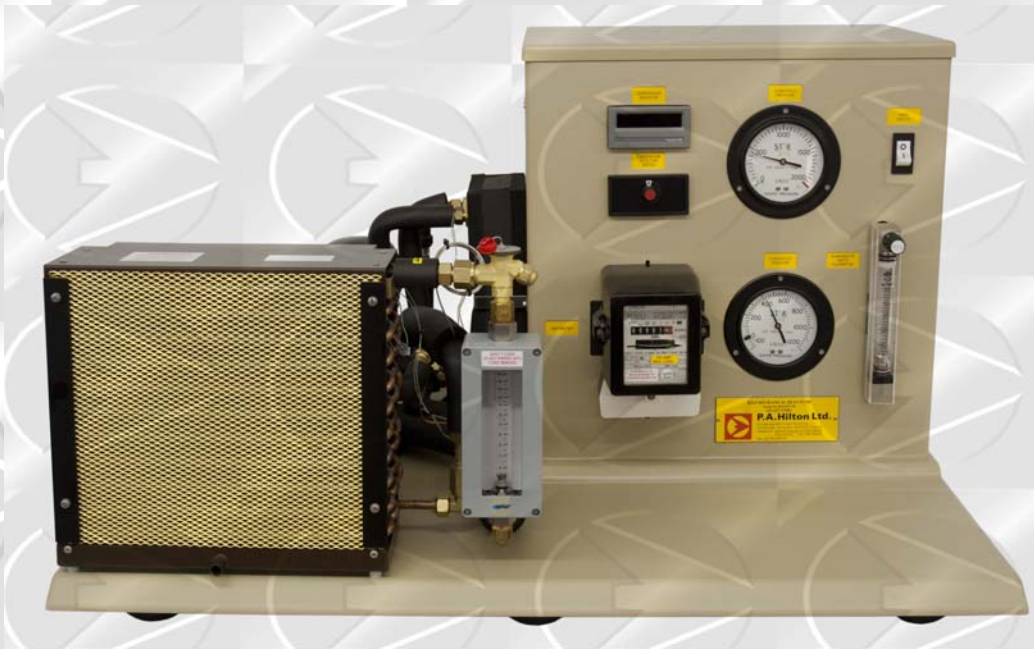




Mechanical Heat Pump R514



- ***Stabilises in minutes allowing many tests to be conducted in a typical laboratory period.***
- ***Allows a complete refrigerant pressure-enthalpy cycle diagram to be drawn at all operating conditions.***
- ***Operates on CFC free R134a refrigerant.***
- ***Allows a complete energy balance to be performed between electrical input and thermal input/output.***
- ***Allows generation of heat pump performance curves over range of conditions.***
- ***Optional Data Acquisition Upgrade.***
- ***Two year warranty***



Introduction

The R514 Hilton Mechanical Heat Pump has been designed to provide students with a practical and quantitative demonstration of the vapour compression cycle, and is suitable for all course levels, from vocational to undergraduate.

Both refrigerators and heat pumps use the vapour compression cycle, and although the applications of these machines differ the components are essentially the same.

The unit described here demonstrates the heat pump application where a large freely available energy source, such as atmosphere, is to be upgraded for water heating.

As a bench top unit designed for student use, the unit will be of particular interest to those studying:

- **Mechanical Engineering**
- **Agricultural Engineering**
- **Energy Conservation**
- **Thermodynamics**
- **Building Services**
- **Chemical Engineering**
- **Marine Engineering**
- **Plant & Process Engineering**
- **Refrigeration and Air Conditioning**
- **Food Technology**
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Experimental Capabilities

- Determination of power input, heat output and coefficient of performance.
- Production of heat pump performance curves over a range of source and delivery temperatures.
- Plotting the vapour compression cycle on a p-h diagram and comparing this with the ideal cycle.
- Determination of energy balances for condenser and compressor.
- Production of heat pump performance curves based on R134a properties, at a variety of evaporating and condensing temperatures.
- Estimation of the effects of compressor pressure ratio on volumetric efficiency.

Description

The components of the heat pump and its instrumentation are mounted on a gloss finish glass reinforced plastic panel.

The heat pump consists of a hermetic compressor, an insulated coiled concentric tube water cooled

condenser, a liquid receiver, a thermostatically controlled expansion valve and air heated evaporator.

The components are clearly but compactly arranged in a manner similar to that used for many domestic air-water heat pumps and all are visible from the front of the unit.

The operating cycle is as follows:

Slightly superheated Refrigerant R134a vapour enters the compressor from the evaporator and its pressure is increased. This brings about a rise in temperature and the hot vapour enters the water cooled condenser. Heat is given up to the cooling water and the refrigerant condenses to a liquid before passing to the liquid receiver and then the expansion valve.

On passing through the expansion valve the pressure of the liquid refrigerant is reduced, causing the saturation temperature to fall to below that of the atmosphere. Thus, as it flows through the evaporator, there is a temperature difference between the refrigerant and the air being drawn across the coils. The resulting heat transfer causes the refrigerant to boil, and on leaving the evaporator it has become slightly superheated vapour, ready to return to the compressor. The degree of superheat is automatically controlled by the expansion valve, which may be adjusted.

The temperature at which heat is delivered in the condenser is controlled by the water flow rate and its inlet temperature. Water may be delivered at up to 50°C.

The evaporating temperature is largely determined by the ambient conditions of temperature and humidity. However, a limited variation is possible, either by restricting the air intake to the evaporator, or by directing warmed air towards the intake. (The air inlet temperature should not be allowed to exceed 35°C to avoid overloading the compressor.)

Variable area flowmeters on both the refrigerant and cooling water circuits, an electrical energy meter recording power input to the compressor and a digital electronic thermometer recording all relevant temperatures, allow an interesting and comprehensive range of experiments to be conducted.

Optional Data Acquisition Upgrade

An optional Computerised Data Acquisition Upgrade RC514A is available to enable all relevant system parameters to be automatically recorded on a PC for further analysis and display. Data may also



be transferred to spreadsheet format for complex analysis and calculation.

Specification

General

A fully instrumented bench top air to water heat pump operating on the mechanical vapour compression cycle with refrigerant R134a as the working fluid.

Detailed

Panel: High quality glass reinforced plastic on which the following components are mounted.

Refrigerant: R134a (HFC134a)

Compressor: Fully hermetic single cylinder reciprocating type. Displacement $8.85 \text{ cm}^3 \text{ rev}^{-1}$

Condenser: Refrigerant to water. Insulated coiled concentric copper tube type.

Liquid Receiver: With valves. Contains entire refrigerant charge if required.

Evaporator: Air to refrigerant. Serpentine copper tube with aluminium fins and with integral fan.

Digital Thermometer: Resolution 0.1°C , with switch to select from six thermocouples.

Flow Meters (2): Variable area type – to indicate R134a and H_2O flow rates.

Pressure Gauges (2): To indicate R134a pressures in evaporator and condenser.

Electrical Energy Meter: Watt-hour type recording electrical input to the compressor.

Safety Features: Condenser high pressure switch and compressor thermal overload switch. Residual current circuit breaker and a combined double pole main switch and overload cut out. All electrical components connected to common earth conductor.

Dimensions

Height: 46cm Depth: 65cm
Width: 95cm Weight: 65kg.

Optional Data Acquisition Upgrade

An optional Data Acquisition Upgrade RC514A comprising of an electronic data logger, menu driven software and all necessary transducers, allows all relevant parameters to be simultaneously displayed and recorded on a suitable PC. The software allows review and printing of data and transfer to spreadsheets for complex analysis and calculation.

Accessories and Spares

Unit supplied with:

One experimental operating and maintenance manual in English, Spanish, French.

Accessories and spares for 2 years normal operation. List available on request.

Services Required

Electrical: A:

Either: 600W 220-240 Volts, Single Phase 50 Hz (with earth /ground).
Line current up to 3.0A at 230v.

Or:

B: 600W 110-120 Volts, Single phase, 60Hz (with earth /ground).
Line current up to 6.0A at 110V.

Water: Cold water, continuous supply.

180 litres/Hour at 15 m head minimum.

Ordering Information

Order as: R514 Mechanical Heat Pump Unit

Optional: RC514A Data Acquisition Upgrade

Electrical Specification

Either: **A:** 220-240 Volts, Single Phase 50Hz(With earth/ground).

B: 110-120 Volts, Single Phase 60Hz(With earth/ground).

Language

Either: English, Spanish, French.

Shipping Specifications

Net Weight: 65kg. (approx.)

Gross Weight: 95 kg. (approx.)

Packing Case Dimensions:

112 x 82 x 76 cm (approx.)

Packing Case Volume:

0.69m³ (approx.)

Also Available On Request

Further detailed specification.

Additional copies of instruction manual.

Recommended list of spares for 5 years operation.



Optional Data Acquisition Upgrade RC514A

Hardware details

The optional Data Acquisition Upgrade RC514A consists of an externally located 35 channel Hilton Data logger D102, together with dedicated software that will operate in the Windows™ environment.

The combined software and hardware package allows computer monitoring of all six relevant system temperatures, condenser and evaporator pressures, refrigerant flow rate, condenser cooling water flow rate and compressor electrical input power.

A duplex set of thermocouples provide the system temperatures. Pressure transducers and the water flow transducer connect to factory fitted internal couplings. The refrigerant flow transducer is a variable area type that may be fitted at any time with a signal transmitter.

The original totalising watt-hour meter is replaced by a direct reading wattmeter with digital display and signal re-transmission.

The additional transducers allow the unit to be operated either with the computer or in the standard manual mode.

As all transducer coupling points are factory fitted the Data Acquisition Upgrade RC514A may be purchased and installed at any time.

Software Details

The pre-configured menu driven Software supplied with the Data Acquisition Upgrade RC514A allows all recommended experiments detailed in the Mechanical Heat Pump R514 manual to be carried out with the aid of computerised data acquisition and on screen data presentation.

This enhances student interest and speeds comprehension of the principles being demonstrated.

Students may be presented with numeric data or graphic data plotted against time.

Data may be printed, stored on disc for later analysis and transferred in ASCII form to most spreadsheets for further analysis and projects.

Additional Data Logging Facility Supplied As Standard

The Hilton Data Logger D102 is an industrially proven 35 channel interface with 15 thermocouple/differential voltage inputs ($\pm 80\text{mV}$ dc), 8 single ended dc voltage inputs ($\pm 8\text{V}$), 8 logic or frequency inputs, 3 ac current inputs one mains voltage input and 8 current sinking output channels. In addition there are on board 12v dc, $\pm 5\text{V}$ dc and $\pm 15\text{V}$ dc power supplies for most commercially available transducers.

The pre-configured Hilton Data Logging software, supplied as standard with the RC514A package, allows the D102 to be disconnected from the R514 transducers and used together with most standard transducers as a stand alone computer data logger and controller for the monitoring and control of existing laboratory equipment.

This further expands the student project capabilities of the RC514A package from teaching and demonstration into the field of research and postgraduate study.

Computer Hardware Requirements

The menu driven Software supplied with the Data Acquisition Upgrade RC514A will operate on an IBM or IBM compatible PC having at least 32 Mb ram, VGA graphics, 1Gb hard drive and an available RS232 serial port. The software is Windows 95/98 compatible.

Order as:

Data Acquisition Upgrade RC514A

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