

The HT17X equipment consists of a heated water bath together with a set of instrumented shaped test pieces. Each of the shapes incorporates a thermocouple to measure the temperature at the centre of the shape.



Shape holder and solid shapes supplied with HT17X



Hardware Description

HT17X mimic diagram and control screen

HT17X graphing screen

The equipment consists of a heated water bath together with a set of instrumented shaped test pieces. Each of the shapes incorporates a thermocouple to measure the temperature at the centre of the shape.

A total of six shaped test pieces are provided, i.e. three simple shapes (a rectangular slab, a long solid cylinder and a solid sphere) each manufactured in two different materials (brass and stainless steel).

Measurements taken on a shape in one material can be used to confirm the conductivity of a similar shape constructed from a different material. Transient-temperature/heat-flow charts are supplied for each of the shapes.

A circulating pump mounted alongside the water bath draws water from the bath and returns it at the base of a vertical cylindrical duct, which is located inside the water bath at the centre. A holder ensures each of the shapes is quickly and correctly positioned within the vertical duct for measurements to be taken.

The upward flow of water at constant velocity passing the shape ensures the heat transfer characteristic remains constant and also ensures the water surrounding the shape remains at a constant temperature.

The rate of water recirculation can be varied by using the software to adjust the DC voltage on the pump or use PID controller to achieve flow-rate set-point automatically. The shape holder has been carefully designed to eliminate the need to touch the shape while its temperature stabilises in air, and also to position the shape accurately inside the water bath while transient measurements are taken.

A thermocouple mounted on the shape holder contacts the hot water at the same instant as the solid shape and provides an accurate datum for temperature/time measurements.

A thermostat allows the water to be heated to a predetermined temperature before taking measurements. The large volume of water in the bath ensures that any change in the temperature of the water, as the measurements are taken, is minimal.

The water bath is heated by a mains powered electrical heater, and protected by a residual current device for operator safety. A thermocouple located in the water bath enable the temperature of the water to be monitored and adjusted to the required temperature.

Experimental Capabilities

- ▶ To observe unsteady state conduction of heat to the centre of a solid shape, when a step change is applied to the temperature at the surface of the shape
- ▶ Using analytical transient-temperature/heat flow charts to determine the conductivity in cylinders with different conductivity
- ▶ Investigating the effect of shape, size and material properties on unsteady heat flow using analytical transient-temperature/heat flow charts

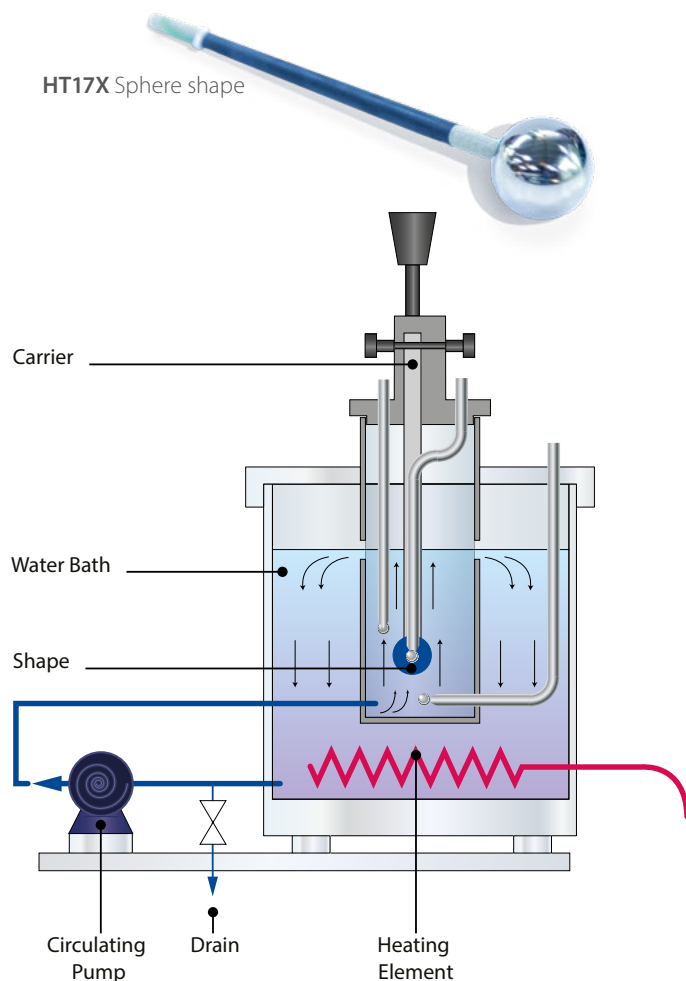
Description

Analytical solutions are available for temperature distribution and heat flow as a function of time and position for simple solid shapes, which are suddenly subjected to convection with a fluid at a constant temperature.

Simple shapes are provided together with appropriate classical transient-temperature/heat-flow charts, which enable a fast analysis of the response from actual transient measurements. Each shape is allowed to stabilise at room temperature then suddenly immersed in a bath of hot water at a steady temperature.

Monitoring of the temperature at the centre of the shape allows analysis of heat flow using the appropriate transient-temperature/heat-flow charts provided.

An independent thermocouple mounted alongside the shape indicates the temperature of the water adjacent to the shape and provides an accurate datum for measurement of the time since immersion in the hot water.



Schematic diagram showing operation of the HT17X

Requirements

Scale

HT
10X



All electrical requirements are obtained from the service unit

Essential accessories

HT10X Computer-Controlled Heat Transfer Service Unit

Ordering specification

The Armfield 'Unsteady State Heat Transfer' accessory HT17X has been designed to allow exercises to be performed in unsteady state heat conduction, when simple solid shapes which are suddenly subjected to convection with a fluid at a constant temperature.

- ▶ The water is heated by an electric heating element in the base of the bath having a nominal rating of 3.0 kW
- ▶ An adjustable thermostat, at the base of the water heater allows the water to be heated to a predetermined temperature before taking measurements
- ▶ Thermocouple at the base of the flow duct, inside the water bath, allows the temperature of the water to be monitored and adjusted to the required temperature
- ▶ Comprises of a set of seven solid shapes, manufactured in three simple shapes and two materials. Each sample has a permanently installed K-type thermocouple inside
- ▶ The thermocouple mounted on the shape holder contacts the hot water at the same instant as the solid shape and provides an accurate datum for temperature/time measurements
- ▶ The resolution of all temperature readings is 0.7°C
- ▶ A circulating pump mounted alongside the water bath draws water from the bath and returns it to the base of the vertical cylindrical flow duct
- ▶ The accessory is mounted on a PVC baseplate, which is designed to stand on the bench top and connect to the HT10X service unit without the need of tools
- ▶ A comprehensive instruction manual is included

Overall dimensions

Length	0.60m
Width	0.40m
Height	0.67m

Packed and crated shipping specifications

Volume	0.29m ³
Gross weight	23kg

Ordering codes

HT17X

Issue: 1

URL: <http://www.armfield.co.uk/ht10x>

Applications

Me ChE CE IP

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