Air Conditioning Laboratory Unit A660

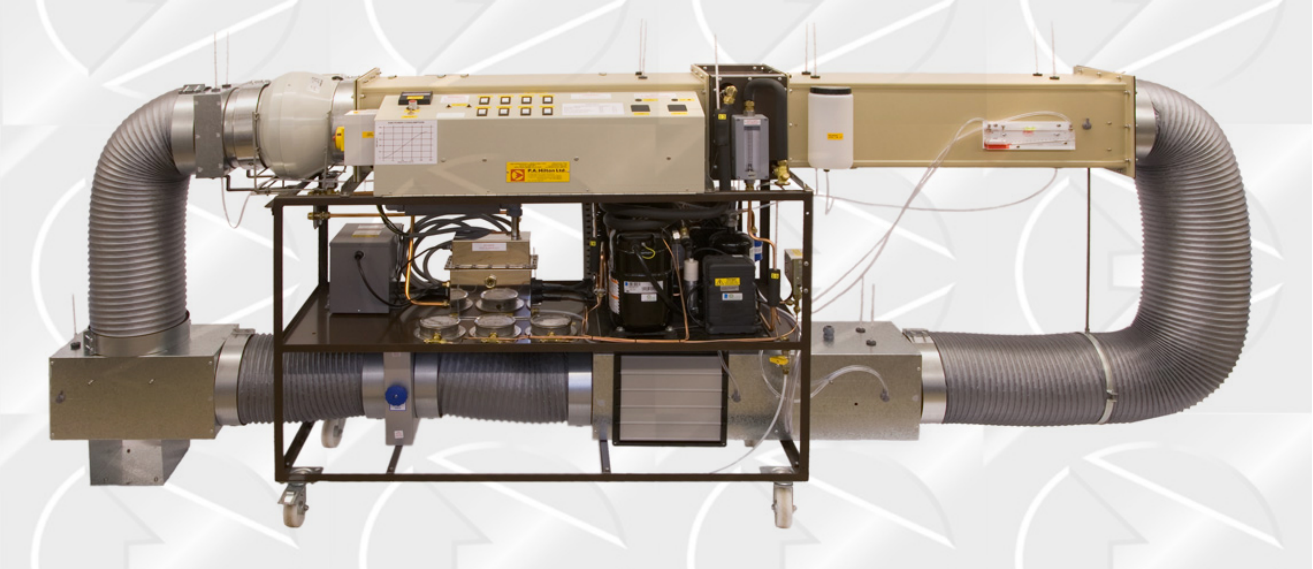

Figure 1: A660 Base Unit shown with optional extra A661B fitted

- ***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 a change of operating conditions.***
- ***May be upgraded at any time to reduce capital outlay.***
- ***Upgrade options available include:***
  1. ***Digital Temperature,***
  2. ***Re-circulation,***
  3. ***Computer linking (with software),***
  4. ***PID control and Environmental Chamber.***
- ***Two year Warranty.***

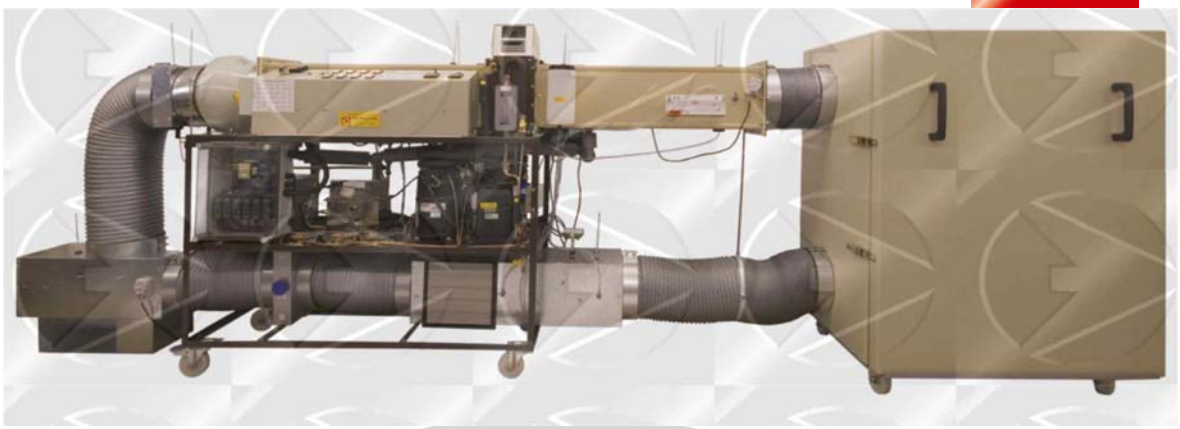

Figure 2: A660 with All Upgrade Options

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 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 volumetirc 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.

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.

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.
- 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.

Optional upgrade paths include:

Digital Temperature Upgrade	**A661A**
Recirculating Duct Upgrade	**A661B**
PID Control Upgrade	**A660C**
Environmental Chamber Upgrade	**A660D**
Computer Linked Upgrade	**AC661A**

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

Accessories and spares for two years normal operation together with a full two-year warranty.

Dimensions

Height 126cm **Depth** 53cm
Width 237cm **Weight:** 165kg
Width 363cm with addition of A661B Recirculating duct
Weight 224 kg with addition of A661B Recirculating duct

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
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 or French

Shipping Specifications

A660 Base unit only without optional upgrades:

Net Weight (approx.)	165 kg
Gross Weight (approx.)	226 kg
Packing Case Volume (approx.)	1.57 m3
Packing Case Dimensions (approx.):	165 x 65 x 146 cm

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.

Also Available On Request

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

Optional Extra A661A
Digital Temperature Upgrade

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

Ordering Information
Order as: Digital Temperature Upgrade A661A

Optional Extra A661B
Recirculating Duct Upgrade

Specification
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.

Experimental Capabilities
- 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.

Ordering Information
Order as: Recirculating Duct Upgrade A661B

Shipping Specification
A661B option only:

Net Weight (approx.)	59 kg
Gross Weight (approx.)	148 kg
Packing Case Volume (approx.)	1.67 m^3
Packing Case Dimensions (approx.)	203 x 107 x 77 cm

Optional Extra A660C
PID Control Upgrade

Note: the A660C must be preceded by the A661B.

Specification
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.

Experimental Capabilities
- 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.

Ordering Information
Order as: PID Control Upgrade A660C

Optional Extra A660D
Environmental Chamber Upgrade

Note: the A660D must be preceded by the A661B.

Specification
A $1m^3$ environmental chamber which 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.

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

Ordering Information
Order as: Environmental Chamber Upgrade A660D

Optional Extra AC661A
Data Acquisition Upgrade

Note: The AC661A must be preceded by the A661A.

Hardware details
The Optional Computerised Data Acquisition Upgrade AC661A consists of a 21 channel Hilton Data logger (D103), together with pre-configured, ready to use, Windows ™ compatible educational software.

Factory fitted coupling points on the A660 allow installation of the upgrade to the unit at any time in the machine's extensive life.

The Hilton Data logger (D103) connects, using the cable supplied, to a standard USB port on the user-supplied PC. If more than one logger is required connection is via a second USB port or standard USB hub.

The combined educational software and hardware package allows immediate computer monitoring and display of all relevant parameters on the A660.

Software Details
The pre-configured menu driven Software supplied with the Computer Upgrade AC661A allows all recommended experiments involving the electronic transducers and instruments on the A660 to be carried out with the aid of computerised data acquisition, data storage and on-screen data presentation. This enhances student interest and speeds comprehension of the principles being demonstrated.

Students are presented with either raw data for later hand calculation or alternatively data may be transferred to most spreadsheets for computerised calculation and graphical presentation.

Data may be stored on disc and displayed at any time using the software supplied. Alternatively data may be transferred to any compatible spreadsheet together with individual time and date stamp on each reading for complex analysis.

Additional Data Logging Facility Supplied As Standard
The D103 is the third generation of Hilton Data Logger. It comprises an industrially proven 21 channel interface with 8 thermocouples (type T and K as standard) / differential voltage inputs (±100mv DC), 8 single ended DC voltage inputs (±8v), 4 logic or frequency inputs and one mains voltage input. In addition there are on board 12v DC, ±5V DC and ±15v DC power supplies for most commercially available transducers.

The Hilton Data Logging software supplied as standard with the AC661A package allows the D103 to be disconnected from the A660 and used together with most standard transducers as a stand-alone computer data logger for the instrumentation and monitoring of existing laboratory equipment using locally sourced industrial transducers. The software is also backwards compatible with our many second generation D102 data loggers that are already in use worldwide.

Full data logger command protocol and communications details are provided in an extensive user manual that allows other software applications to communicate with the logger via the USB interface. Users can write their own software, typically in LabView, Matlab, C, C++, Visual Basic etc. This further expands the student project capabilities of the AC661A package from teaching and demonstration into the field of research and postgraduate study.

New for 2013*: *p-h software also available. Contact a sales representative for more details

Computer Hardware Requirements
The menu driven Software supplied with the Computer Upgrade AC661A will operate on a PC which has at least 0.5Gb Mb ram, VGA graphics, 1Gb hard drive, CD drive and an available USB port. The software is Windows 2000, XP and 7 compatible.

Ordering Information
Order as: Data Acquisition Upgrade AC661A

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