

**HT
SERIES**

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Unsteady-State Heat Transfer – HT17

Shape holder and solid shapes supplied with HT17

Hardware Description

The equipment consists of a heated water bath together with 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, ie 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 past 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 HT10XC to adjust the DC voltage on the pump. 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



Typical mimic diagram showing spherical shape immersed in the hot water bath

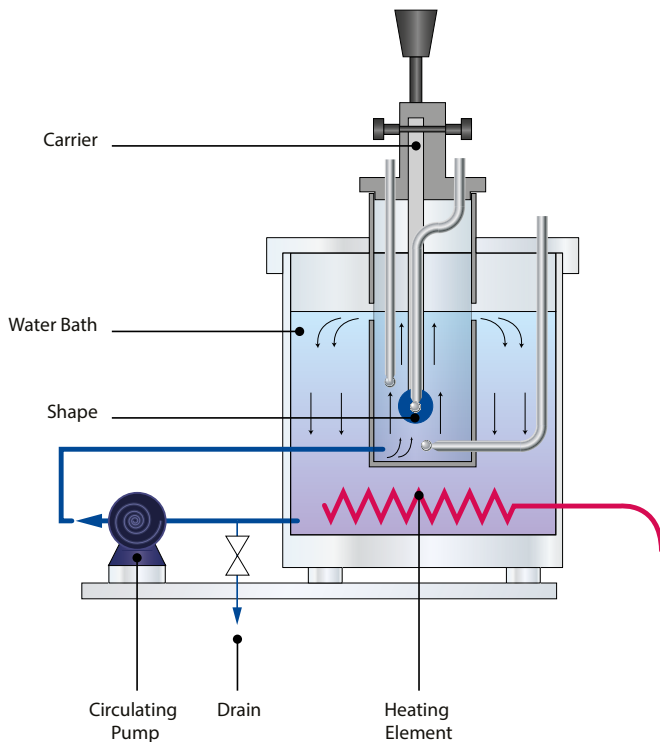
Unsteady-State Heat Transfer – HT17 Description

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 HT17

Requirements

Scale

HT 10XC



Electrical supply:

HT17-A:	230V / 1ph / 50Hz @ 13 amp
HT17-B:	115V / 1ph / 60Hz @ 26 amp
HT17-G:	230V / 1ph / 60Hz @ 13 amp

Essential accessories

HT10XC Computer-Controlled Heat Transfer Service Unit with associated PC for data logging

Ordering specification

- ▶ A small-scale accessory to demonstrate how temperature measurements can be influenced by sources of thermal radiation
- ▶ Comprises three K-type thermocouples with different styles of bead mounted in a vertical air duct. A fan at the base of the duct provides a variable air flow over the cylinder. A band heater heats the duct wall adjacent to the thermocouple beads
- ▶ Heater rating 216W at 24V DC
- ▶ K-type thermocouples measure the air temperature upstream and the surface temperature of the heated duct section
- ▶ On the computer-controlled unit the air flow is electronically adjustable over the range of 0-9 m/s by a variable-speed fan, otherwise it is manually adjustable
- ▶ The air flow rate is measured by a vane-type anemometer in the outlet duct
- ▶ A radiation shield can be lowered over the thermocouples to demonstrate the improvement in reading accuracy when the thermocouples are shielded from the source of radiation
- ▶ The accessory is mounted on a PVC baseplate, which is designed to stand on the benchtop and connect to the Heat Transfer Service Unit without the need for tools
- ▶ A comprehensive instruction manual is included

Overall dimensions

Length	0.60 m
Width	0.40 m
Height	0.67m

Packed and crated shipping specifications

Volume	0.17m ³
Gross weight	14kg

Ordering codes

HT17-A:	230V / 1ph / 50Hz @ 13 amp
HT17-B:	115V / 1ph / 60Hz @ 26 amp
HT17-G:	230V / 1ph / 60Hz @ 13 amp