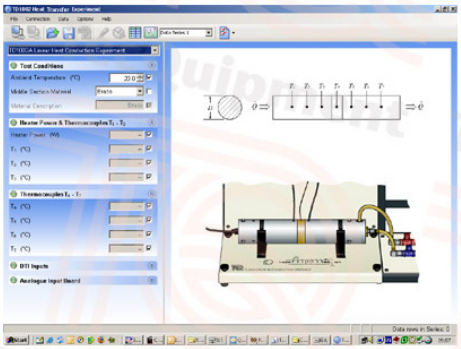
TD1002

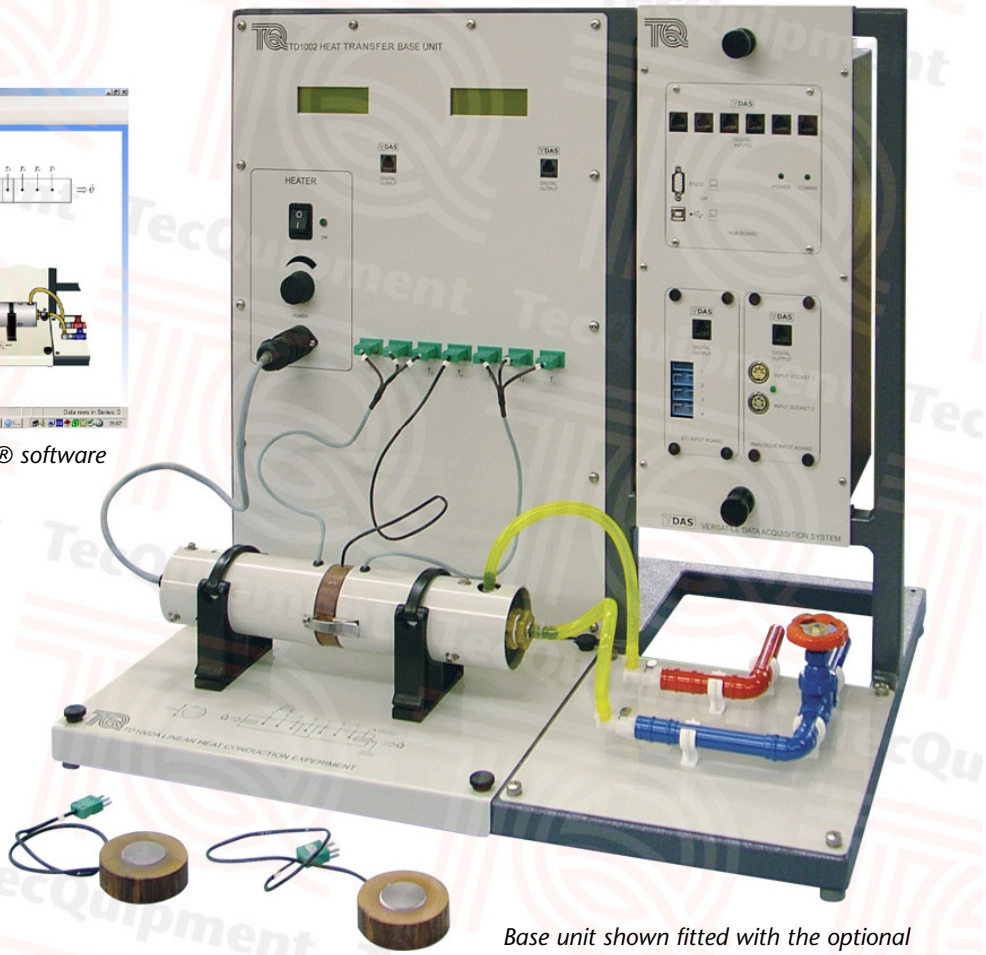
Heat Transfer Experiments

A range of optional experiments that study different methods of heat transfer

Works with VDAS®



Typical Screenshot of the VDAS® software



Base unit shown fitted with the optional VDAS-F and the optional Linear Heat Conduction Experiment (TD1002a)

- A self-contained bench-top Base Unit with four optional experiments
- Available experiments include the two most common heat conduction studies – linear and radial heat conduction
- Simple and safe to use - foolproof fittings allow students to change and connect the optional experiments quickly and easily – needs no tools
- The Base Unit has clear digital displays of all readings – you do not need a computer to work it or take readings
- Optional Linear Heat Conduction Experiment includes different metal sections to allow more experiments
- The experiments each have a bedplate with a clear schematic diagram to show students how they connect, and the measuring point positions
- Can connect to TecQuipment's Versatile Data Acquisition System (VDAS®)

TecQuipment Ltd, Bonsall Street, Long Eaton, Nottingham NG10 2AN, UK

T +44 115 972 2611 • **F** +44 115 973 1520 • **E** info@tecquipment.com • **W** www.tecquipment.com

TecQuipment

TD1002

Heat Transfer Experiments

Description - Base Unit

The Base Unit (TD1002) is the core of the TD1002 range. It provides cold water and heater power to the optional experiments and all the instruments needed to measure their performance.

The Base Unit's water system connects to a suitable cold water supply and drain. It includes a hand-operated valve to help give a controllable water flow and a simple return pipe, both colour-coded.

The water connections to the optional experiments are self-sealing quick connectors - for safety and simplicity. The inlet and outlet fluid streams have different colours to reduce errors. Changing an experiment takes less than a minute.

The Base Unit provides a variable and measured electrical current to the heater in each experiment and works with a safety switch to stop the heater from becoming too hot. It also includes sockets for the thermocouples built into each optional experiment.

Clear, multiline digital displays on the Base Unit show the temperatures and heater power of each experiment.

A spare area to the right of the Base Unit frame allows you to fit the optional VDAS-F hardware.

Each optional experiment is on a bedplate that has a clear schematic diagram showing the connections and measuring point positions. The bedplate fixes to the Base Unit with thumbscrews (students need no tools).

Note: You need at least one of the optional experiments. You cannot do experiments with just the Base Unit.

You can do tests with or without a computer connected. However, for quicker tests with easier recording of results, TecQuipment can supply the optional Versatile Data Acquisition System (VDAS). This gives accurate real-time data capture, monitoring and display, calculation and charting of all the important readings on a computer (computer not included).

Standard Features

- Supplied with comprehensive user guide
- Two-year warranty
- Made in accordance with the latest European Union directives

Studies (with optional experiments):

- Demonstration and calculations of Linear Heat Conduction.
- Demonstration and calculations of Radial Heat Conduction.
- Demonstration and calculations of Surface Heat Transfer (conduction, convection and radiation).
- Demonstration and calculations of Heat Conduction through liquids and gasses.
- Calculation of the thermal conductivity (k value).
- Demonstration of the effectiveness of thermal paste.
- Demonstration and calculations of thermal resistances (R value) in series.
- Demonstration of 'thermal lag'.

Essential Ancillaries

- Linear Heat Conduction Experiment (TD1002a)
- Radial Heat Conduction Experiment (TD1002b)
- Extended Surface Heat Transfer Experiment (TD1002c)
- Conductivity of Liquids and Gasses Experiment (TD1002d)

Recommended Ancillaries

- VDAS-F (frame-mounted version of the Versatile Data Acquisition System)

Operating Conditions

Operating environment:
Laboratory environment

Storage temperature range:
–25°C to +55°C (when packed for transport)

Operating temperature range:
+5°C to +40°C

Operating relative humidity range:
80% at temperatures < 31°C decreasing linearly to 50% at 40°C

Sound Levels

Less than 70 dB(A)

Essential Services

Bench Space Needed - 650 mm x 480 mm

Clean Water Supply and Waste.

Electrical Supply:

50 Hz to 60 Hz

100 VAC to 120 VAC at 5 A

OR

220 VAC to 240 VAC at 5 A

TecQuipment Ltd, Bonsall Street, Long Eaton, Nottingham NG10 2AN, UK
T +44 115 972 2611 • **F** +44 115 973 1520 • **E** info@tecquipment.com • **W** www.tecquipment.com

TecQuipment

TD1002

Heat Transfer Experiments

Description - Linear Heat Conduction Experiment (TD1002a)

A solid brass bar of circular cross-section, made in two sections with an interchangeable middle section. The first brass section includes three thermocouples and the electric heater (heat source). The second brass section includes a small water-cooled chamber (heat sink) and three more thermocouples. The interchangeable middle sections (supplied) are made of different metals:

- Brass - so the bar becomes effectively one length of brass
- Aluminium
- Stainless steel
- Copper

Each middle section has a thermocouple fitted.

The electric heater and thermocouples connect to sockets on the Base Unit, which also supplies the cold water feed and drain for the heat sink.

Students turn on the cooling water flow and adjust the heater power until the experiment reaches equilibrium and then record the temperatures as the heat conducts along the bar.

Insulation around the bar reduces heat loss by convection and radiation, so that the results should match the theory for simple linear conduction only.

Description - Radial Heat Conduction Experiment (TD1002b)

A solid brass disc with an electric heater (heat source) at its centre and a circular cross-section cooling tube (heat sink) around its circumference.

Students turn on the cooling water flow and adjust the heater power until the experiment reaches equilibrium.

At equally-spaced radii on the disc, seven thermocouples measure the temperature as the heat conducts radially outwards from the heater.

Insulation around the disc reduces heat loss by convection and radiation, so that the results should match the theory for simple radial conduction only.

Description - Extended Surface Heat Transfer Experiment (TD1002c)

A solid bar with an electric heater (heat source) at one end. The bar has a matt black coating for a consistent and predictable emissivity value.

Heat conducts along the bar and transfers to the local surroundings by natural convection and radiation. Thermocouples measure the temperature along the surface of the bar at equally-spaced intervals.

Students use initial test results to predict the temperatures and heat flow along the bar.

Description - Conductivity of Liquids and Gasses Experiment (TD1002d)

This experiment has three concentric cylinders. The inner cylinder contains a heater (the heat source). The test liquid or gas forms a second, thin cylinder around the heat source. The third cylinder surrounds them both. It connects to the cooling water supply from the Base Unit and forms the heat sink. Heat passes by conduction from the heat source through the test liquid or gas to the heat sink. Thermocouples measure the temperature on the inside and outside edges of the cylinder of test liquid or gas.

Caps of thermally-insulating material at the ends of the cylinders reduce heat loss, but students do an initial experiment to calibrate the equipment to allow for heat losses and improve experiment accuracy.

Students turn on the cooling water and the heater and measure the temperatures at each side of the test gas or liquid. They then compare their results with those predicted from theory for conduction in liquids and gasses.

Note: The TD1002d equipment is made of brass, aluminium, tufnol, nylon and nickel-plated parts. For safety reasons and to avoid damage to the equipment, only use test fluids that will not damage or react with the materials used to make the TD1002d. TecQuipment do not supply and cannot be held responsible for the test fluids that you use.

Suitable test fluids include:

- Normal, dry air
- Carbon Dioxide
- Castor Oil

Technical Details

Nett Dimensions and Weights
Base Unit (TD1002):
650 mm x 480 mm x 590 mm high and 24 kg

Linear Heat Conduction Experiment (TD1002a):
390 mm x 280 mm x 130 mm high and 4 kg

Radial Heat Conduction Experiment (TD1002b):
390 mm x 280 mm x 170 mm high and 5.3 kg

Extended Surface Heat Transfer Experiment (TD1002c):
430 mm x 280 mm x 90 mm high and 2 kg

Conductivity of Liquids and Gasses Experiment (TD1002d):
430 mm x 280 mm x 150 mm high and 6 kg

- TecQuipment Ltd, Bonsall Street, Long Eaton, Nottingham NG10 2AN, UK
- **T** +44 115 972 2611 • **F** +44 115 973 1520 • **E** info@tecquipment.com • **W** www.tecquipment.com

TecQuipment