LAMINAR/VISCOUS FLOW HEAT TRANSFER UNIT
H971

Year 1
study

Features
- Digital PID temperature control. Stabilises in minutes to allow rapid data collection.
- Investigation of laminar heat transfer under varying conditions.
- Investigation of non-dimensional Nusselt number and Graetz number relationship.

Description
The Hilton H971 Laminar/Viscous Flow Heat transfer unit has been designed to provide students with experimental work related to the transfer of heat in a concentric tube heat exchanger, when flow is laminar.

Heat transfer is allowed to take place between oil and water in a concentric tube. Oil flowing in the inner tube is raised to a maximum temperature of 90°C in a tank fitted with an electric heating element. Control is by a panel mounted digital PID controller and the maximum temperature is limited by a separate thermostat for operator safety.

The heated oil is pumped from the tank into the core tube of the diagonally mounted concentric tube heat exchanger. As it flows downwards, the oil is cooled as heat is transferred to the flow of cooling water which surrounds the core tube.

On leaving the oil passes through a flow control valve to a strong glass measuring cylinder fitted with a contents scale. By measuring the volume change over time, an accurate flow rate may be determined. A quick acting valve and internal overflow allows oil back to the heater tank for re-circulation.

Mains cold water passes through a combined flow control valve and flowmeter to a separate pair of valves mounted on the front panel. These valves direct the cold water to

either end of the heat exchanger and allow instantaneous flow reversal from concurrent to counter-current flow.

Thermocouples sense the hot and cold stream temperatures and the wall temperatures on entry and exit. A digital thermometer with a selector switch, displays the temperature sensed by the oil, water and pipe temperature thermocouples.

Related laws

- Nusselt number
- Graetz number
- Chemical Engineering
- Marine engineering
- Mechanical Engineering
- Plant & Process engineering

Learning capabilities

- Demonstration of a simple concentric tube heat exchanger with con-current and counter-current flow.
- Simple energy balance for a heat exchanger.
- Determination of surface heat transfer coefficients on both the oil and water sides and of the overall heat transfer coefficient.
- Establishment of the relationship between Nusselt Number and Graetz Number(Nu=f Gza) for Reynolds Numbers up to 1400.

Technical Specification

- Panel: High quality GRP.
- Heat Exchanger: Concentric tube type with 2 inlet, 2 outlet and 2 pipe surface type T thermocouples . Area 0.0305m2.
- Heater Tank: Capacity approximately 2.5 litre with 500W heater controlled by digital PID controller.
- Measuring Tank: Pyrex glass, effective capacity 0.5 litre.
- Pump: Continuous rated to circulate hot oil.
- Flow Meter: For cold water.
- Digital Thermometer: 0.1°C resolution, with multi-way selector switch.
- Cold water flow reversal valves x 2.
- Safety Features:
- - Thermostat to limit oil temperature to 90°C
- - Combined main switch and overload cut out
- - Residual current circuit breaker
- - All metal components connected to common earth conductor.

What's in the Box?

- 1 x H971
- 1 x Stopwatch
- 1 x Funnel
- 2 x Reinforced hosing
- 1 x Heat Transfer Oil
- Instruction manual
- Packing list
- Test sheet

Weights & Dimensions

- Weight: 60 kg
- Length: 1060mm
- Width: 430mm
- Height: 920mm

Essential Services

- 1.4kW (6A) 220-240 Volts, Single Phase, 50Hz(With earth/ground).
- 1.4kW (12A) 110-120 Volts, Single Phase, 60Hz(With earth/ground).
- Cold Water: Continuous supply, 180 litres per hour at 20m head.

Ordering information

To order this product, please call PA Hilton quoting the following codes:
H971/230
H971/115