Refrigeration Cycle Demonstration Unit R633

Figure 1: ***R633 Unit***

- ***Ozone friendly, low pressure, non-toxic working fluid allows evaporation and condensation to be seen in glass cylinders.***
- ***A Bench top unit specifically designed for unsupervised operation.***
- ***Fast response to controls allows efficient use of laboratory time.***
- ***Negligible operating and maintenance costs.***
- ***Two-year warranty.***

Experimental Capabilities

- Demonstration of the vapour compression refrigeration and heat pump cycle with visual observation of all-important processes.
- Investigation and demonstration of the pressure-temperature relationship during evaporation and condensation.
- Demonstration of: -
    - Charging
    - Pumping over or pumping down the refrigerant charge into the condenser.
    - The effect of air in refrigeration systems.
- Determination of effect of evaporating and condensing temperatures on the refrigeration rate and condenser heat output.
- Investigation of the effect of compressor pressure ratio on system performance.
- Determination of overall heat transfer coefficient in a simple shell and tube type heat exchanger.
- *With the addition of the optional temperature indicator R633A: -*
- Development of a refrigeration cycle diagram on a pressure - enthalpy chart.
- *With the addition of the optional digital wattmeter R633B: -*
- Measurement of the electrical power used to drive the vapour compression refrigeration and heat pump cycle.

Insert 1: Optional Digital Temperature Indicator upgrade. R633A

Insert 2: Optional Digital Wattmeter Upgrade R633B

Special Design Features

- Specifically designed for safe unsupervised operation by students.
- Low-pressure non-toxic working fluid R141b enables both evaporation and condensation to be safely observed in glass components.
- Very Low ODP (0.1) working fluid using components that will be supportable well into the next millennium.
- Self contained bench top unit requiring only minimal electrical power and cooling water.
- Visual impact of the unit aids student understanding of a complex process.
- Low thermal inertia allows a large range of experiments to be carried out in a short period.
- Optional factory, or user fitted, upgrades to give digital temperature readout (R633A) and compressor electrical power consumption (R633B).

Description

The vapour compression refrigeration and heat pump cycle is of paramount importance in food and drug preservation, air conditioning, heat pumps as well as other industrial and commercial process.

The importance of the efficient and safe use of refrigeration systems has now been added to by the problems of ozone depletion and global warming.
It is therefore more essential than ever before that students have a thorough understanding of both the practical aspects of refrigeration and the thermodynamic processes affecting the performance of the cycle.

Often the most difficult aspect for new students to grasp is the process of evaporation at low pressure and condensation at high pressure.
By utilising a non-toxic working fluid with a low vapour pressure, the evaporation and condensation processes are clearly visible in thick walled glass chambers.

The evaporator consists of a closed, thick walled glass chamber containing a pool of R 141b into which is immersed a specially treated copper coil.
An hermetic compressor draws vapour from the evaporator and compresses this before discharging it to the condenser. The reduction in evaporator pressure causes the refrigerant to boil, so extracting heat from the water flowing through the coil and generating more vapour to be drawn into the compressor.

From the compressor the high-pressure vapour passes to the condenser, which is of similar construction to the evaporator but contains a nickel-plated water-cooled copper coil. Vapour condenses on the surface of the coil and falls to the bottom of the chamber. The heat given up by the refrigerant phase change is transferred to the cooling water flowing through the cooling coil.

A float controlled expansion valve at the base of the condenser chamber controls the flow of high pressure refrigerant liquid returning to the evaporator. After passing through the expansion valve the refrigerant expands to form a liquid vapour mixture at the same pressure as the evaporator and the cycle is repeated.

The standard instrumentation fitted enables measurement of the condenser and evaporator pressures and temperatures as well as water flow rates and water temperatures.
The condensing and evaporating pressures are varied by adjustment of the water flow rate to the evaporator and condenser coils using integral control valves on individual flowmeters.

An *optional Digital Temperature Indicator Upgrade R633A*, allows the measurement of the above temperatures plus the compressor discharge and condensed liquid temperatures to 0.1°C resolution. The addition of these parameters allow a complete refrigeration cycle diagram to be plotted on an R141b Pressure-Enthalpy Diagram.
An *optional Digital Wattmeter Upgrade R633B* allows measurement of the instantaneous electrical power being consumed by the compressor. Range 0-1999W resolutions 1 W.

Figure 2: Data showing pressure temperature relationships for refrigerant

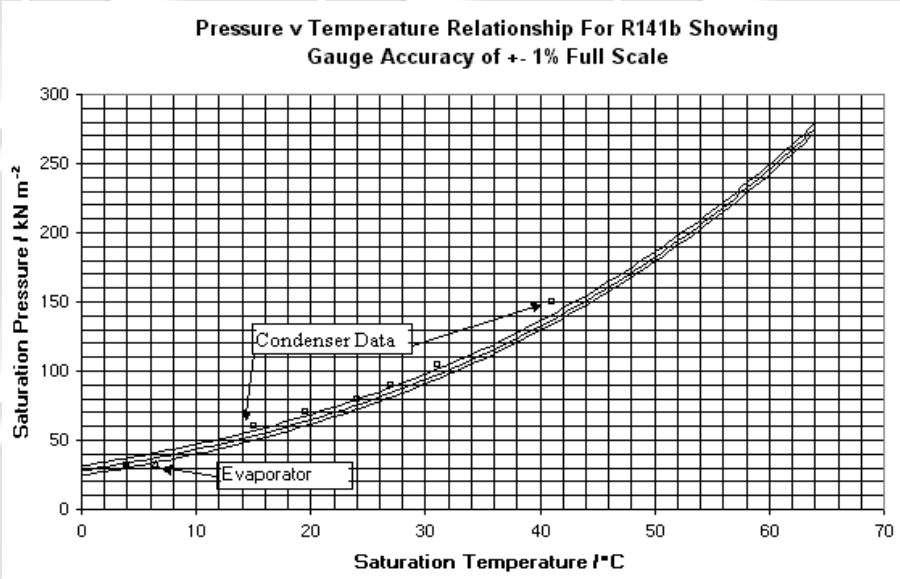
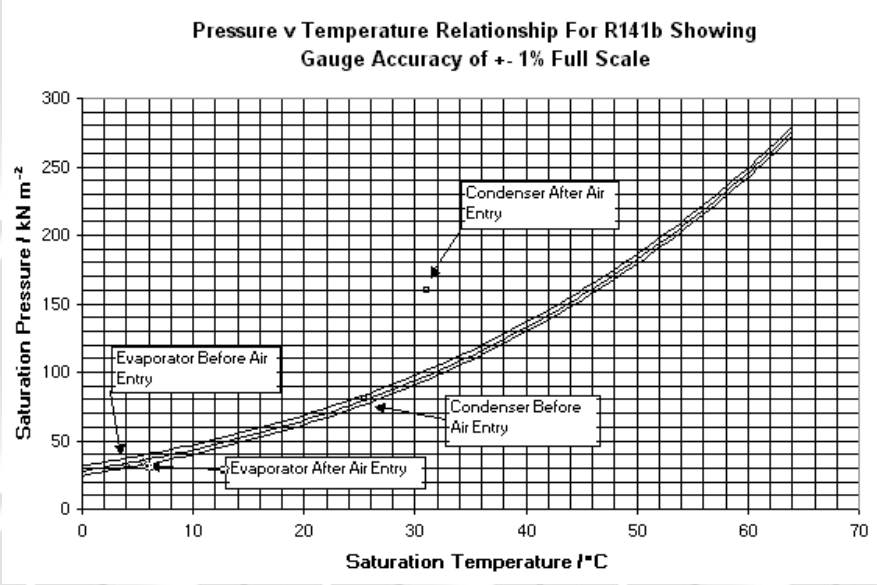


Figure 3: Data showing the effect of air in refrigeration systems



Specification

General

Refrigeration Cycle Demonstration Unit with low-pressure non-toxic refrigerant and water cooled cylindrical glass evaporator and condenser.

Detailed

A bench mounted vapour compression refrigeration cycle demonstration unit using a hermetic compressor and water cooled flooded glass condenser and evaporator. Unit operates on low-pressure non-toxic ozone friendly refrigerant.

Internal electrical and mechanical safety devices allow for unsupervised operation by students.

Standard instrumentation fitted enables measurement of the condenser and evaporator pressures and temperatures as well as water flow rates and water temperatures.

Unit supplied with a detailed experimental operating and maintenance manual giving example experimental results and sample calculations.

Equipment supplied with spares and accessories for two years normal operation together with a full two-year warranty.

Further specification details available on request

An *optional digital temperature indicator upgrade* allows measurement of all system temperatures to 0.1°C with the addition of compressor discharge and condensed liquid temperatures so enabling a cycle diagram to be drawn on a Pressure-Enthalpy chart.

Services required

Electrical: A: 220/240 Volts Single Phase 50Hz (with earth/ground). Line current up to 4.5 A at 230v.

B: 110/120 Volts Single Phase 60Hz (with earth/ground). Line current up to 9.0 A at 115v

Water: 6 litre/minute at a minimum of 28m head.

Ordering Information

Order as: Refrigeration Cycle Demonstration Unit. R633

And: Optional Digital Temperature Indicator Upgrade. R633A

And: Optional Digital Wattmeter Upgrade. R633B

Electrical Specification

Either:

A: 220/240V Volts Single Phase 50Hz (with earth/ground**)**

B: 110/120 Volts Single Phase 60Hz (with earth/ground)

Shipping Specifications

Net Weight: 64kg.(220/240v)
71kg(110/120v)

Approximate Gross Weight:
100kg. (220/240v)
107kg. (110/120v)

Packing Case Dimensions:
0.92 x 0.65 x 1.05m

Packing Case Volume:
0.63m^3

Accessories and Spares

Unit supplied with:

One experimental operating and maintenance manual in English, French, or Spanish (Other languages on request). Accessories and spares for 2 years normal operation.

Also available: Recommended list of spares for 5 years normal operation**.**

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