



## ***Concentric Tube Heat Exchanger H952***



- ***Plot classic 4 point temperature profiles through the heat exchanger in Concurrent and Counter-Current flow.***
- ***Stabilises in minutes and allows rapid data collection.***
- ***Investigate Logarithmic Mean Temperature difference, Overall Heat Transfer Coefficient and the Nusselt, Reynolds, Prandtl Relationship.***
- ***Optional Computerised Data Acquisition Upgrade.***
- ***Two year warranty.***



## ***Introduction***

The Hilton H952 Concentric Tube Heat Exchanger allows rapid measurement of surface and overall heat transfer coefficients in turbulent flow conditions.

The unit is bench mounted and self-contained. It enables detailed temperature profiles, overall heat transfer coefficients and the important relationship between Nusselt, Reynolds and Prandtl Numbers to be established.

The Hilton H952 Concentric Tube Heat Exchanger will provide interesting and instructive experimental work for all students studying heat transfer, and will be of particular interest to those studying:

- **Thermodynamics**
- **Heat Transfer**
- **Chemical Engineering**
- **Mechanical Engineering**
- **Building Services**
- **Marine Engineering**
- **Plant and Process Engineering**
- **Refrigeration**
- **Food Processing/Technology**
- **Air Conditioning**

## ***Experimental Capabilities***

- Determination of heat transfer rate, logarithmic mean temperature difference, overall heat transfer coefficient and 4 point hot and cold stream temperature profiles.
- Determination of surface heat transfer coefficient inside and outside the tube, and of the effect of fluid velocity.
- Comparison of performance in concurrent and in counter-current flow.
- Investigation of the relationship between Nusselt (Nu), Reynolds (Re) and Prandtl (Pr) Numbers for Reynolds Numbers up to 65000 and for Prandtl Numbers between 2.5 and 5.0.
- Determination of the constants in  $Nu = k Re^a Pr^b$ .

## ***Description***

### ***Heat Exchanger***

This is a classic concentric tube type with hot water flowing through the central tube while cooling water flows through the annular space. The heat exchanger has been divided into three

equal sections in order to allow examination of the intermediate stream temperature conditions and temperature distribution through the heat exchanger.

Thermocouples sense the hot and cold stream temperatures at the four stations and the wall temperatures on entry and exit.

### ***Hot Water Circuit***

Hot water provided by an electrical heater, is fed by a pump into the upper end of the central tube of the heat exchanger. The water cools as it flows through the heat exchanger, and on leaving passes through a flow meter and then back to the heating tank, where it is reheated.

### ***Cold Water Circuit***

Mains cold water passes through a combined flow control valve and flowmeter to a separate pair of valves mounted on the front panel. These valves direct the cold water to either end of the heat exchanger and allow instantaneous flow reversal from concurrent to counter-current flow.

### ***Instrumentation and Control***

Valves are provided to control the flow rate of the hot and cold streams of water.

A digital PID controller regulates the power input to the water heater and allows control of the water temperature. A thermostat, sensing the temperature in the heating tank limits the water temperature to approximately 90°C for operator safety.

A digital thermometer with a selector switch, displays the temperature sensed by the water and pipe temperature thermocouples.

Independent variable area water flowmeters with control valves, allow the measurement of the hot and cold streams at all flow conditions.

### ***Optional Data Acquisition Upgrade.***

An optional computerised data acquisition upgrade HC952A 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. This upgrade can be factory fitted prior to delivery or supplied later as a user installed upgrade.



## Operation

Due to the low thermal inertia of the system, experimental work can be commenced within a few minutes of switching on.

Concurrent or counter-current flow may be established and investigated in detail or reversed instantaneously for immediate and graphic comparison of performance.

Temperature profiles of the hot water and cold water streams through the heat exchanger may be plotted over a range of velocities, temperatures and in either flow direction.

For the more advanced students, a series of tests may be made at constant mean hot water temperature (giving a constant Pr), to establish the relationship between Nu and Re. This may then be followed by another series of tests at a constant Re to establish the relationship between Nu and Pr. The standard expression connecting Nu, Re and Pr may then be deduced.

## Specification

### General

Concentric tube heat exchanger for concurrent or counter-current flow under turbulent flow conditions. With all ancillary equipment and instrumentation for the determination of temperature profiles, surface and overall heat transfer coefficients during turbulent concurrent and counter-current flow.

### Detailed

**Panel:** High quality glass reinforced plastic having an attractive appearance on which the following are mounted.

**Heat Exchanger:** Concentric tube type with inlet, outlet and two intermediate measuring points plus pipe temperature. Area  $0.0288\text{m}^2$ .

**Water Heater:** 3kW with electronic control.

**Pump:** Continuous rated to circulate hot water.

**Flow Meters (1+1):** For hot and cold water.

**Digital Thermometer:**  $0.1^\circ\text{C}$  resolution, with multi-way selector switch.

**Cold water flow reversal valves(2):** To establish concurrent and counter-current flow.

## Dimensions

Height: 920mm Depth: 430mm  
Width: 1060mm Weight: 60kg.

## Optional Data Acquisition Upgrade

An optional Computerised Data Acquisition Upgrade RC952A 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 allow 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 or French.

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

## Services Required

**Electrical: A:** 3.2kW 220-240 Volts, Single Phase  
50Hz(With earth/ground).  
Line current up to 14A at 230v.

Or: **B:** 3.2kW 110-120 Volts, Single  
Phase  
60Hz(With earth/ground).  
Line current up to 28A at 110v.

**Cold Water:** Continuous supply,  
180 litres per hour at 20m head.

## Ordering Information

**Order as:** H952 Concentric Tube Heat Exchanger

**Optional:** HC952A 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 or French.

## Shipping Specifications

**Net Weight:** 60kg. (approx).

**Gross Weight:** 105kg. (approx).

**Packing Case Dimensions:**  
122 x 60 x 120 cm (approx).

**Packing Case Volume:**  
 $0.878\text{m}^3$  (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 HC952A

### *Hardware details*

The optional Data Acquisition Upgrade HC952A consists of an internally 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 ten relevant system temperatures, the hot water flow rate and the cooling water flow rate.

A duplex set of thermocouples allow data logging of all ten system temperatures. The hot water and cold water flow transducers connect to easily accessed, factory fitted internal locations.

The addition of the transducers and data logger 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 HC952A may be purchased and installed at any time.

### **Software Details**

The pre-configured menu driven Software supplied with the Data Acquisition Upgrade HC952A allows all recommended experiments detailed in the Concentric Tube Heat Exchanger H952 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 HC952A package, allows the D102 to be disconnected from the H952 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 HC952A 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 HC952A 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, 2000 and XP compatible.

### **Order as:**

Data Acquisition Upgrade HC952A

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