

**COMPUTER-CONTROLLED HEAT TRANSFER TEACHING EQUIPMENT – HT10XC**

The Armfield HT10XC is a service unit that can be used in conjunction with a range of small-scale accessories for a wide range of demonstrations into the modes of heat transfer.

The factors that affect heat transfer can be investigated and some of the practical problems associated with the transfer of heat can be visualised.

The heat transfer accessories may be individually connected to the HT10XC service unit, which provides the necessary electrical supplies and measurement facilities for investigation and comparison of the different heat transfer characteristics.



**Key Features**

- ▶ Small-scale, benchtop equipment
- ▶ Common service unit avoids unnecessary cost duplication for control and instrumentation
- ▶ Multiple accessories available covering a wide range of heat transfer investigations
- ▶ Safety functions implemented to allow remote access
- ▶ Improved accuracy for quantitative results, which can be related directly to theory
- ▶ Integral USB interface
- ▶ Educational software, including mimic diagrams, real-time control and data logging, graph plotting, and detailed “Help” facility

UK office - email: [sales@armfield.co.uk](mailto:sales@armfield.co.uk) tel: +44 (0) 1425 478781 (for ROW)  
 USA office - email: [info@armfield.inc](mailto:info@armfield.inc) tel: +1 (609) 208-2800 (USA only)

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## HT10XC Computer Controlled Heat Transfer Teaching Equipment

### HT10XC Heat Transfer Service Unit

The service unit is housed in a robust steel enclosure and designed for benchtop use. It provides control outputs to the accessories, and instrumentation inputs from the accessories.

#### OUTPUTS:

- ▶ A stabilised, variable DC supply to the heater of the heat transfer accessory under evaluation
- ▶ Drive to flow-regulation valves on HT11C and HT12C
- ▶ Drive to the variable-speed air blowers used on HT14C and HT16C

#### INPUTS AND INSTRUMENTATION:

Temperatures: . . . . . (up to ten off, dependent on accessory)  
 Heater voltage: . . . . . (All accessories except HT17)  
 Heater current: . . . . . (All accessories except HT17)  
 Heat radiated: . . . . . (HT13)  
 Light radiated: . . . . . (HT13)  
 Air velocity: . . . . . (HT14, HT14C, HT16, HT16C, HT19)  
 Cooling water flow rate: . . (HT11C, HT12C, HT18C)

In manual mode, the outputs listed above are under control of potentiometers on the front panel of the unit. In remote mode the outputs to the accessories are controlled by the computer.



### Ordering specification

- ▶ A benchtop service unit designed to interface to a range of heat transfer accessories
- ▶ Provides a variable, stabilised 0-24V DC supply to the heater of the heat transfer accessory, with a current capability of 9A
- ▶ Provides a drive signal for a proportioning solenoid valve used for flow control
- ▶ Provides a control signal to a variable-speed blower used for generating air flow
- ▶ Ten temperature inputs and conditioning circuits for K-type thermocouples:
  - ▶ Nine off, 0-133°C, resolution <0.1°C
  - ▶ One off, 0-500°C, resolution <0.15°C
- ▶ Instrumentation inputs for heater voltage, heater current, air flow, water flow, radiation and light meter
- ▶ Integral USB interface, and educational software for all accessories
- ▶ Outputs can be controlled manually from the front panel, or controlled by the software from a user-supplied PC
- ▶ Easy interfacing to third-party software, eg LabVIEW
- ▶ Watchdog circuit for operator and equipment safety in case of computer or interface failure when being controlled remotely
- ▶ A comprehensive instruction manual describing how to carry out the laboratory teaching exercises in unsteady state heat transfer and their analysis as well as assembly, installation and commissioning is included

### Software

Full educational software is provided with the HT10XC for all the Armfield heat transfer accessories. Separate programs are provided for each accessory, 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 other signals such as flow rates, heater voltage and current, etc are displayed on a diagrammatic representation of the equipment
- ▶ A software 'button' switches the equipment from "standby" mode to fully on
- ▶ The control outputs are operated by using up/down arrows or typing in a value between 0 and 100%. The sensor values can be read directly in engineering units
- ▶ Data from the sensors is logged into a spreadsheet format, with operator control over the sampling intervals (or 'single-shot')
- ▶ Sophisticated graph-plotting facilities are provided, including plotting of both measured and calculated values. Comparisons between data taken on different runs can be displayed. Also the graphs update in real-time as the samples are being taken
- ▶ Student questions and answers, including a layered "Hint" facility
- ▶ Processing of measured values to obtain calculated values – this can be linked to the questions and answers to ensure student understanding
- ▶ The data samples can be saved, or exported 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.

### Requirements

### Scale



#### Single Phase Electrical supply:

- ▶ See ordering codes for specific requirements  
 (Current figures are worst-case figures, including the supply to appropriate accessory)

### Overall dimensions

Length	0.39m
Width	0.32m
Height	0.24m
Packed and crated shipping specifications	
Volume	0.05m <sup>3</sup>
Gross weight	15kg

### Ordering codes

<b>HT10XC-A:</b>	230V / 1ph / 50Hz @ 5 amp
<b>HT10XC-B:</b>	115V / 1ph / 60Hz @ 10 amp
<b>HT10XC-G:</b>	220V / 1ph / 60Hz @ 5 amp