P·A·Hilton Ltd

HEAT TRANSFER

A thorough understanding of the basic modes of Heat Transfer is a fundamental requirement for most courses in Science and Engineering. For over half a century P.A.Hilton Ltd has been recognised as the leading manufacturer of teaching equipment in this field. Our Heat Transfer range covers both fundamental principles as well as units for more advanced studies.

Our unique expertise has produced a range of equipment that enable students to visualise many of the physical processes involved in Heat Transfer while at the same time making accurate and meaningful experiments related to these processes.

Designed to teach all the fundamental principles of heat transfer and thermodynamics, our units are applicable to the broadest range of courses ensuring high utilisation and excellent value for money with negligible operating and maintenance costs.

Many of the ranges detailed within this brochure have a common instrumentation and service unit with a series of optional add-on modules available, designed for specific applications. These are continuing to be expanded and reference to our sales department is recommended for the latest additions. This modular approach gives maximum flexibility to educational establishments to align their laboratory equipment to curriculum requirements and budgets.

Data Acquisition Upgrades are available for the vast majority of units within the Heat Transfer range, allowing the key experimental parameters to be captured using the Universal Data Acquisition software.

CONDUCTION

CONVECTION

RADIATION

CONDENSATION

COOLING TOWER

CROSS FLOW

FLUIDISATION

FLOW BOILING

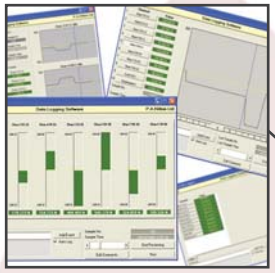
HUMIDITY

H102 Series

Heat Exchangers are a vital component in many industrial processes enabling heat to be transferred from one fluid to another. There are many specialized forms of heat exchanger but four of the most common types found in industry are **Concentric Tube, Shell and Tube, Plate** and **Jacketed Vessel**. The H102 series includes these and a continually expanding range of variants. Students need to be aware of the characteristics of these and other heat exchangers if they are to be involved in the design, operation or service of any heat transfer process.

H102A - Concentric Tube Heat Exchanger

H102B - Plate Heat Exchanger



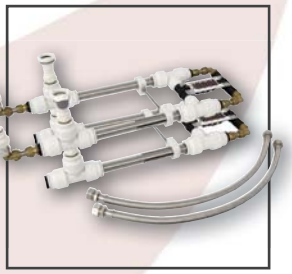
HC102A - Data Acquisition Upgrade

H102C - Shell & Tube Heat Exchanger

H102M - Water to Air Heat Transfer Module

H102D - Jacketed Vessel with Coil and Stirrer

H102K - Film and Dropwise Condensation



H102E - Extended Concentric Tube Heat Exchanger

H102 Heat Exchanger Service Unit*

A bench mounted panel with integral electrical console providing services for any of the optional heat exchangers in the range. Temperature controlled hot water is provided and the hot and cold flow is controlled and measured using variable area flowmeters. The optional heat exchangers are connected using non-drip, self sealing couplings. Standard instrumentation consists of up to 12 thermocouples, a digital panel meter, and two flowmeters. Optional data acquisition is available for attachment to this unit.

** H102 shown with optional H102C Shell & Tube Heat Exchanger Fitted*

H102J - Recycle Loops

H102F - Extended Plate Heat Exchanger

H102H - Coiled Concentric Tube Heat Exchanger

H102G -Water to Water Turbulent Flow Heat Exchanger

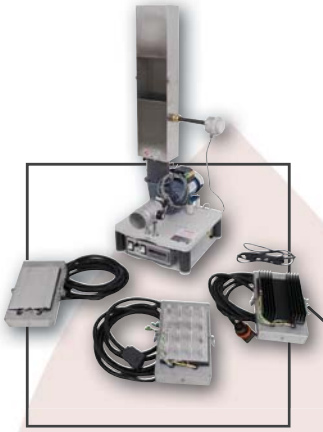
H112 Series

The Hilton Heat Transfer series comprises a control, instrumentation and power supply console (H112) into which are connected a wide variety of optional experimental and demonstrational modules. The range of optional modules include the three fundamental modes of heat transfer and a wide range of additional experiments in thermodynamics and thermodynamic properties of materials. Data Acquisition of the modules is also available. A number of the key optional modules are shown below.

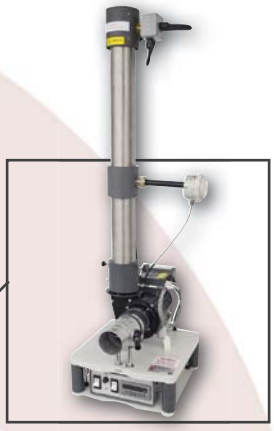
Other Modules available:
H112Q - Thermoelectric Heat Pump
H112R - Closed Cycle Hot Air Engine
H112S - Boiling Heat Transfer
HC112 - Data Acquisition Upgrade

H112A - Linear Heat Conduction

H112B - Radial Heat Conduction

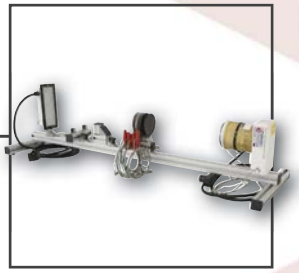


H112P - Free and Forced Convection from Flat, Pinned and Finned Plates



H112D - Combined Convection and Radiation

H112N - Thermal Conductivity of Building Materials



H112C - Laws of Radiant Heat Transfer and Radiant Heat Exchange

H112 Heat Transfer Service Unit

A fully instrumented bench top Heat Transfer Service Unit providing regulated and adjustable AC power for all of the optional modules plus a number of auxiliary power outlets. The unit includes instrumentation that is common to all modules, this being a 12 point digital temperature indicator and digital current and voltage meter. Where appropriate, additional instrumentation is supplied with the various optional modules. The range of optional modules currently include convection, conduction (steady state and transient), radiation, perfect gases, thermodynamic properties of fluids and solid materials, enhanced methods of heat transfer, thermoelectric heat transfer, boiling and condensing heat transfer and a closed cycle heat engine. However the range is continuously being expanded. Internal electronic and mechanical safety devices to allow for unsupervised operation by students. Optional data acquisition is available for attachment to this unit

H112M - Marcet Boiler (Saturation Pressure-Temperature)

H112E - Extended Surface Heat Transfer

H112J - Perfect Gas Law Demonstration

H112H - Thermal Conductivity of Liquids and Gases

H112G - Unsteady State Heat Transfer

H112F - Radiation Errors in Temperature Measurement

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H352 Series

Cross Flow Heat Exchangers are one of the most common types of heat exchanger used in countless engineering applications such as engine radiators, air heaters, refrigeration evaporators and condensers, super-heaters and economisers. The normal configuration involves heat transfer between one fluid flowing through a bundle of tubes and another flowing transversely over the outside of the tubes. The tubes may have extended surfaces internally and/or externally in order to enhance heat transfer between the two fluids. The Cross Flow Heat Exchanger H352 can utilise any of a number of optional heat exchanger modules and in addition may be upgraded for computerised data acquisition.

H352G - Water to Air Heat Exchanger

H352A - Plain Tube and Tube Bundle in Cross Flow

H352F - Pitot Static Traverse Plate

H352B - Local Heat Transfer Element

H352 Cross Flow Heat Exchanger*

The unit is designed to enable students to investigate steady state rates of free and forced convective heat transfer at various air velocities and is supplied complete with a separate bench mounting instrumentation console and a variable speed fan as standard. Two manometers record intake depression whilst instrumentation measures surface, intermediate and free stream temperatures dependant upon the optional module in use. The optional modules are shown and a computer upgrade covering all optional cross flow heat exchanger modules can be supplied together with menu driven Windows software for computerised data acquisition.

**H352 Cross Flow Heat Exchanger Shown With Optional Plain Tube of H352A fitted*

H352E - Heat Pipe Investigation

H352D - Free and Forced Convection from Flat, Pinned and Finned Plates

H352C - Finned Tube Bundle in Cross Flow

H050 Boyles Law Demonstrator

The demonstration of Boyle's Law is one of the fundamental experiments for student chemists, physicists and engineers of all disciplines. The H050 bench top unit is completely self-contained incorporating a combined compressor and vacuum pump, allowing investigation both above and below atmospheric pressure. Instrumentation includes gas pressure, volume and temperature allowing the investigation of the characteristic gas equation. For operator safety the unit includes a high pressure cut out, relief valves, residual current circuit breaker and overload cut out.

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H411 Flow Boiling Demonstration Unit

This floor-mounted unit has been designed to provide a visual demonstration of the flow boiling processes that can occur inside the vapour generating tubes of practical plant such as refrigeration, steam, chemical and food processing systems. A real (not simulated) boiling process is used and all the stages of evaporation from warming of sub-cooled liquid to nucleation, bubble flow, slugging, annular flow, droplet entrainment and finally superheated vapour can be observed and demonstrated. The unit operates under steady state conditions allowing the processes to be studied for prolonged periods of time.

H656 Boiling Heat Transfer Unit

Boiling is the one of most important processes in the transfer of heat and is used in many industrial applications. For example, power generation, refrigeration, refining and nuclear engineering all depend upon an effective boiling process. Students need to be aware of the modes of pool boiling and to make both qualitative and quantitative assessments of convective, nucleate and film boiling. The unique design allows the student to see the processes taking place inside a glass cylinder and measure temperatures and heat flux under steady state conditions. The unit responds very rapidly to a load change and a wide range of conditions can be investigated in a typical laboratory period. A computerised data acquisition upgrade is available as an optional extra.

H694 Fluidisation and Fluid Bed Heat Transfer Unit

Fluidised bed combustion is of interest due to the benefits of potentially cleaner and lower temperature combustion of low grade fuels. In addition the action of the fluidized bed of solid particles results in very high rates of heat transfer. Application of fluidised beds is more widespread in industry than is usually appreciated, covering such diverse fields as power generation and food processing. The objective of the unit is to investigate the heat transfer from a heated cylinder at a range of depths in an air fluidized bed of granular material and compare this with natural convection. The process of fluidization is also investigated together with the pressure and temperature through the bed. Fluidisation takes place within a transparent chamber and the range of bed material supplied can be rapidly changed.

H813 Dew Point Hygrometer

A complete, self contained, dew point hygrometer that allows rapid and repeated measurement of the dew point of air using the classic chilled mirror method. The unit does NOT require the use of volatile or flammable coolant. A small air sampling pump draws air from either the laboratory or a remote location through the sensing chamber. The temperature at which water vapour condenses on the mirror is recorded together with the ambient dry bulb temperature using the thermometers supplied. Together, the measurements allows students to determine the condition of the sampled air either by calculation or using the psychrometric chart supplied. The unit is complimentary to the Hilton Air Conditioning Laboratory Unit A660 and the Bench Top Cooling Tower H893.

H814 Humidity Measurement Bench

The Hilton H814 Humidity Measurement Bench allows students to investigate the methods available for the measurement of humidity, wet and dry bulb temperature, expansion and contraction of materials and electronic relative humidity sensors. This is often a difficult concept for students to understand but is fundamental for the study of air conditioning and evaporative cooling methods (e.g. cooling towers). This unit is complimentary to the H813 Dew Point Hygrometer. The unit is bench mounted and self-contained.

H893 Bench Top Cooling Tower

Reproduces all the processes that are found in an industrial system serviced by a forced draught cooling tower. The unit incorporates a process load, circulating pump, packed column, water distribution, volume control system and fan. Standard instrumentation allows measurement of the air, circulating water mass flow rate and all end state temperatures using wet and dry bulb thermocouples. Evaporation rates under varying load and flow conditions can also be investigated. The unit is supplied with one column of packing density 110m^2/m^3. Additional columns with different packing densities together with a column enabling the construction of driving force diagrams and an empty column for student project work are available as optional extras. A computerised data acquisition upgrade is available as an optional extra.

H911 Film and Dropwise Condensation Unit

Although the differences in the modes of boiling heat transfer are generally recognised many students are not aware that two distinct modes of condensation can also occur given the correct conditions. This self-contained bench top unit allows the investigation of heat fluxes and heat transfer coefficients during the dropwise and filmwise condensation of steam. The considerable difference between the appearance and heat transfer rates of dropwise and filmwise condensation is clearly demonstrated. A vacuum pump is fitted to the unit so that the effect of non-condensable gases in condensers may be investigated. A computerised data acquisition upgrade is available as an optional extra.

H931 Steam to Water Heat Exchanger

The unit is self contained and designed for bench top use having its own steam generator and condenser tubes housed in a thick walled glass cylinder. The tubes may be connected in a single, double or four pass configuration and full instrumentation is provided for the investigation of the thermal performance in each configuration. A differential pressure gauge also allows the pressure drop due to flow velocity to be investigated in each configuration.

H981 Temperature Measurement Methods & Calibration Unit

This unit enables students to investigate the many different methods of measuring temperature and to determine the advantages and disadvantages of the various sensor and indicator types. Up to nine different methods of temperature measurement are included and students undertake detailed experiments to compare not only accuracy but also the way in which the instruments work. The operation of platinum resistance temperature sensors and their importance in the International Temperature Scale (ITS-90) are investigated in detail. Optional computerized data acquisition and traceable calibration standards are also available and add to the extreme versatility of this unit.

Hilton Data Acquisition Upgrade

With most of the Hilton Heat Transfer units, it is possible to upgrade to a Data Acquisition system as an optional extra. This will allow the key experimental parameters of temperature, pressure and flow to be measured, displayed, recorded, printed and graphically/numerically displayed on a host computer. The built in transducer power supplies, control features and on-board conversion to engineering units and data storage make the unit particularly versatile. The windows based software also allows a number of numerical and graphical display options to be chosen. Data files saved can be exported to Excel or another spreadsheet program.

OTHER EXPERIMENTS AVAILABLE *(Refer to our Website for details)*

H061 Laboratory Cooling Plant with Ice Store
H953 Water / Water Turbulent Flow Heat Transfer Unit
H972 Laminar / Viscous Flow Heat Transfer Unit

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