



Bench Top Cooling Tower H893



Figure 1: H893 Shown with Column B (fitted) and Optional Column E

- ***Demonstrates all processes found in a full scale forced draught cooling tower***
- ***Rapid stabilisation allows experimental work to commence immediately upon switching on***
- ***Columns with varying packing densities available as optional extras. Optional Packing Characteristics Column also available***
- ***Can be linked to External Loads of up to 1.5 kW including the R515 Mechanical Heat Pump or R833 Air and Water Heat Pump via an intermediate reservoir system***
- ***Two year warranty***



Introduction

The Hilton Bench Top Cooling Tower has been designed to meet the demand for a compact cooling tower which clearly demonstrates all the processes found in a full size forced draught cooling tower and behaves in a representative manner.

Supplied with standard column B, a number of additional columns are available as optional extras to cope with a wide variety of educational needs in the study of Thermodynamics, Heat and Mass Transfer, Refrigeration and Air Conditioning.

The unit will be of particular interest to those studying:

- **Building Services**
- **Chemical Engineering**
- **Energy Transfer and Conservation**
- **Mechanical Engineering**
- **Mining Engineering**
- **Plant and Process Engineering**

Experimental Capabilities

Basic Unit with Column B

- Observation of water flow pattern and distribution.
- Measurement of all “end states”, and rates of flow of water, air and make-up.
- Plotting of end states on a psychrometric chart and the application of the steady flow equation to draw up energy balances.
- Investigation of performance at,
(a) A range of process cooling loads.
(b) A range of inlet temperatures.

ADDITIONAL COLUMNS (Optional)

Columns A and/or C

- Investigation of effect of the packing surface area/volume ratio on,
(a) Cooled water temperature approach to wet bulb temperature at inlet to column.
(b) Pressure drop across packing

Column D (Empty Column)

- Investigation of performance of locally designed and manufactured packing (student projects).

Column E (Packing Characteristics Column)

- Enables air and water properties to be measured at three stations within the packing.
- Provides data for the construction of enthalpy driving force diagrams.
- Determination of the Characteristics Equation for the packing.

Description

BASIC UNIT

Water Circuit

Warm water is pumped from the load tank through the control valve and water flow meter to the column cap where its temperature is measured. The water is uniformly distributed over the top packing deck and, as it spreads over the plates, a large thin film of water is exposed to the air stream. During its downward passage through the packing, the water is cooled, largely by the evaporation of a small portion of the total flow.

The cooled water falls from the lowest packing deck into the basin, from where it flows past a thermocouple and into the load tank where it is re-heated for re-circulation.



Due to evaporation, the level of the water in the load tank slowly falls. This causes the float operated needle valve to open and transfer water from the make-up tank into the load tank. Under steady conditions, the rate at which the water leaves the make-up tank is equal to the rate of evaporation, plus any small airborne droplets in the air discharge

Air Circuit

Air from the atmosphere, pre-heated by external means if desired, enters the fan at a rate, which is controlled by the intake damper setting. The fan discharges into the distribution chamber and the air passes wet and dry bulb thermocouples before it enters the packed column. As the air stream flows through the packings, its moisture content increases and the water is cooled. On leaving the top of the column the air passes through the droplet arrester, which traps most of the entrained droplets and returns them to the packings. The air is then discharged to the atmosphere via the air measuring orifice and further wet and dry bulb thermocouples. All of the foregoing may be observed through the transparent structure of the column.

All temperatures are indicated by a digital temperature indicator and thermocouple selector switch.

OPTIONAL ADDITIONAL COLUMNS

Columns A and C

Column B supplied with the basic unit may be quickly replaced by either column A or C. All columns have the same external dimensions, but contain different quantities of packing, so that the effect of packing area upon the performance of the cooling tower may be investigated.

Column D (Empty Column)

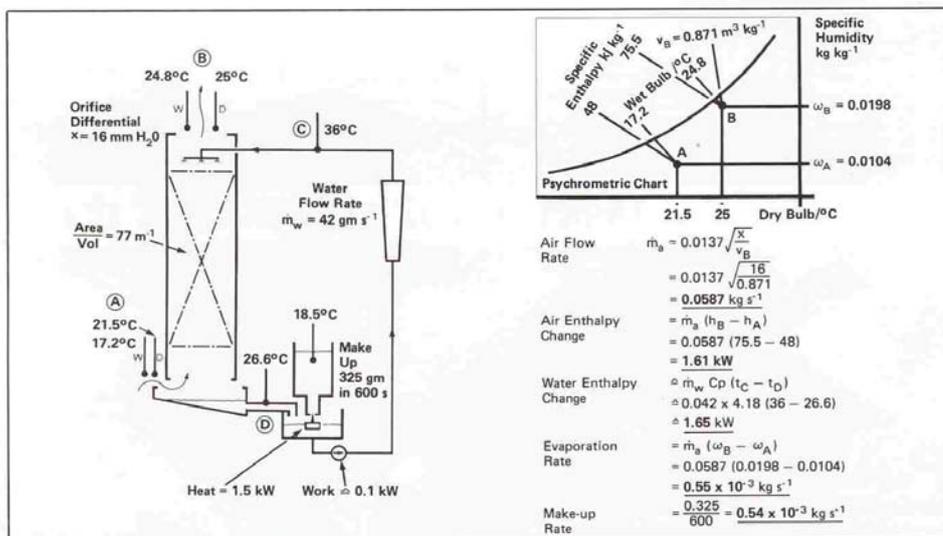
This column has no internal fittings or packing and is available so that students can make and investigate the performance of their own packing and water distribution system.

Column E (Packing Characteristics Column)

This is available for those who wish to investigate the way in which the air and water properties change as they pass in opposite directions through the column. From this information, enthalpy driving force diagrams may be constructed and the packing characteristics equation determined.

Column E is similar to column C, but is about 300mm higher. The packing is arranged in four blocks with intermediate spaces in which the water and air dry and wet bulb thermometers are measured by thermocouple sensors. These temperatures are displayed by digital indicator mounted on the side of the column.

TYPICAL OBSERVATIONS & RESULTING BALANCES – BASIC UNIT:





Specification

General

Bench top, forced draught cooling tower with integral load and make-up tanks, circulating pump, complete with all necessary instruments. Optional additional columns available.

Detailed

Basic unit: Constructed in Impact Resistant Plastic and housing load tank with 0.5 and 1.0 kW heaters and float level control, make-up tank, bronze circulating pump, air fan, electrical control panel with digital temperature indicator.

Packed Column 'B': Constructed in transparent P.V.C. with eight decks of inclined laminated plastic packing, water distribution troughs and pressure tapings. Packing density 110m² per m³.

Cap: Transparent P.V.C. fitted with 80mm dia. Sharp edged orifice, droplet arrester and water distributor.

Instrumentation:

Digital Temperature indicator with channel selector switch for all wet bulb, dry bulb and water temperatures. Variable area water flowmeter and manometer for airflow.

Additional Columns

Column A: As column B but with a packing density of 77m² per m³

Column C: As column B but with a packing density of 200m² per m³

Column D: Empty Column

Column E: (Packing Characteristics Column). Similar to column C but with packing arranged to allow measurement of air and water properties within column. Fitted with thermocouple sensors, selector switch and digital thermometer.

Dimensions

	Base Unit	Columns A, C & D	Column E
Height:	120cm	60cm	90cm
Depth:	45cm	15cm	15cm
Width:	75cm	15cm	25cm

Optional Data Acquisition Upgrade

An optional Data Acquisition Upgrade HC894A 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: 1.6 kW. 220-240 Volts, Single Phase 50Hz (With earth/ground).

Or: **B:** 1.6 kW. 110-120 Volts, Single Phase, 60Hz (With earth/ground).

Water: Demineralised or distilled
Approx. 2 kg / hour

Ordering Information

Order as: H893 Bench Top Cooling Tower

Optional Extra Columns:

H893A Column A

H893C Column C

H893D Column D

H893E Packing Characteristics Column

HC894A 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

(Basic Unit with Column B) (Estimated)

Net Weight: 56 kg. (approx.)

Gross Weight: 96 kg. (approx.)

Packing Case Dimensions: 112 x 82 x 73 cm (approx.)

Packing Case Volume: 0.670m³ (approx.)

Also Available On Request

Further detailed specification.

Additional copies of instruction manual.

Recommended list of spares for 5 years operation.

Suitable chiller details.



Optional Extra HC894A **Data Acquisition Upgrade**

Hardware details

The Optional Computerised Data Acquisition Upgrade HC894A 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 H893 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 H893.

Software Details

The pre-configured menu driven Software supplied with the Computer Upgrade HC894A allows all recommended experiments involving the electronic transducers and instruments on the H893 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 spread-sheets 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 spread-sheet 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 ($\pm 100\text{mv DC}$), 8 single ended DC voltage inputs ($\pm 8\text{v}$), 4 logic or frequency inputs and one mains voltage input. 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 Hilton Data Logging software supplied as standard with the HC894A package allows the D103 to be disconnected from the H893 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 HC894A package from teaching and demonstration into the field of research and postgraduate study.

Computer Hardware Requirements

The menu driven Software supplied with the Computer Upgrade HC894A 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.

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