



Air Conditioning Laboratory Unit A660

Figure 1: A660 Base Unit



- May be upgraded at any time to reduce capital outlay.***
- High accuracy wet and dry bulb sensors before and after each process to determine air condition.***
- All processes fully instrumented to allow energy and mass balances across each process of heating cooling and humidity change.***
- Reaches stability rapidly after change of operating conditions.***
- Upgrade options available include: Digital Temperature, Re-circulation, Computer linking (with software), PID control and environmental chamber.***
- Two year Warranty.***

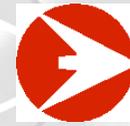
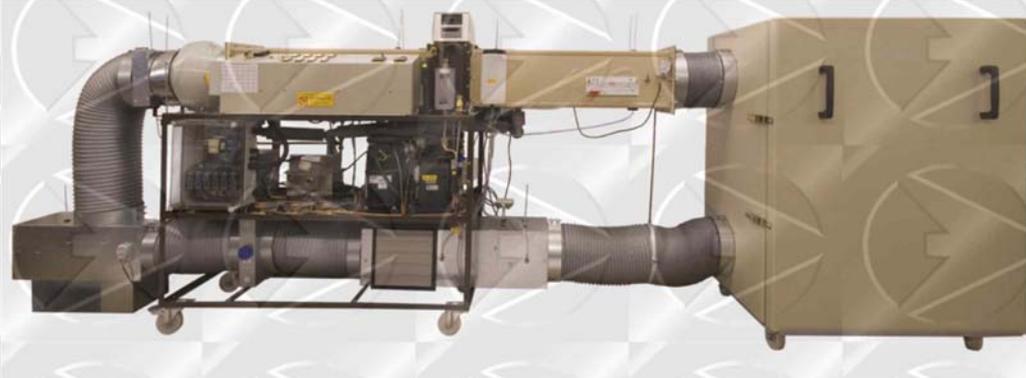


Figure 2: A660 With All Upgrade Options



Introduction

The range of temperature, humidity and air movement which the majority of individuals regard as comfortable is extremely narrow. It is therefore increasingly common for close controlled air conditioning to be applied to new and refurbished buildings and transport facilities.

This increasing use of air conditioning, if not carefully designed, installed and maintained could be a major contributor to the causes of global warming.

Therefore student engineers training for careers involved in the design, operation or servicing of air conditioning plant must be completely familiar with the processes occurring between air inlet and its discharge to the conditioned space.

The new Hilton Air Conditioning Laboratory Unit A660 is an expandable teaching and experimental unit that enables students to investigate the basic air conditioning processes of heating, cooling, humidification, de-humidification and air movement that are of fundamental importance to undergraduate engineers.

The addition of optional upgrades, which may be added at any stage in the units extensive life, allow students to investigate air re-circulation and mixing, computer monitoring, dynamic humidity and temperature control and the environmental control of a test chamber.

The unit is applicable for the teaching of students in:

- Refrigeration and air conditioning
- Building services
- Mechanical Engineering
- Marine engineering
- Plant and process engineering
- Food processing
- Chemical engineering
- Mining engineering
- Control engineering

Experimental Capabilities

Air conditioning laboratory Unit A660

- Demonstration of the processes and components used in heating, cooling, humidification, de-humidification of an airstream.
- Measurement of air psychrometric condition before and after humidification, heating, de-humidification / cooling using pairs of precision wet and dry bulb sensors.
- Determination of a heat and mass balance across each process resulting in heating, cooling and humidity change using the instrumentation fitted.
- Construction of a complete refrigeration cycle diagram for the air-cooling plant plus an energy balance between the refrigeration circuit and the change in air enthalpy and its mass flow across the evaporator.
- Investigation of the volumetric efficiency of the refrigeration compressor under varying load.
- Determination of the specific heat capacity of air, by measurement of the change in psychrometric condition across a heating or cooling process.

Digital Temperature Upgrade A660A Allows all of the above experiments with all temperatures displayed on a single switched digital temperature indicator to 0.1°C resolution.



Computer Linked Upgrade AC660A (Must be preceded by A660A)

- Data logger with 35 input channels, 8 output channels and on board power supplies ($\pm 5v$, $\pm 15v$, $+12v$) for transducers.
- All necessary transducers to record all relevant parameters including refrigerant pressures and flow rate, duct air pressures, compressor voltage and current, fan voltage all system temperatures and active system heaters.
- Windows™ compatible software for real time computerised data acquisition including: Display of data in numeric, bar chart or graphical format, storage of data on disc, on screen calibration of each channel, interrogation of each channel, review of collected data in numeric, bar chart or graphical format and conversion of data to spreadsheet format for advanced calculation procedures.
- Upgraded units retain manual instruments and are therefore not PC dependant.

Recirculating Duct Upgrade A661B

- Investigation of the effects of air recirculation proportion on the energy requirement of the air conditioning process.
- Investigation of the enthalpy of mixing of two airstreams.

PID Control Upgrade A660C (Must be preceded by A661B)

- Investigation of proportional, integral and derivative (PID) control of humidity and temperature in the Recirculated air.
- Investigation of computer control of two PID controllers and the system response time.

Environmental Chamber Upgrade A660D (Must be preceded by A661B)

- Investigation of humidity and temperature in an enclosed test chamber.
- Investigation of the effect of temperature and humidity on materials and substances.

Description

A complete, upgradeable, instrumented air conditioning laboratory unit mounted on a steel frame and castor wheels. Upgrades may be added at any stage in the unit's long life to spread the investment costs.

The base unit comprises a variable speed radial acting axial flow fan discharging into a 250mm square duct with steam humidifier, electrical pre-heaters, direct expansion cooling coil/de-humidifier, electrical re-heaters and orifice plate for airflow measurement. Air-cooling is provided by vapour compression refrigeration system with pressure, temperature and refrigerant flow measurement. This allows the construction of a full cycle diagram and the balancing of refrigerant system energy balance against the airside energy transfer.

Air condition is recorded before and after each process using precision wet and dry bulb thermometers.

Instrumentation allows the electrical power to each resistive load to be measured and balanced against the air enthalpy change and mass flow.

Addition of the Digital Temperature Upgrade A660A gives all system temperatures on a single switched digital temperature indicator to 0.1° C resolutions.

Addition of the Computer Linked Upgrade AC660A (Must be preceded by A660A) allows computerised data acquisition of all relevant system parameters in real time. Data may be recorded to disc and displayed in numeric, bar chart or graphical format. Similar displays may be used for review of stored data. Data is also converted to spreadsheet format for later or advanced analysis and project work.

Software also allows individual calibration of each channel and interrogation of each channel for student investigation.

Addition of the Recirculating Duct Upgrade A661B allows the proportion of recirculated air to be varied and its effect upon the energy requirements for air conditioning to be investigated. Additional psychrometric measuring points supplied allow the enthalpy of two-mixed streams to be investigated.

Addition of the PID Control Upgrade A660C (Must be preceded by A660B) allows investigation of the individual and combined effects of Proportional, Integral and Derivative control of temperature and humidity and the components that are required for the process. Additional software allows the process to be computer controlled and monitored as in a Building Energy Management System.

Addition of the Environmental Chamber Upgrade A660D (Must be preceded by A660B) adds considerable realism to the air conditioning process by providing a significant volume that may be heated cooled and humidified either under manual control or by PID control with the addition of the A660C upgrade.

Specification

An upgradeable fully instrumented air conditioning laboratory unit incorporating steam humidification, direct expansion refrigeration cooling and de-



humidification, reheating, variable speed radial acting axial flow fan and airflow measurement. All parts in corrosion proof plastic, stainless steel, galvanised steel, brass or copper.
Full two-year warranty.

Psychrometric condition measured before and after each process by high precision wet and dry bulb sensors with 0 to 100% RH measurement capability. Airflow is adjustable to at least 0.14m³/s with switchable heating up to 4kW and switchable steam injection up to 5kW electrical equivalent. Cooling is by a fully instrumented vapour compression cycle with nominally 2kW capacity.

Available upgrade paths include:

Digital temperature measurement.
Computerised data acquisition via RS232 port with Windows™ compatible software allowing display and review of data in numeric, bar chart and graphical format with conversion to spreadsheet format for advanced calculation and display.
Recirculation duct to allow variation of proportion of mixing with additional psychrometric measuring points.
Digital proportional, integral derivative control of return duct humidity and temperature conditions.
Environmental chamber 1m³.

Dimensions

Height 126cm **Depth** 53cm
Width 237cm **Weight:** 165kg
(Width 363cm with addition of A660B Recirculating duct)
(Weight 224 kg with addition of A660B Recirculating duct)

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: 380/415v 3 phase, 50Hz 5 wire system comprising 3 phase, neutral and earth. Line current up to 20A per phase.

B: 208/220v 3 phase, 50 or 60Hz. 4 wire system comprising 3 phases and earth. Line current up to 32 Amps per phase.

Clean water:

Up to 10 litres per hour at a minimum 2m head.
May be mains or tank source.

Ordering Information

Order as:

A660 Air Conditioning Laboratory Unit

Optional:

Digital Temperature Upgrade	A660A
Recirculating Duct Upgrade	A661B
PID Control Upgrade	A660C
Environmental Chamber Upgrade	A660D
Computer Linked Upgrade	AC660A

Electrical specification

Either:

A: 380/415v 3 phase, 50Hz 3 phase, neutral and earth.

Or

B: 208/220v 3 phase, 50 or 60Hz. 3 phase and earth.

Language

Either: English Spanish French

Shipping Specifications

Net Weight (A660) (approx)	165kg
Net Weight (A660B) (approx)	59kg
Gross Weight (A660) (approx)	226kg
Gross Weight (A660B) (approx)	148kg
Packing Case Dimensions (A660):	
165 x 65 x 146 cm (approx)	
Packing Case Dimensions (A660B):	
203 x 107 x 77 cm (approx)	
Packing Case Volume (A660) (approx) 1.57m ³	
Packing Case Volume (A660B) (approx) 1.67m ³	

Also Available On Request

- Further detailed specification.
- Additional copies of instruction manual.
- Recommended list of spares for 5 years operation.

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