

COMPUTER CONTROLLED HEAT EXCHANGER SERVICE MODULE – HT30XC

A range of small scale heat exchangers, designed to illustrate the principles and techniques of indirect heat transfer between fluid streams. Different types of heat exchanger can be 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 by a user supplied personal computer, which serves as the operator interface. Full data logging, control and educational software is supplied with the equipment.

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

BENCH TOP DESIGN
FULL DATA LOGGING WITH USB INTERFACE
SEVEN INTERCHANGEABLE HEAT EXCHANGER MODULES AVAILABLE



HT30CX fitted with HT35 cross flow heat exchanger



Quick connectors allowing co- or counter-current flow



Features / benefits

- ▶ Small scale, bench top equipment
- ▶ Fast response times allow in depth investigations in a short time
- ▶ Representative of industrial heat exchangers
- ▶ Multiple, industrially representative heat exchangers available
- ▶ Computer controlled, including reversing of one of the fluid streams for co-current and counter-current investigations
- ▶ Standard USB interface
- ▶ Safety functions implemented to allow for remote operation by computer
- ▶ 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

Computer Controlled Heat Exchanger Service Module – HT30XC

Description - requires HT30XC base unit

The HT30XC is a service unit, to allow the operation of one of the Armfield range of small scale heat exchanger systems.

It provides controlled cold water flow, hot water direction can easily be reversed using the quick release pipe couplings 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 changed over, to enable comparisons between different types of heat exchanger to be made.

The HT30XC requires a user supplied personal computer for the operator interface. The computer connects the HT30XC 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 HT30XC. 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 quick release fittings on the flexible interconnecting tubes, and a simple location system using thumbscrews to secure the exchangers onto the service unit.

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 using the quick release pipe couplings enabling co-current and counter-current investigations over a wide range of flow rates.

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

Switching on the unit puts it into "Standby" mode. From this mode it is necessary for a regular series of pulses to be received from the software (via the built in USB interface) to fully power up the unit. This ensures that unless the control software is running, the heaters, the pump and the cold water control valve cannot be switched on. The unit also includes an emergency stop switch.

All electrical circuits are located in a bench mounted ABS supporting base, and protected by a Residual Current Device (RSD) for operator safety. The ABS base includes a drip tray and drain tap in case of water spillage or leakage.



HT30XC details showing heater & hot water circulation system



Tubular Heat Exchanger – HT31

Description - requires HT30XC base 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.

Two versions are available, the HT31 is a basic version with two sections and a single interim temperature measurement point.

HT31 Essential Accessories

- ▶ HT30XC Computer controlled service unit

Technical specifications

Temperature measurements points	6 off: <ul style="list-style-type: none"> ▶ Hot fluid inlet ▶ Hot fluid mid-position ▶ Hot fluid outlet ▶ Cold fluid inlet ▶ Cold fluid mid-position ▶ Cold fluid outlet
Number of tube sections	2
Heat transfer area	0.02m ²

Overall dimensions

Length	0.16 m
Width	0.51 m
Height	0.39 m
Packed and crated shipping specifications	
Volume	0.05 m ³
Gross weight	4 kg

Technical Details

On both our HT31 and HT36 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

- ▶ HT31 - Tubular heat exchanger - See HT30XC for power options

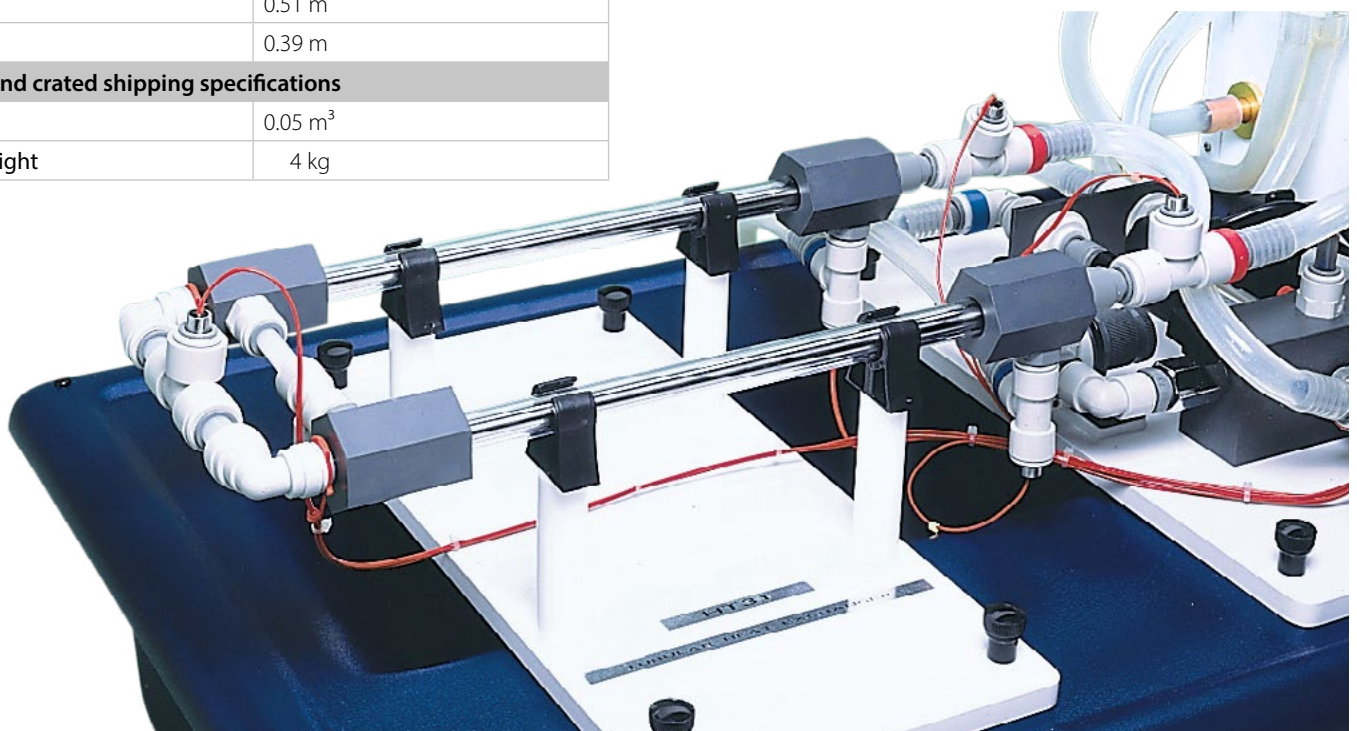


Plate Heat Exchanger – HT32

Description - requires HT30XC base unit

The plate heat exchanger is extremely versatile and commonly used in the food and chemical processing industries. Different combinations of plates and gaskets can be arranged to suit a particular application.

The miniature exchanger supplied, consists of a pack of plates with sealing gaskets held together in a frame between end plates. Hot and cold fluids flow between channels on alternate sides of the plates to promote heat transfer.

The HT32 has a single heating section configured for multi-pass operation with passes in series. It comprises seven individual plates, which are clamped together using two stainless steel threaded bars and nuts. It is possible to dismantle and reassemble the heat exchanger using only three plates to demonstrate a single pass.

Technical specifications

Number of plates	► 7 (5 effective plates)
Heat transfer area	► 0.04m ²
Heat exchanger configuration	► Single heating stage
Temperature measurements points	4 off: ► Hot fluid inlet ► Hot fluid outlet ► Cold fluid inlet ► Cold fluid outlet
Clamping mechanism	Dual screw threads with nuts

Overall dimensions

Length	0.17 m
Width	0.18 m
Height	0.39 m
Packed and crated shipping specifications	
Volume	0.03 m ³
Gross weight	6 kg

Ordering codes

- HT32 - Plate heat exchanger - See HT30XC for power options

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

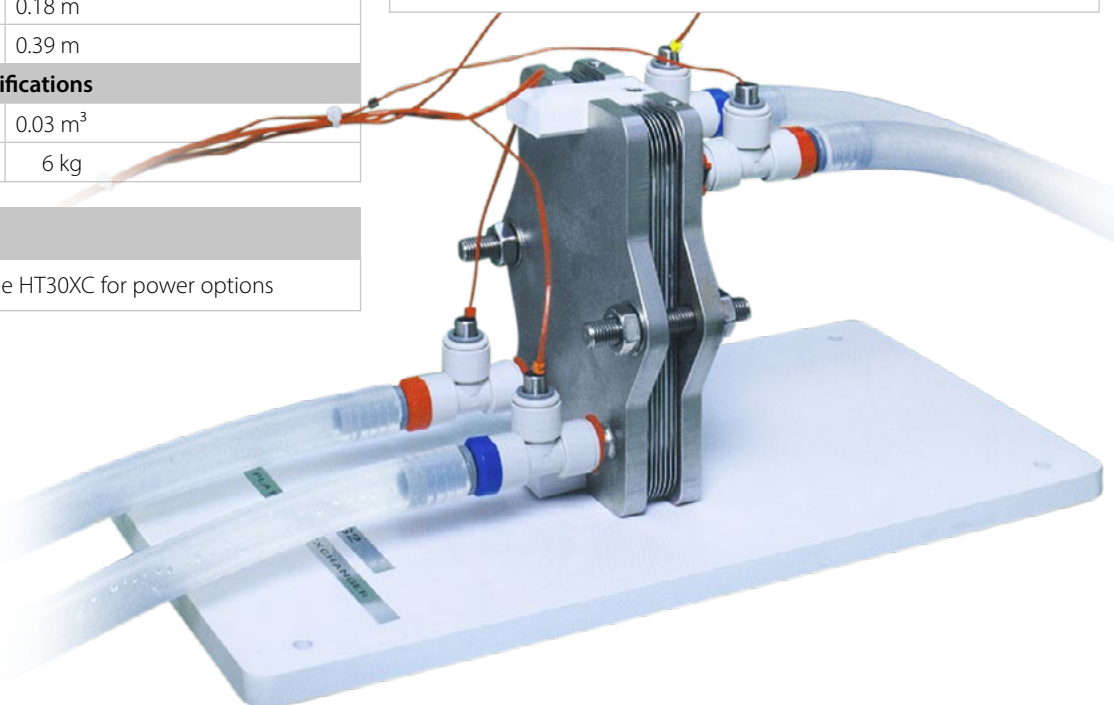
The plates are mounted in a frame incorporating fixed and moving end plates with connections for hot and cold fluids. The exchangers are easily dismantled for inspection of the heat transfer surfaces.

Features

- A small scale plate heat exchanger system for use with an Armfield 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

HT32 Essential Accessories

- HT30XC Computer controlled service unit



Shell and Tube Heat Exchanger – HT33

Description - requires HT30XC base 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 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 HT31 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 are installed at the following four locations:
 - Hot fluid
 - Hot fluid outlet
 - Cold fluid inlet
 - Cold fluid

Overall dimensions

Length	0.19 m
Width	0.43 m
Height	0.39 m

Packed and crated shipping specifications

Volume	0.06 m ³
Gross weight	5 kg

Features

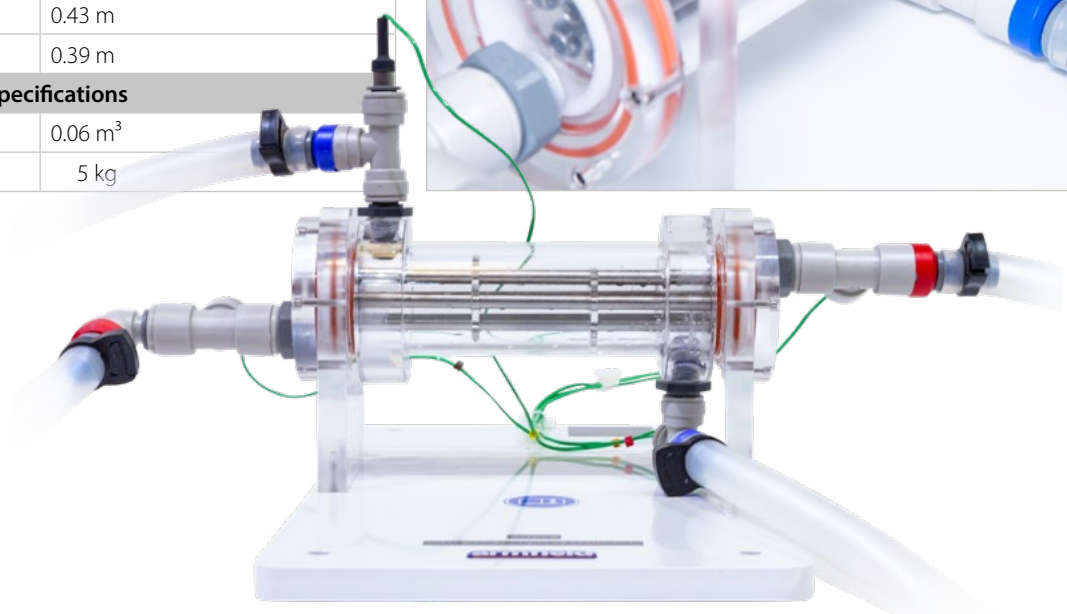
- ▶ A miniature shell and tube heat exchanger for use with an Armfield Heat Exchanger Service Unit
- ▶ Comprises an outer shell and seven internal tubes. There are two transverse baffles inside the shell
- ▶ Four temperature sensors are supplied in tappings at fluid inlets and outlets
- ▶ The heat exchanger 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

HT33 Essential Accessories

- ▶ HT30XC Computer controlled service unit

Ordering codes

- ▶ HT33 - Shell & Tube heat exchanger - See HT30XC for power options



Jacketed Vessel With Coil & Stirrer - HT34

**HT
SERIES**

Description - requires HT30XC base 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 Armfield Heat Exchanger Service unit
- ▶ Comprises processing vessel with outer jacket, inner coil, variable speed stirrer and baffle
- ▶ K-Type thermocouples measure the vessel contents and the inlet and outlet temperature of both fluid streams (6 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

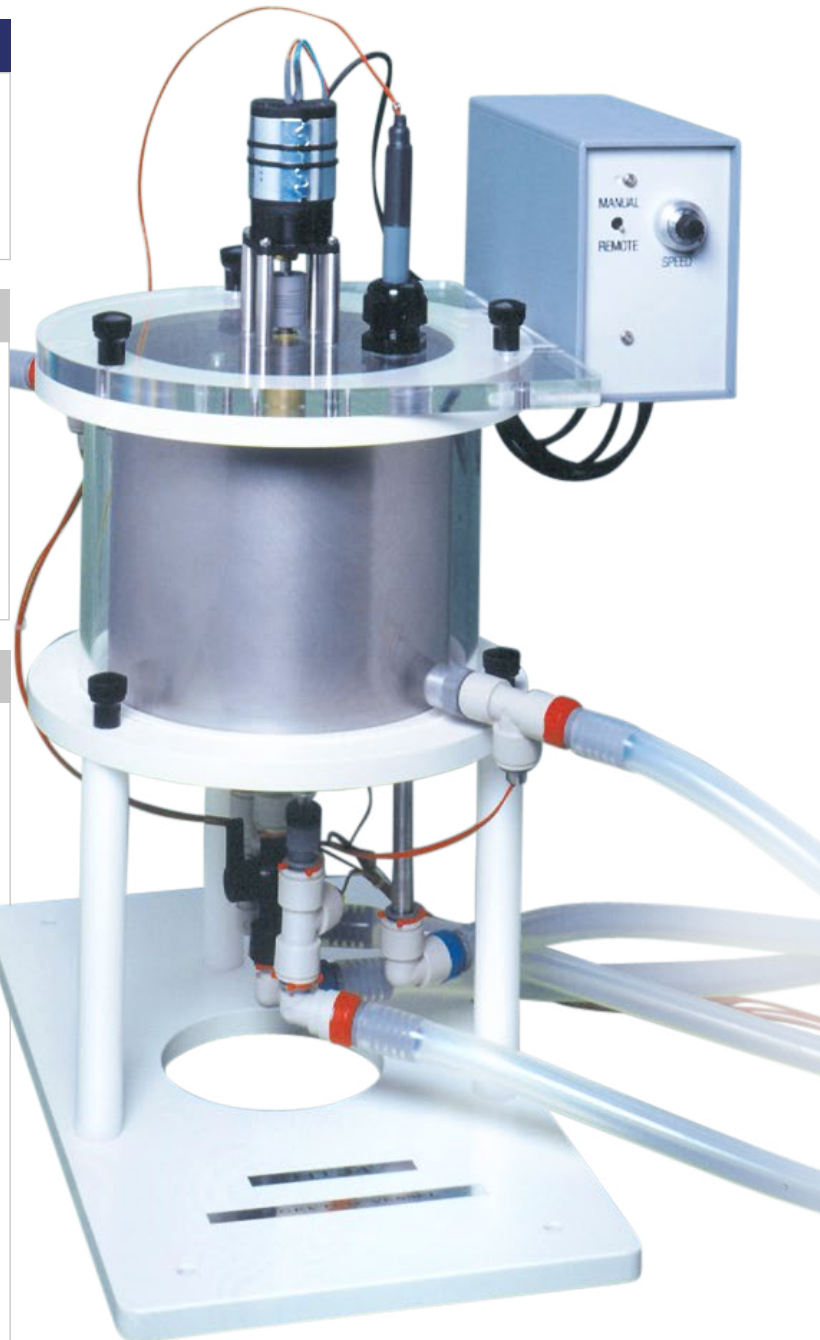
Technical Details

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.
- ▶ Thermocouples are installed at the following six locations:
 - ▶ Vessel contents (cold fluid)
 - Hot fluid inlet from jacket
 - Hot fluid inlet to coil
 - Hot fluid outlet from coil
 - 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	0.40 m
Width	0.18 m
Height	0.39 m
Packed and crated shipping specifications	
Volume	0.10 m ³
Gross weight	9 kg



HT34 Essential Accessories

- ▶ HT30XC Computer controlled service unit

Ordering codes

- ▶ HT34 - Jacketed Vessel With Coil & Stirrer - See HT30XC for power options

Cross Flow Heat Exchanger - HT35

Description - requires HT30XC base 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 HT35, 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.

Technical Details

- ▶ This unit consists of a PVC rectangular duct, 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 2m/s
- ▶ The fins of the radiator are made from copper and shine in the light, and allow a heat transfer area of 14,000mm².
- ▶ Four thermocouples measure input and output water and air temperatures
- ▶ Quick release hot fluid connections allow rapid connection to HT30XC as well as connection to the HT35 software.
- ▶ The exercises proposed with the HT35 provide function of basic engineering concepts such as psychrometric properties and mathematical iteration
- ▶ The HT35 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 HT35 software is an interactive tool for high understanding of the factors and variables involved in the cross flow heat exchange

Overall dimensions

Length	0.15 m
Width	0.75 m
Height	0.40 m
Packed and crated shipping specifications	
Volume	0.09 m ³
Gross weight	6 kg

Ordering codes

- ▶ HT35 - Cross flow heat exchanger - See HT30XC for power options

Features

- ▶ A small scale cross flow heat exchanger system for use with the Armfield 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 HT35 enables variation of the parameters involved in the cross flow exchange process and therefore a complete analysis of the phenomena
- ▶ K-type thermocouples measure the inlet and outlet water and air temperatures, as well as permitting the connection of the air velocity sensor to the HT30XC
- ▶ The air mass flow rate is derived using an air velocity sensor
- ▶ The HT35 is mounted on a PVC baseplate which is designed to be installed on the plinth of the Heat Exchanger Unit without the need for tools
- ▶ A comprehensive instruction manual is included

HT35 Essential Accessories

- ▶ HT30XC Computer controlled service unit



Extended Tubular Heat Exchanger - HT36

**HT
SERIES**

Description for HT36 - requires HT30XC base 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 HT36 unit has four longer 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

Temperature measurements points	10 off: <ul style="list-style-type: none"> ▶ Hot fluid inlet ▶ Hot fluid interim positions (x3) ▶ Hot fluid outlet ▶ Cold fluid inlet ▶ Cold fluid interim positions (x3) ▶ Cold fluid outlet
Number of tube sections	4 * Can also be configured for 1/2 or 3 sections
Heat transfer area	0.08m ²

Overall dimensions

Length	0.2 m
Width	0.95 m
Height	0.4 m
Packed and crated shipping specifications	
Volume	0.1 m ³
Gross weight	10 kg

Technical Details

On both our HT31 and HT36 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.

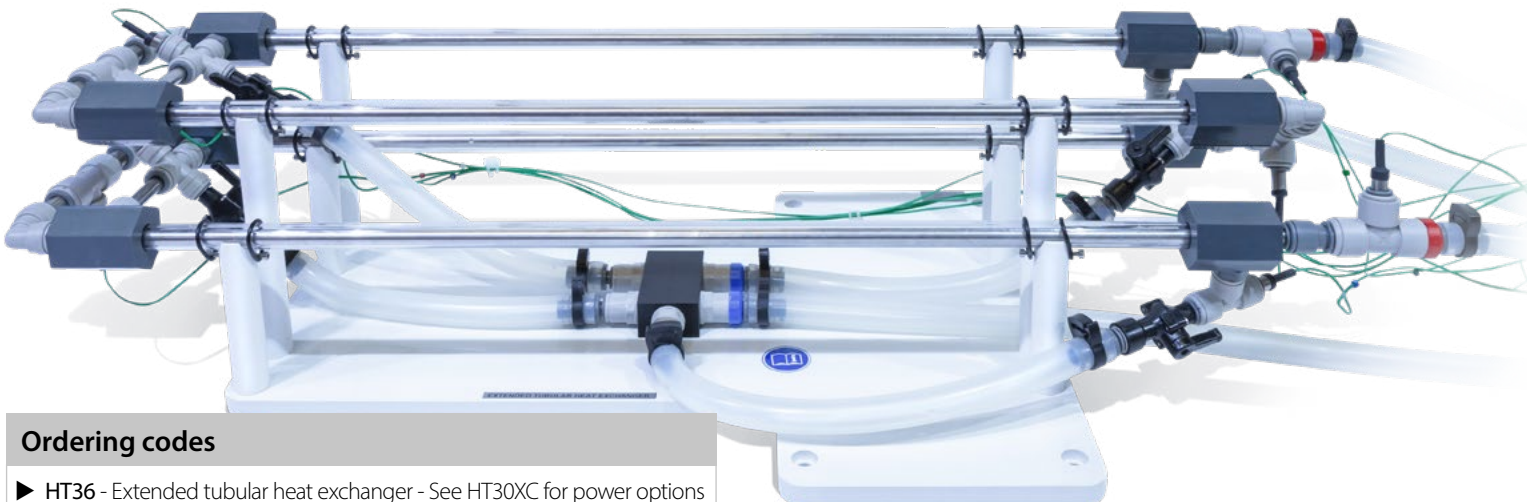
The tubes can be dismantled for cleaning.

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

HT36 Essential Accessories

- ▶ HT30XC Computer controlled service unit



Ordering codes

- ▶ HT36 - Extended tubular heat exchanger - See HT30XC for power options

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Issue: 4

URL: <http://www.armfield.co.uk/ht30xc>

Applications

ChE ME CE IP

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Extended Reconfigurable Heat Exchanger - HT37

Description for HT37 - requires HT30XC base unit

The HT37 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 HT37.

These can be used in conjunction with the plates from the pre-assembled modules to investigate these other 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
Temperature measurements points	10 off: <ul style="list-style-type: none"> ▶ Hot fluid inlet ▶ Hot fluid interim positions (up to 3) ▶ Hot fluid outlet ▶ Cold fluid inlet ▶ Cold fluid interim positions (up to 3) ▶ Cold fluid outlet
Clamping mechanism	Dual screw threads with nuts

Overall dimensions

Length	0.17 m
Width	0.18 m
Height	0.39 m

Packed and crated shipping specifications

Volume	0.03 m 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

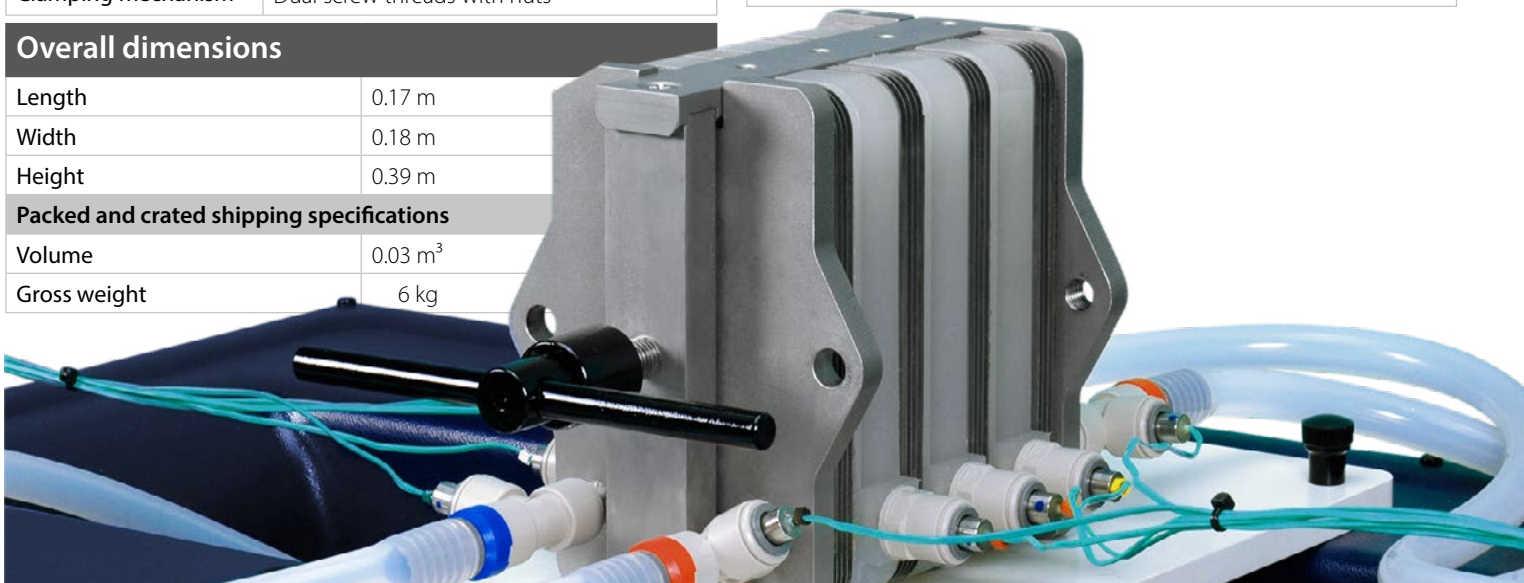
- ▶ A small scale plate heat exchanger system for use with an Armfield Heat Exchange Service Unit to teach the fundamental concepts of heat exchangers
- ▶ Comprises a number of stainless steel plates, each with a pressed chevron pattern and a food grade silicon rubber sealing gasket, mounted in a frame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

HT37 Essential Accessories

- ▶ HT30XC Computer controlled service unit

Ordering codes

- ▶ HT37 - Extended Reconfigurable Heat exchanger - See HT30XC for power options





armSOFT™

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

Description of armSOFT educational software

Features

Full educational software is provided with the HT30XC for all the Armfield heat exchangers. Separate 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:

- ▶ All the temperatures and flow rates are displayed on a diagrammatic representation of the equipment
- ▶ A software "button" switches the equipment from "standby" mode to fully on
- ▶ The cold water flow control valve is operated by using up/down arrows or typing in a value between 0 and 100%. The actual flow rate can be read directly in L/min
- ▶ The hot water flow rate is set by entering a required set point into a PID control function. This use of PID control ensures the flow is stable despite changes in the viscosity of the water due to heating
- ▶ The heater is again controlled in a PID loop, by setting a required temperature set point
- ▶ Data from the sensors is logged into a spreadsheet format, under operator control
- ▶ Sophisticated graph plotting facilities are provided. Comparisons between data taken on different runs can be displayed
- ▶ Student questions and answers, including a layered "Hint" facility
- ▶ Processing of measured values to obtain calculated results (this can be linked to the questions and answers to ensure student understanding)
- ▶ The data samples (measured and calculated) can be saved, or exported directly in Microsoft Excel format.
- ▶ Data from the sensors can be displayed independently from the data logging. This can be in bar graph format, or a recent history graphical display (useful to check for temperature stability prior to taking a sample)
- ▶ Presentation screens are available, giving an overview of the software, the equipment, the procedure and the associated theory. This is backed up by a detailed "Help" facility giving in-depth guidance and background information



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Applications

ChE ME CE IP

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Instructional capabilities

Training exercises that are common to each of the heat exchangers when used with the HT30XC:

- ▶ 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 HT34 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:

HT30XC-A: 230V, 50Hz, 10Amp

HT30XC-B: 115V, 60Hz, 20Amp

HT30XC-G: 230V, 60Hz, 10Amp

- ▶ Software requires a computer running Windows XP or above 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 1 bar gauge (min)

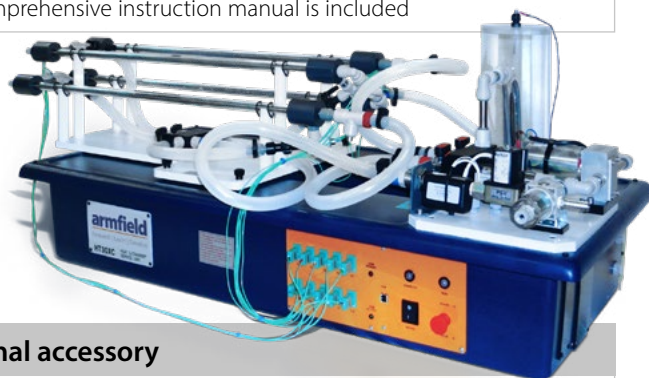
Overall dimensions

Length	0.45 m
Width	1.00 m
Height	0.5 m
Packed and crated shipping specifications	
Volume	0.33 m ³
Gross weight	33 kg

Ordering specification

HT30XC - Computer Controlled Heat Exchanger Service Module

- ▶ A lightweight bench top service unit, designed to accommodate a range of different small scale heat exchangers
- ▶ Comprises hot water vessel, 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 the quick release pipe couplings 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 flow control valve, which is under computer control
- ▶ 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. HT32 & HT36 Plate Heat Exchangers)
- ▶ Up to ten temperatures (K-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 0.2 to 9 L/min, resolution 0.1 L/min
- ▶ All data is available to a (user supplied) Windows PC, via a USB interface. This computer is also used to control the flow rates, hot water temperature, the flow rates and hot water temperature
- ▶ Full software for educational use is included
- ▶ Ability for users to write and use their own software (Eg. Labview)
- ▶ Includes failsafe hardware facilities for remote operation, Eg. over the internet, when used with the customers software
- ▶ A comprehensive instruction manual is included



Optional accessory

- ▶ HT31-Tubular Heat Exchanger
- ▶ HT32-Plate Heat Exchanger
- ▶ HT33-Shell & Tube Heat Exchanger
- ▶ HT34-Jacketed Vessel With Coil & Stirrer
- ▶ HT35-Cross Flow Heat Exchanger
- ▶ HT36-Extended Tubular Heat Exchanger
- ▶ HT37-Extended Reconfigurable Plate Heat Exchanger

Ordering codes

- ▶ HT30XC-A
- ▶ HT30XC-B
- ▶ HT30XC-G

Knowledge base

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

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Armfield recognises that it is not enough to just supply quality engineering equipment, but that it must also ensure a complete range of services both pre and post-sale:

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- ▶ Expert consultation in laboratory design and layout
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