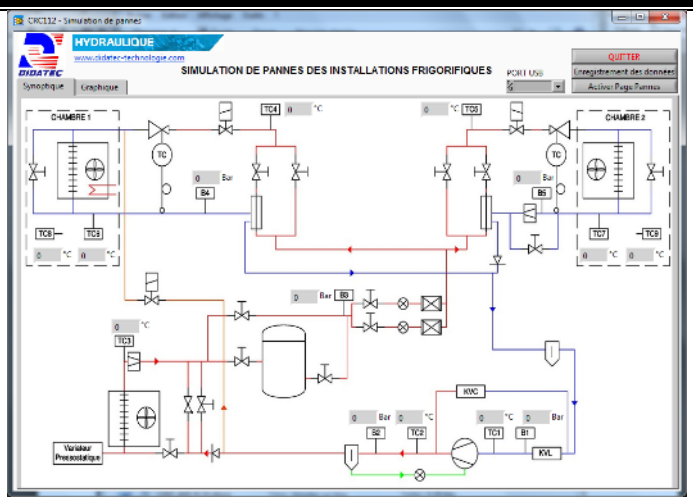
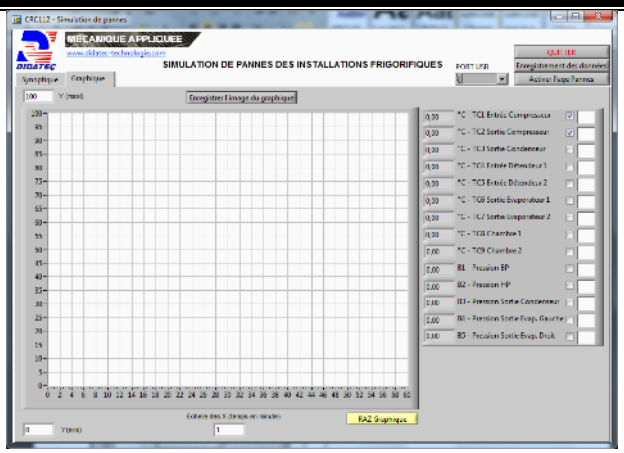
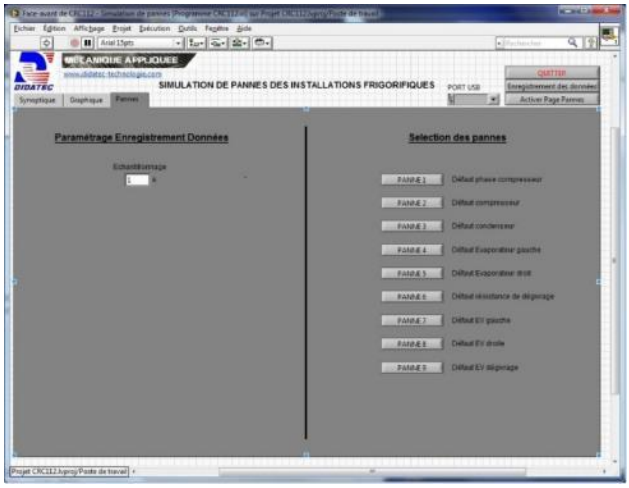


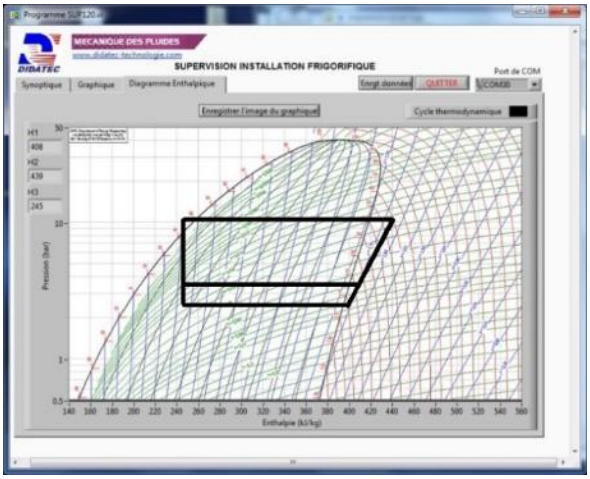
Diagram of the installation and real-time data



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

- Instruction manual
- Pedagogical manual
- Technical documentation of components
- Practical work
- Electrical diagram
- Fluidic diagram
- Enthalpy diagram
- Free software without a license
- CE Certificate of Conformity

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