

COMPUTER CONTROLLED HEAT EXCHANGER SERVICE UNIT – HT30X

A range of small scale heat exchangers, designed to demonstrate the principles and techniques of indirect heat transfer between fluid streams. Different heat exchanger types are mounted on a common bench-top service unit. Small scale versions of commonly used industrial heat exchangers are available (including plate, tubular and shell and tube) for analysis and comparison.

The equipment is controlled either by a user supplied personal computer or an optional ACU screen. **Full data logging, control and educational software is supplied with the equipment as standard.**

BENCH TOP DESIGN

**SUPPLIED WITH COMPUTER CONTROL AND DATA-LOGGING AS STANDARD
SEVEN INTERCHANGEABLE HEAT EXCHANGER MODULES AVAILABLE
CAN BE CONFIGURED FOR COMPUTER CONTROLLED OR STAND ALONE (REQUIRES ACU) OPERATION**

In addition, the equipment has been fitted with failsafe systems, including a watchdog circuit, providing safe operation from a remote computer.

HT32X - Plate Heat Exchanger

HT33X - Shell and Tube Heat Exchange

HT31X - Tubular Heat Exchanger

HT30X - Service Unit

HT34X - Jacketed Vessel
With Coil & Stirrer

The HT30X service unit is available with seven interchangeable heat exchanger modules.

HT35X - Cross Flow Heat Exchanger

HT36X - Extended Tubular Heat Exchanger

HT37X - Extended Reconfigurable Plate Heat Exchanger

Features / benefits

- ▶ Small-scale, computer control bench top equipment
- ▶ A common service unit avoids unnecessary cost duplication for control and instrumentation
- ▶ Multiple accessories representative of industrial heat exchangers
- ▶ Computer controlled, including reversing of hot fluid streams for co-current and counter-current investigations
- ▶ armBUS connection via USB
- ▶ Full educational software with data logging, control, graph plotting, and detailed "Help"
- ▶ Suitable for project work. The service bench provides facilities for evaluating in-house heat exchanger designs
- ▶ Fail-safe hardware facilities for remote operation, via NetCan
- ▶ 20 users can connect to view the live readings within the local network. (Requires ArmBus-NetCan)
- ▶ Full control or read only access available at the time of setup when multiple users are operating the machine
- ▶ Educational software, including mimic diagrams, real-time control, data logging and graph plotting
- ▶ Embedded software based PID control of hot and cold-water flow
- ▶ Stand alone operation via ACU Touch Screen option

Computer Controlled Heat Exchanger Service Unit – HT30X

Description

The HT30X is a service unit which controls the operation of a broad range of Armfield interchangeable small scale heat exchanger modules.

It provides controlled cold water flow, hot water direction can easily be reversed using software control, enabling co-current and counter-current investigations, and the required instrumentation for a series of in-depth investigations into heat exchanger performance.

The individual heat exchangers can be quickly swapped, to enable comparisons between different types of heat exchanger.

The HT30X requires a user supplied personal computer for the operator interface. The computer connects the HT30X using a USB interface, providing a simple and straightforward installation and set up procedure.

Once the appropriate heat exchanger has been installed and set up, all other functions can be performed under computer control.

Appropriate measures have been implemented so that in the case of computer failure or communications breakdown, the system shuts itself down in a safe manner.

A wide selection of heat exchanger options are available for use with the HT30X. Ranging from simple exchangers to demonstrate co-current and counter-current flow, to reconfigurable systems with interim temperature measurements, capable of being used for in-depth heat exchanger analysis.

The heat exchangers are easily interchanged, with location studs and flexible interconnecting tubes with push connectors.

Hardware description

The service unit provides two fluid streams to the heat exchanger, a hot water stream and a cold water stream. The hot water stream is heated in a vessel fitted with an electric heater.

The heater is switched on and off by a solid state relay (SSR), which is under software control. A thermostat limits the maximum water temperature to 75°C for operator safety.

A centrifugal pump circulates water from the vessel, through the heat exchanger and back into the heater vessel. The pump speed is under software control, while the direction can easily be reversed as the hot water recirculation pump is bi-directional.

The cold water stream is generated from a mains water supply. The flow through the heat exchanger is adjusted by a variable flow valve, again under software control. A manually adjustable pressure regulator is used to minimise the effect of mains pressure fluctuations.

Conditioning circuits for up to 12 K-type thermo-couples are included, (the thermocouples themselves are supplied with the heat exchangers). The instrumentation includes flowmeters to measure the flow rates of the two fluid streams.

All electrical circuits located within the service module are protected by a residual current device (RCD) for operator safety. The base includes a drip tray in case of water leak or spillage.

ACU Screen - Touch screen, stand alone option

armBUS NetCan, connects up-to 20 users to one piece of equipment



Instructional capabilities

Training exercises that are common to each of the heat exchangers when used with the HT30X:

- ▶ Demonstration of indirect heating/cooling by transfer of heat from one fluid stream to another when separated by a solid wall
- ▶ Energy balance determination (heat balance) and calculation of efficiencies by measuring the flow rates and temperature changes in the hot and cold fluid streams
- ▶ Introduction to different types of heat exchanger and comparison of the differences in operation and performance
- ▶ Using the Logarithmic Mean Temperature Difference (LMTD) in heat transfer calculations
- ▶ Definition and measurement of Overall Heat Transfer Coefficient (U)
- ▶ Demonstration of the differences between counter-current and co-current operation, (not relevant for some HT34X configurations)
- ▶ Demonstration of the transition from linear to turbulent flow
- ▶ Effect of hot and cold fluid flow rate on the heat transfer coefficient
- ▶ Effect of driving force (temperature differential) on the heat transfer coefficient
- ▶ Investigation of heat loss and reduction in heat transfer coefficient due to fouling of the heat transfer surfaces (suitable student project using user induced fouling)

Requirements

Scale



Single Phase Electrical supply:

HT30X-A: 230V, 50Hz, 10Amp

HT30X-B: 115V, 60Hz, 20Amp

Software requires a computer running Windows 7 or later with a USB port (computer not supplied by Armfield)

- ▶ At least one heat exchanger module is required, additional heat exchangers are optional.
- ▶ Cold water supply and drain: 5 Litres/minute at 1bar gauge (min)

Optional accessory

- ▶ HT31X-Tubular Heat Exchanger
- ▶ HT32X-Plate Heat Exchanger
- ▶ HT33X-Shell & Tube Heat Exchanger
- ▶ HT34X-Jacketed Vessel With Coil & Stirrer
- ▶ HT35X-Cross Flow Heat Exchanger
- ▶ HT36X-Extended Tubular Heat Exchanger
- ▶ HT37X-Extended Reconfigurable Plate Heat Exchanger

Overall dimensions

| | |
|--------|-------|
| Length | 0.51m |
| Width | 0.90m |
| Height | 0.48m |

Packed and crated shipping specifications

| | |
|--------------|--------------------|
| Volume | 0.33m ³ |
| Gross weight | 35kg |

Ordering codes

- ▶ HT30X-A
- ▶ HT30X-B

Ordering specification

HT30X- Computer Controlled Heat Exchanger Service Unit

- ▶ A lightweight bench top service unit, designed to accommodate a range of different small scale heat exchangers
- ▶ Comprises hot water vessel, bi-directional hot water recirculation pump, cold water control system, computer interface and all necessary instrumentation
- ▶ The hot water vessel is made from clear acrylic (for visibility) and includes a 2kW heater with thermostatic over-temperature cut-out and low water level detection
- ▶ Hot water direction can easily be reversed using software enabling co-current and counter-current investigations over a wide range of computer controlled flow rates
- ▶ The cold water system includes a manually adjustable pressure regulator and a software controlled flow control valve
- ▶ Flow rates for both fluid streams in excess of 5L/min are achievable, but this may be restricted by some designs of heat exchanger (e.g. HT32X & HT37X Plate Heat Exchangers)
- ▶ Up to twelve temperatures (K and T type thermocouples) can be monitored using the service unit. Operating range, 0-75°C, resolution 0.1°C
- ▶ Two flow meters are included. Operating range 0.3 to 10 L/min, resolution 0.1 L/min, operating temperature 0-125°C
- ▶ All data is available to a (user supplied) Windows PC, via a USB interface. This computer is also used to manually or automatically control the cold water flow rate, hot water temperature and flow rate, variable speed fan and stirrer
- ▶ Full software for educational use is included as standard
- ▶ Includes failsafe hardware facilities
- ▶ Connects armBUS via LAN to PC.
- ▶ 20 Users can connect to view the live readings with in the local network
- ▶ Master and view only options available at the time of setup when multiple users operating the machine
- ▶ A comprehensive instruction manual is included

Pump

Heater

| | |
|----------------------------------------------------------|---------------------------|
| Power consumption: 120W | Power: 2kW |
| Max flow rate: 480 L/h (to reduce water usage) | Thermostat: 0-75°C |
| Max head: 20M | |

Internal / external expansion for armBUS & sensors

External (easy access)

| | |
|----|------------------------------------------------------------------------------|
| 3x | Mixed IO port C2 is configurable to various sensor types |
| 2x | Temperature ports T7&T8 |
| 1x | ABMC 1W port for expanding the number of PCBs connected to the 1-Wire system |
| 2x | 5-Way M12 ports (for NET CAN or legacy armBUS Inline sensors) |

Internal (requires mechanical body modification)

| | |
|-----|------------------------------------------------|
| 12x | Internal Digital Output ports (24V) |
| 1x | Internal 0-5V Output port |
| 1x | Internal 0-24V Output port |
| 1x | Internal 0-5V Analogue input port (5V+ supply) |
| 1x | Internal 5-way armBUS port |
| 2x | Internal Hall counters (5V+ supply) |

Armfield standard warranty applies with this product

Knowledge base

- > 28 years expertise in research & development technology
- > 50 years providing engaging engineering teaching equipment

Benefit from our experience, just call or email to discuss your laboratory needs, latest project or application.

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Aftercare

Installation
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Training
Service and maintenance
Support: armfieldassist.com



Tubular Heat Exchanger – HT31X

Description - requires HT30X service unit

The tubular heat exchanger is the simplest form of heat exchanger and consists of two concentric (coaxial) tubes carrying the hot and cold fluids. In these miniature versions the tubes are separated into sections to reduce the overall length and to enable the temperature at points along both fluid streams to be measured.

HT31X Essential accessories

- ▶ HT30X Computer Controlled Heat Exchanger Service Unit

Technical specifications

Thermocouples on Accessory

- ▶ Hot fluid mid-position
- ▶ Cold fluid mid-position

Thermocouples on Service Unit

- ▶ Hot fluid inlet
- ▶ Hot fluid outlet
- ▶ Cold fluid inlet
- ▶ Cold fluid outlet

| | |
|-------------------------|--------------------|
| Number of tube sections | 2 |
| Heat transfer area | 0.02m ² |

Overall dimensions

| | |
|--------|-------|
| Length | 0.16m |
| Width | 0.63m |
| Height | 0.39m |

Packed and crated shipping specifications

| | |
|--------------|--------------------|
| Volume | 0.05m ³ |
| Gross weight | 4 kg |

Technical details

On both our HT31X and HT36X heat exchangers, the inner tube is used for the hot fluid and the outer annulus for cold fluid. This minimises heat loss from the exchanger without the need for additional insulation.

The inner tubes are constructed from stainless steel and the outer annulus from clear acrylic, providing visualisation of the heat exchanger construction and minimising thermal losses.

The tubes can be dismantled for cleaning.

Features

- ▶ A small scale Tubular Heat Exchanger system for use with an Armfield Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of sections of concentric tubes, the outer section constructed from clear acrylic for visibility and the inner tube from stainless steel
- ▶ The tubes are easily dismantled for cleaning
- ▶ A comprehensive instruction manual is included

Ordering codes

- ▶ **HT31X** - Tubular Heat Exchanger - See HT30X for power options



Software screen for HT31X, PID control of temperature and flow



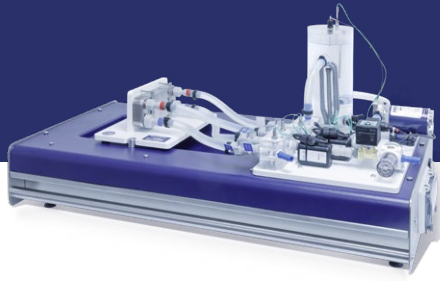


Plate Heat Exchanger – HT32X

Description - requires HT30X service unit

The plate heat exchanger is extremely versatile and commonly used in the food and chemical processing industries.

The HT32X has a single heating section configured for multi-pass operation with passes in series.

It comprises 10 individual plates. When being assembled, each second plate is rotated by 180°, thus forming two separately rotated flow chambers by the means of which the mediums being involved in the heat transfer are conducted in counter flow.

HT32 Essential accessories

- ▶ HT30X Computer Controlled Heat Exchanger Service Unit

Technical specifications

| | |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of plates | ▶ 10 (8 effective plates) |
| Heat transfer area | ▶ 0.12m ² |
| Heat exchanger configuration | ▶ Single heating stage |
| Temperature measurements points | Thermocouples on Service Unit <ul style="list-style-type: none"> ▶ Hot fluid inlet ▶ Hot fluid outlet ▶ Cold fluid inlet ▶ Cold fluid outlet |
| Clamping mechanism | Vacuum soldering |

Overall dimensions

| | |
|--------|-------|
| Length | 0.07m |
| Width | 0.19m |
| Height | 0.40m |

Packed and crated shipping specifications

| | |
|--------------|--------------------|
| Volume | 0.03m ³ |
| Gross weight | 6kg |

Technical details

As suggested by its name, the plate heat exchanger consists of wave-shaped panels that are assembled in a unique way. There are interspaces between the plates.

The plates are manufactured from thin sheets of stainless steel, embossed with corrugations that promote turbulent mixing even at low Reynolds numbers. This turbulent mixing has the advantages of creating very high heat transfer coefficients and reduce fouling that may occur.

Hot and cold fluid flows may be configured for either cocurrent or countercurrent operation.

Plate details:

| | |
|-------------------------------------|-------------------------|
| Plate overall dimensions: | 191mm x 73mm |
| Effective heat transfer area: | 0.12m ² |
| Projected heat transmission area: | 0.015m ² |
| Number of plates: | 10 |
| Conductive panel (Plate thickness): | 0.26mm |
| Distance between plates: | 2.1mm |
| Material: | Stainless steel, copper |

Features

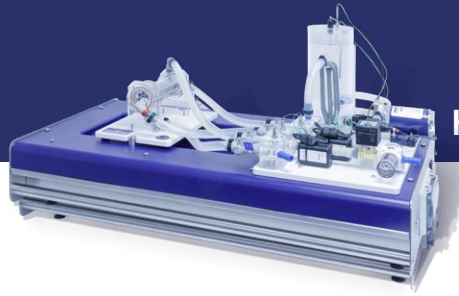
- ▶ A small scale plate heat exchanger system for use with an Armfield Computer Controlled Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of stainless steel plates, each with a pressed chevron pattern, soldered with copper using a vacuum soldering procedure
- ▶ A comprehensive instruction manual is included

Ordering codes

- ▶ **HT32X** - Plate Heat Exchanger
- See HT30X for power options



Software screen for HT32X, PID control of temperature and flow



Shell and Tube Heat Exchanger – HT33X

Description - requires HT30X service unit

The shell and tube heat exchanger is commonly used in the food and chemical process industries. This type of exchanger consists of a number of tubes in parallel enclosed in a cylindrical shell. Heat is transferred between one fluid flowing through the tubes and another fluid flowing through the cylindrical shell around the tubes.

The miniature exchanger supplied is designed to demonstrate liquid to liquid heat transfer in a 1-7 shell and tube heat exchanger (one shell and seven tubes with two transverse baffles in the shell).

Technical details

The accessory consists of a miniature shell and tube heat exchanger with the following features:

- ▶ Hot fluid in the inner tubes and cold fluid in outer shell to minimise heat loss from the exchanger without the need for additional insulation
- ▶ Seven stainless steel tubes, 6.35mm OD
- ▶ The outer annulus, end caps and baffles are constructed from clear acrylic to allow visualisation of the heat exchanger construction and minimise thermal losses
- ▶ Nominal combined heat transfer area of 20,000mm², (equivalent to that of the HT31X Tubular Heat Exchanger for direct comparison)
- ▶ Cold fluid (cold water) enters one end of the shell at the bottom and exits at the opposite end at the top having flowed over and under two transverse baffles inside the shell
- ▶ Thermocouples installed on the HT30X service unit to measure:
 - Hot fluid
 - Hot fluid outlet
 - Cold fluid inlet
 - Cold fluid

Features

- ▶ A miniature shell and tube heat exchanger for use with an Armfield Computer Controlled Heat Exchanger Service Unit
- ▶ Comprises an outer shell and seven internal tubes. There are two transverse baffles inside the shell
- ▶ The heat exchanger is constructed from stainless steel tube and clear acrylic. It is mounted on a PVC baseplate which is designed to be installed on the plinth of the Heat Exchanger Service Unit without the need for tools
- ▶ The stainless steel tubes can be removed from the heat exchanger for cleaning
- ▶ A comprehensive instruction manual is included

HT33X Essential accessories

- ▶ HT30X Computer Controlled Heat Exchanger Service Unit

Ordering codes

- ▶ HT33X - Shell & Tube Heat Exchanger - See HT30X for power options

Overall dimensions

| | |
|--------|-------|
| Length | 0.19m |
| Width | 0.43m |
| Height | 0.39m |

Packed and crated shipping specifications

| | |
|--------------|--------------------|
| Volume | 0.06m ³ |
| Gross weight | 5 kg |



Software screen for HT33X, PID control of temperature and flow



Jacketed Vessel With Coil & Stirrer - HT34X

Description - requires HT30X service unit

Vessel Heating or cooling of a process liquid in a tank, either batchwise or with continuous product feed, is common practice throughout industry.

The characteristics of the heat transfer using an external jacket or internal coil can be demonstrated together with the effect of stirring the vessel contents.

Features

- ▶ Miniature jacketed vessel heat exchanger system for use with an Computer Controlled Armfield Heat Exchanger Service Unit
- ▶ Comprises processing vessel with outer jacket, inner coil, variable speed stirrer and baffle
- ▶ Thermocouples measure the vessel contents and the inlet and outlet temperatures of both fluid streams (**5 in total**)
- ▶ The Heat Exchanger is designed to be installed on the service unit without the need for tools
- ▶ A comprehensive instruction manual is included

Technical details

The accessory consists of a jacketed vessel with the following features:

- ▶ The vessel consists of a stainless steel wall with PVC base and clear acrylic top. A glass outer jacket allows the wall of the vessel to be surrounded with hot fluid for indirect heating from the outside. Alternatively, a stainless steel coil inside the vessel allows the cold fluid contained within the vessel to be indirectly heated from inside.
- ▶ The vessel incorporates a variable speed stirrer and baffle arrangement to provide thorough mixing of the vessel contents when required.
- ▶ An adjustable overflow enables the volume of liquid inside the vessel to be varied with a maximum capacity of two litres and a minimum of one litre.
- ▶ The vessel can be operated batchwise by simply filling to the overflow or with continuous feed of cold liquid to the base of the vessel, the excess liquid flowing from the overflow to drain.
- ▶ Temperature can be measured at the following 5 locations:
 - Vessel contents (cold fluid)
 - Hot fluid inlet to jacket/coil
 - Hot fluid outlet from jacket/coil
 - Cold water outlet to drain
 - Cold fluid inlet to vessel
- ▶ Quick release hot and cold fluid connections enable rapid connection to HT30X and conversion from heating jacket to heating coil.

Overall dimensions

| | |
|--------|-------|
| Length | 0.40m |
| Width | 0.18m |
| Height | 0.39m |

Packed and crated shipping specifications

| | |
|--------------|--------------------|
| Volume | 0.10m ³ |
| Gross weight | 9 kg |



Software screen for HT34X, PID control of temperature and flow

HT34X Essential accessories

- ▶ HT30X Computer Controlled Heat Exchanger Service Unit

Ordering codes

- ▶ **HT34X** - Jacketed Vessel With Coil & Stirrer - See HT30X for power options



Cross Flow Heat Exchanger - HT35X

Description - requires HT30X service unit

The cross flow heat exchanger is commonly used in applications such as heating, ventilating and air conditioning. It is also encountered as vehicle engine radiator.

This type of heat exchange occurs when the flow direction of the two fluids cross each other. In the HT35X, hot water flows in and out of a radiator, perpendicular to air stream, which is being pulled into the radiator by an axial fan.

The convection between the two fluids through fins surface on the radiator implements the heat exchange.

Features

- ▶ A small scale cross flow heat exchanger system for use with the Armfield Computer Controlled Heat Exchanger Service Unit to teach the fundamentals concepts of heat transfer
- ▶ Some parts in the heat exchanger such as probes and axial fan can be easily removed for cleaning
- ▶ The HT35X enables variation of the parameters involved in the cross flow exchange process and therefore a complete analysis of the phenomena
- ▶ Thermocouples measure the inlet and outlet water from the base unit and air temperatures. The air velocity sensor connects to the HT30X, 0-5m/s
- ▶ The air mass flow rate is derived using an air velocity sensor
- ▶ The HT35X is mounted on a PVC baseplate which is designed to be installed on the plinth of the Computer Controlled Heat Exchanger Service Unit without the need for tools
- ▶ A comprehensive instruction manual is included

HT35X Essential accessories

- ▶ HT30X Computer Controlled Heat Exchanger Service Unit

Technical details

- ▶ This unit consists of a PVC rectangular duct, variable speed axial fan and a single fan radiator
- ▶ The radiator is accommodated in the middle and across the air duct
- ▶ The axial fan is located between the radiator and one edge of the duct. It can provide max air velocity of 5m/s
- ▶ The fins of the radiator are made from copper and allow a heat transfer area of 11,000mm²
- ▶ Four thermocouples measure the base unit and accessory's input and output water as well as the air temperatures
- ▶ Quick release hot fluid connections allow rapid connection to HT30X
- ▶ The exercises proposed with the HT35X provide function of basic engineering concepts such as psychrometric properties and mathematical iteration
- ▶ The HT35X software includes application of the LMTD (Log Mean Temperature Difference) method for cross flow heat exchanger as well as the effectiveness - NTU (Number of Transfer Units) method
- ▶ An air velocity sensor provides measurement of air flow inside the duct, which can be directly observed on the units software
- ▶ The HT35X software is an interactive tool for high understanding of the factors and variables involved in cross flow heat exchange



Software screen for HT35X, PID control of temperature and flow

Overall dimensions

| | |
|--------|-------|
| Length | 0.15m |
| Width | 0.75m |
| Height | 0.40m |

Packed and crated shipping specifications

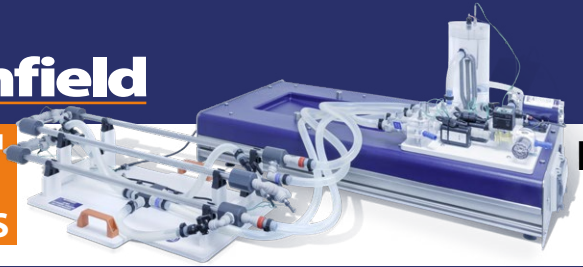
| | |
|--------------|--------------------|
| Volume | 0.09m ³ |
| Gross weight | 6kg |

Ordering codes

- ▶ HT35X - Cross Flow Heat Exchanger - See HT30X for power options

Extended Tubular Heat Exchanger - HT36X

HT
SERIES



Description for HT36X - requires HT30X service unit

The tubular heat exchanger is the simplest form of heat exchanger and consists of two concentric (coaxial) tubes carrying the hot and cold fluids. In these miniature versions the tubes are separated into sections to reduce the overall length and to enable the temperature at points along both fluid streams to be measured.

The HT36X unit has four tube sections, giving four times the overall heat transfer area and three interim temperature measurement points in each fluid stream.

The unit has sufficient heat transfer area to demonstrate the classic counter current flow conditions where the outlet of the heated stream is hotter than the outlet of the cooled stream.

Technical specifications

Thermocouples from Accessory

- ▶ Hot fluid interim positions x3
- ▶ Cold fluid interim positions x3

Thermocouples on Service Unit

- ▶ Hot fluid inlet
- ▶ Hot fluid outlet
- ▶ Cold fluid inlet
- ▶ Cold fluid outlet

Number of tube sections

4

* Can also be configured for 1, 2 or 3 sections

Heat transfer area

0.08m²

Overall dimensions

| | |
|--------|-------|
| Length | 0.2m |
| Width | 0.95m |
| Height | 0.4m |

Packed and crated shipping specifications

| | |
|--------------|-------------------|
| Volume | 0.1m ³ |
| Gross weight | 10kg |

Technical details

On both our HT31X and HT36X heat exchangers, the inner tube is used for the hot fluid and the outer annulus for cold fluid. This minimises heat loss from the exchanger without the need for additional insulation.

The inner tubes are constructed from stainless steel and the outer annulus from clear acrylic, providing visualisation of the heat exchanger construction and minimising thermal losses.

The tubes can be dismantled for cleaning.

Features

- ▶ A small scale Tubular Heat Exchanger system for use with an Computer Controlled Armfield Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of sections of concentric tubes, the outer section constructed from clear acrylic for visibility and the inner tube from stainless steel
- ▶ The tubes are easily dismantled for cleaning
- ▶ A comprehensive instruction manual is included

HT36X Essential accessories

- ▶ HT30XC Computer Controlled Heat Exchanger Service Unit



Software screen for HT36X, PID control of temperature and flow



Ordering codes

- ▶ **HT36X** - Extended Tubular Heat Exchanger - See HT30X for power options

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Issue: 5

URL: <http://www.armfield.co.uk/ht30x>

Applications

ChE ME CE IP

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Extended Reconfigurable Plate Heat Exchanger - HT37X

Description for HT37X - requires HT30X service unit

The HT37X is designed to be reconfigurable by the student and can accommodate up to four sections of heating. Each section provides an additional temperature measurement point for each fluid stream. In order to make the unit easy to reconfigure, these sections are supplied as pre-assembled groups of plates complete with an intermediate plate (containing the temperature measurement points). Using the four heating sections provided, students can compare heat exchangers of different heat transfer area and different numbers of passes. A quick release clamp system enables the different arrangements to be changed quickly and easily without using tools.

Also supplied is a pre-assembled regeneration section to demonstrate this important energy efficient method of heating. The regeneration section can be used in conjunction with one, two or three of the standard heating sections in different configurations.

Plate heat exchangers can be implemented in a wide variety of configurations, with parallel passes, serial passes, or combinations of both. For more advanced investigations into these effects, (e.g. for project work) a further twelve loose plates are supplied with the HT37X.

These can be used in conjunction with the plates from the pre-assembled modules to investigate additional configurations.

Technical specifications

| | |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of plates | <ul style="list-style-type: none"> ▶ 5, 10, 15 or 20 (no regeneration) ▶ 6, 11, 16 or 21 (with regeneration) |
| Heat transfer area | ▶ 0.096m ² |
| Heat exchanger configuration | ▶ Configurable sections, with a separate regeneration section |
| Thermocouples from Accessory | Thermocouples on Service Unit <ul style="list-style-type: none"> ▶ Hot fluid inlet ▶ Hot fluid outlet ▶ Cold fluid inlet ▶ Cold fluid outlet |
| Clamping mechanism | Dual screw threads with nuts |

Overall dimensions

| | |
|--------|-------|
| Length | 0.17m |
| Width | 0.18m |
| Height | 0.39m |

Packed and crated shipping specifications

| | |
|--------------|--------------------|
| Volume | 0.03m ³ |
| Gross weight | 6 kg |

Technical details

The plates used in these heat exchangers have been specifically developed by Armfield for use in miniature heat exchanger systems. They are fabricated from 316 stainless steel, with a pressed chevron pattern to promote turbulence and provide multiple support points. Silicone rubber gaskets are used on each plate to seal the adjacent flow channels from each other.

Plate details:

| | |
|-----------------------------------|-------------------------------|
| Plate overall dimensions: | 75mm x 115mm |
| Effective diameter: | 3.0mm |
| Plate thickness: | 0.5mm |
| Wetted perimeter: | 53.0mm |
| Projected heat transmission area: | 0.008m ² per plate |

The plates are mounted in a frame incorporating fixed and moving end plates with connections for hot and cold fluids. The exchangers are easily dismantled for inspection of the heat transfer surfaces.

Features

- ▶ A small scale plate heat exchanger system for use with an Armfield Computer Controlled Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of stainless steel plates, each with a pressed chevron pattern and a food grade silicon rubber sealing gasket, mounted in a frame
- ▶ Easily dismantled for cleaning
- ▶ A comprehensive instruction manual is included

HT37X Essential accessories

- ▶ HT30X Computer Controlled Heat Exchanger Service Unit

Ordering codes - See HT30X for power options

- ▶ HT37X - Extended Reconfigurable Plate Heat Exchanger



armBUS Software

Available for many Armfield products, with a wide range of features

Description of armSOFT educational software

Features

ArmBUS software is provided as standard with the HT30X for all the Armfield heat exchanger accessories.

Individual programs are provided for each exchanger, and each program contains a selection of separate exercises that can be performed.

The actual details are exercise specific, but typically the following interfaces are available:

- ▶ Full Graphical User Interface (GUI) for each experiment with display screens tailored for each exercise
- ▶ All the temperatures and flow rates are displayed on a diagrammatic representation of the equipment
- ▶ Student questions and equations can be accessed individually for each exercise
- ▶ The hot-water flow rate utilises optional Manual/Automatic control to control the pump output. Manual control allows the user to select a percentage of the total power to supply to the pump. Automatic control allows the user to input the desired set point which the PID control will reach and maintain. The use of automatic control ensures the flow is stable despite changes in the viscosity of the water due to heating
- ▶ Real-time flow rate readings are displayed in L/min
- ▶ Sensor data is collated and calculations are displayed in a data-log, a tabulation function provided with the armBUS software. The data is in tabulated format and can be saved and accessed through a .csv file compatible with software such as Microsoft Excel
- ▶ The cold-water flow control valve utilises optional Manual/Automatic settings to control water flow from the mains. Manual control allows the user to open/close the valve between 0 and 100%. Automatic control allows the user to input the desired set point which the PID control will reach and maintain so long as the input pressure is adequate.
- ▶ The heater utilises optional Manual/Automatic control to supply power to the heater element in the boiler. Manual control allows the user to select a percentage of the total power to supply to the heater. Automatic control allows the user to select a set point (°C), and then PID control software heats the water to and maintains a set temperature
- ▶ The data from the sensors is plotted and displayed in a user-configurable graphing function of the software. It can be displayed separately from the data logging and each sensor output can be viewed independently
- ▶ Processing of measured values to obtain calculated results (this can be linked to the questions and answers to ensure student understanding, answers to equation calculations can be found as part of the datalogger output)



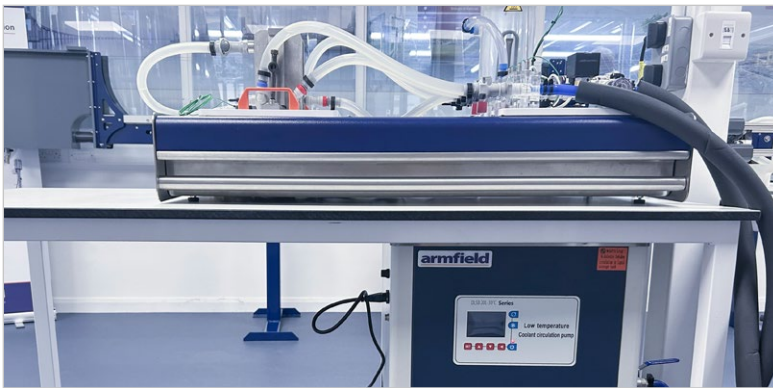
CW-20 Water Chiller Unit - requires HT30X service unit

Sustainable Cooling for Precision Experiments

In an ever-changing world, the need to preserve water and energy has never been more important. At Armfield, we recognize this challenge and are committed to providing sustainable solutions for laboratory and classroom environments.

The CW-20 Water Chiller Unit is a high-quality, low-noise cooling system designed to work seamlessly with the HT30X. With a 20L capacity, a cooling power of up to 1.8 kW, and the ability to reach temperatures as low as -30°C , this unit eliminates the need for continuous water supply, minimizing waste and ensuring a stable, controlled steady-state operation.

For customers operating in regions where water conservation is critical, the CW-20 is the ideal accessory to enhance efficiency, sustainability, and precision in thermodynamics and heat transfer experimentation.



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