THERMAL CONDUCTIVITY OF METAL ROD

MODEL HMT. 001

Thermal conductivity is the intrinsic property of a material which relates its ability to conduct heat. It's study is important in engineering heat transfer application as materials of high thermal conductivity are widely used in heat sink applications and materials of low thermal conductivity are used as thermal insulation.

This experiment aims at calculating value of thermal conductivity of given Metal rod using a well-engineered experimental setup. A Metal Bar , one end of which is heated while the other end projects inside cooling jacket. The middle potion is surrounded by cylindrical shell filled with insulating powder. Thermocouples are placed on rod, shell and cooling jacket to determine thermal conductivity. Water flow rate is also measured.

Specifications	Control Panel	Heater	Thermocouples
• Test Bar: 300 mm long / 25 mm Dia./ Brass • Shell Dia.: 175 mm • Measuring Flask 1 litre	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Band Type • Dimmer Controller	• K-type (Cr.Al) • 8 Nos. • Multi-Channel Temp. Indicator

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CRITICAL HEAT FLUX APPARATUS

MODEL HMT. 002

Critical heat flux describes the thermal limit of a phenomenon where a phase change occurs during heating which suddenly decreases the efficiency of heat transfer. The understanding of CHF phenomenon is important for safe and economic design of many heat transfer units including nuclear reactors, fossil fuel boilers, fusion reactors, electronic chips, etc.

The experiment is designed to illustrate the characteristics of the boiling phase change phenomenon. It involves observing the rate of boiling of a saturated liquid on the surface of a submerged hot wire object and measuring the variation of the object temperature with time

The objective of this experiment is to observe the regimes of nucleate, transition, and film boiling in a pool of saturated liquid, to determine the rate of boiling, and to construct the boiling curve.

Specifications	Control Panel	Heater	Thermocouples
• Transparent Glass Container : 150 mm Dia.	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Multi-Channel Temp. Indicator • Toggle ON/OFF	• Nichrome wire : 0.135 mm Dia • Dimmer Controller	• PT-100 (RTD)

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HEAT TRANSFER THROUGH COMPOSITE WALL

MODEL HMT. 003

Composite materials are widely used for purposes associated with transfer of heat. Therefore it is important to determine the rate of heat transfer through different layers of composite wall and develop expressions that model the heat transfer in composites.

The experimental set-up consists of test specimen made of different materials aligned together on both sides of the heater unit. The first test disc is next to a controlled heater. The temperatures at the interface between the heater and the disc is measured by a thermocouple, similarly temperatures at the interface between other discs are measured. The whole set-up is kept in a convection free environment.

Specifications	Control Panel	Heater	Thermocouples
• Wall : Dia: 200 mm • MS : 16 mm Thk • Bakelite : 12 mm Thk • Wood : 8 mm Thk	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Plate Type • Dimmer Controller	• K-type (Cr.Al) • 8 Nos. • Multi-Channel Temp. Indicator

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CRITICAL RADIUS OF INSULATING MATERIAL

MODEL HMT. 004

Insulating materials reduce heat fluxes. As the thickness of insulating material increases, the thermal resistance increases. However, adding layers of insulation to curved surfaces, such as cylinders and spheres, increases the surface area for convection. This may actually increase the heat transfer.

The apparatus is used to determine critical radius for insulated cylinders by determining heat transfer coefficient and the thermal conductivity of the insulation.

Specifications	Control Panel	Heater	Thermocouples
• Radius: 25 mm • Insulating Material: Asbestos	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Cartridge Type • Dimmer Controller	• K-type (Cr.Al) • 8 Nos. • Multi-Channel Temp. Indicator

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EMISSIVITY MEASUREMENT APPARATUS

MODEL HMT. 005

Knowledge of surface emissivity is important both for accurate non-contact temperature measurement and for heat transfer calculations.

Experimental setup consists of two circular plates identical in size and are provided with heating coils. The plates are kept in an enclosure and heat input can be varied by regulators and is measured by an ammeter and voltmeter. Each plate has thermocouple and one to read the chamber temperature. One plate is blackened by a layer of enamel black paint to form the idealized black surface whereas the other plate is the test plate. The aim is to measure the emissivity of the test plate surface.

Specifications	Control Panel	Heater	Thermocouples
• Test and Black Plates: 150 mm Dia	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Plate Type • Dimmer Controller	• K-type (Cr.Al) • 3 Nos. • Multi-Channel Temp. Indicator

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HEAT TRANSFER IN FORCED CONVECTION

MODEL HMT. 006

Forced convection heat transfer mechanism is found very commonly in everyday life, including central heating, air conditioning, steam turbines and in many other machines.

The forced convection apparatus has a Constant speed fan with variable flow control valve The heater is located at the centre of the test section. The forced air flowing through the pipe causes the heat transfer due to convection process. This temperature difference between up and down stream can be determined using the thermocouples placed along the test section.

Specifications	Control Panel	Heater	Thermocouples
• Test Pipe: 32 mm dia • Length: 400 mm • Centrifugal Blower • Orifice meter and Manometer arrangement to measure flow rate	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF • Blower Speed Regulator	• 400 Watt • Band Type • Dimmer Controller	• K-type (Cr.Al) • 7 nos. • Multi-Channel Temp. Indicator

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HEAT PIPE DEMONSTRATOR

MODEL HMT. 007

Heat pipe is a heat transfer device which finds its applications in computer system cooling, spacecraft and HVAC systems.

The apparatus aims to determine thermal conductivity of heat pipe and its comparison with other pipes. Heat pipe is made up of SS with partially filled and evacuated distilled water.

Specifications	Control Panel	Heater	Thermocouples
• Heat Pipe: 38 mm Dia 380 mm Long • Other : SS and Cu Pipe • Water Jacket	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Band Type • Dimmer Controller	• K-type (Cr.Al) • 6 Nos. • Multi-Channel Temp. Indicator

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THERMAL CONDUCTIVITY OF INSULATION POWDER

MODEL HMT. 008

Determination of thermal conductivity is important as it is the measure of how quickly heat passes through given material. Insulating powders are widely used in heat insulation applications

The apparatus consists of two thin walled concentric copper spheres. The inner sphere houses the heating coil. The insulating powder is packed between the two shells. The power supply to the heating coil is adjustable. Thermocouples are embedded on the outer surface of the inner sphere and inner of the outer shell.

Specifications	Control Panel	Heater	Thermocouples
• Sphere: ID: 75 mm • OD 150 mm • MOC: Copper	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Spherical Type • Dimmer Controller	• K-type (Cr.Al) • 6 Nos. • Multi-Channel Temp. Indicator

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HEAT TRANSFER THROUGH LAGGED PIPE

MODEL HMT. 009

Pipe lagging is the process of providing insulation to prevent heat diffusion from pipe. The insulating material is normally wrapped around pipes.

The apparatus is designed to study the lagging phenomenon. Three concentric pipes are arranged between two supports. The gap between the pipes are filled compactly by two different insulating materials and heater is provided at the center of inner pipe. Temperature at various points are measured with thermocouples.

Specifications	Control Panel	Heater	Thermocouples
• Test Bar: 400 mm long / 25 mm Dia./ Brass • Outer Shell Dia.: 125 mm • Middle Shell Dia.: 75 mm • Inner Shell Dia.: 25 mm	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Cartridge Type • Dimmer Controller	• K-type (Cr.Al) • 6 Nos. • Multi-Channel Temp. Indicator

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THERMAL CONDUCTION IN LIQUIDS / GASES

MODEL HMT. 010

Thermal conductivity is the property of a material to conduct heat. Thermal conductivity of liquids plays a significant role in the cooling of electrical equipment's such as transformers.

The apparatus setup consist of two concentric cylinder with thin gap through which liquid or gas can be introduced. Set of temperature sensor measures the heat conduction in fluid medium from which its thermal conductivity can be determined

Specifications	Control Panel	Heater	Thermocouples
• Dia: 39.2 mm • Fluid Film Thickness: 0.4 mm • Length: 300 mm	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Cartridge Type • Dimmer Controller	• K-type (Cr.Al) • PT-100 Type -2 • Multi-Channel Temp. Indicator

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HEAT TRANSFER IN NATURAL CONVECTION

MODEL HMT. 011

Natural convection is present both in nature and engineering applications. From ocean currents to cooling of molten metals and fluid flows around fins to solar ponds all follows natural convection mechanism

The apparatus is used to determine the overall heat transfer coefficient using natural convection. A Rectangular Duct with open ends has a vertical brass tube with heater fitted at bottom . The Heat Transfers From The Tube To The Surrounding Air By Natural Convection. Temperature sensors Measures values At Different Points Including duct temperature.

Specifications	Control Panel	Heater	Thermocouples
• Test Pipe: Brass • Dia: 32 mm • Length: 400 mm	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • BandType • Dimmer Controller	• K-type (Cr.Al) • 6 Nos. • Multi-Channel Temp. Indicator

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PARALLEL AND COUNTER FLOW HEAT EXCHANGER

MODEL HMT. 012

A heat exchanger are widely used in refrigeration, air conditioning, power plants and automobiles.

The apparatus allows heat exchange between hot and cold water in both parallel flow and counter flow fashion. This is made possible with the help of simple valve arrangement. Temperature indicators are placed to measure hot water inlet and outlet as well as cold water inlet and outlet temperature. Effectiveness and LMTD values of the heat exchanger can be determined

Specifications	Control Panel	Heater	Thermocouples
• Inner tube: GI/21 mm Dia • Outer Tube: GI/60 mm Dia • Effective Length: 750 mm • Valve arrangement for Parallel and Counter Flow • 1 ltr. Measuring Jar • Stopwatch	• Multi-Channel Temp. Indicator • Toggle ON/OFF	• 2 Litre Water Geyser	• K-type (Cr.Al) • 6 Nos.

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PLATE TYPE HEAT EXCHANGER

MODEL HMT. 013

Plate type heat exchanger are highly efficient and commonly used in low temperature applications such as refrigeration and air conditioning.

The apparatus allows heat exchange between hot and cold water in counter flow fashion. Temperature indicators are placed to measure hot water inlet and outlet as well as cold water inlet and outlet temperature. Effectiveness and LMTD values of the heat exchanger can be determined

Specifications	Control Panel	Heater	Thermocouples
• PHE Dimension: 200 x 80 mm • Plates: 14 • Necessary Valve arrangement • 1 ltr. Measuring Jar • Stopwatch	• Multi-Channel Temp. Indicator • Toggle ON/OFF	• 2 Litre Water Geyser	• PT-100(RTD) • 4 Nos.

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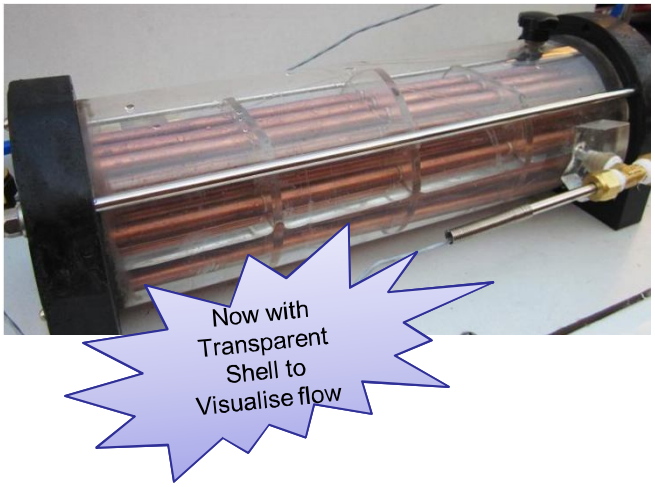
SHELL AND TUBE TYPE HEAT EXCHANGER

MODEL HMT. 014



Typical industrial applications for shell and tube heat exchangers include Oil transformer cooling; Exhaust gas heat recovery and Steam heating

Apparatus is Straight Tube Single Pass type Shell type heat exchanger Shell is made of clear Perspex and Tubes are copper. There is Arrangement for Counter and Parallel Flow. Temperature indicators are placed to measure hot water inlet and outlet as well as cold water inlet and outlet temperature. Effectiveness and LMTD values of the heat exchanger can be determined

Specifications	Control Panel	Heater	Thermocouples
• Shell Dia. 100 mm • Shell Length: 300 mm • No. of Baffle: 3 Nos. • No. of tubes: 17	• Multi-Channel Temp. Indicator • Toggle ON/OFF	• 2 Litre Water Geyser	• PT-100(RTD) • 4 Nos.

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SHELL AND TUBE TYPE HEAT EXCHANGER

MODEL HMT. 014 .1 (Larger 1000 m Shell)

Specifications	Control Panel	Heater	Thermocouples
• Shell Dia. 100 mm • Shell Length: 1000 mm • No. of Baffle: 3 Nos. • No. of tubes: 6	• Multi-Channel Temp. Indicator • Toggle ON/OFF	• 2 Litre Water Geyser	• PT-100(RTD) • 4 Nos.

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SPECIFIC HEAT OF AIR APPARATUS

MODEL HMT. 015

Set up is designed to evaluate the Specific Heat of Air at constant pressure.

The Specific Heat of Air apparatus has a Constant speed fan with variable flow control valve The heater is located at the center of the test section. The forced air flowing through the pipe causes the heat transfer due to convection process. Specific Heat is evaluated by taking the heat balance between heat supplied by heater and heat gained by air.

Specifications	Control Panel	Heater	Thermocouples
• Pipe Dia: 25 mm • Orificemeter • Water Manometer • ½ HP Blower	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Cartridge Type • Dimmer Controller	• K-type (Cr.Al) • 4 Nos. • Multi-Channel Temp. Indicator

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STEFAN BOLTZMAN'S APPARATUS

MODEL HMT. 016

The most commonly used law of thermal radiation is the Stefan Boltzmann's Law. The apparatus is designed to determine the Stefan Boltzmann constant for the given material.

Flanged Hemisphere is fixed in a flat non-conducting plate. Outer surface of the hemisphere is enclosed in water jacket heated separately. Thermocouple measures mean temperature, and the response of temperature with time on a disc fitted at centre is used to calculate the Stefan Boltzmann constant.

Specifications	Control Panel	Heater	Thermocouples
• Hemisphere Jacket: 110 mm • Water Jacket: 150 mm Dia	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF	• 400 Watt • Immersion Type • Dimmer Controller	• K-type (Cr.Al) • 6 Nos. • PT-100 • 2 No. • Multi-Channel Temp. Indicator

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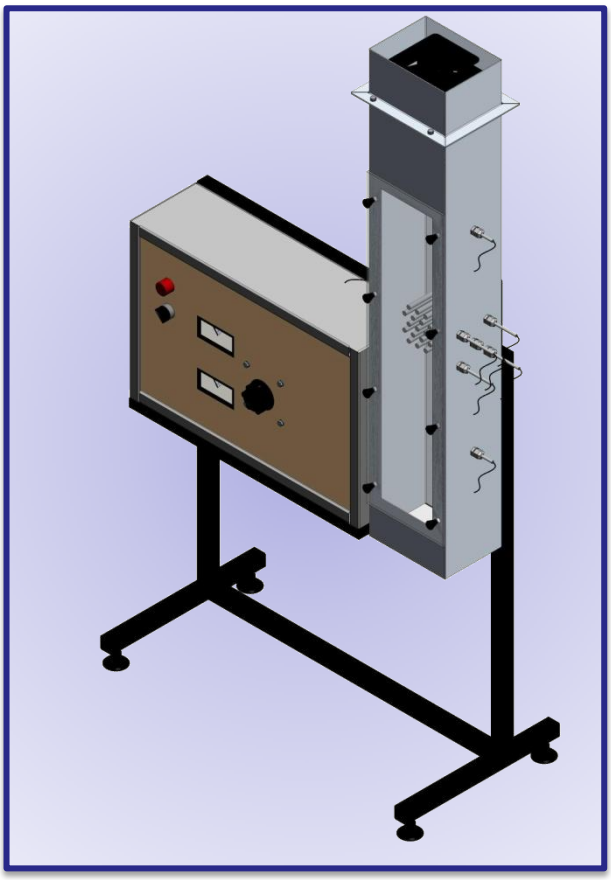
PIN FIN APPARATUS



MODEL HMT. 017

The rate of heat transfer can increased by extending the surface area. One of the most common method is by using fins. A pin fin heat sink has pins that extend from base and it can be cylindrical, elliptical or square.

Apparatus aims at studying heat transfer rate from the fin & the fin effectiveness in natural & forced conviction.

Specifications	Control Panel	Heater	Thermocouples
• Pin Fin MOC: Brass • Pin Fin Dia: 12 mm • Duct Length: 150 mm • Centrifugal Blower • Orifice meter and Manometer arrangement to measure flow rate	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Optional Wattmeter: 400W) • Toggle ON/OFF • Blower Speed Regulator	• 400 Watt • Band Type • Dimmer Controller	• K-type (Cr.Al) • 6 nos. • Multi-Channel Temp. Indicator

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DROP AND FILM WISE CONDENSATION

MODEL HMT. 018

Filmwise condensation occurs on 'wettable' materials as a formation of film on the surface, While dropwise condensation occurs on 'nonwettable' material as spherical drops form on the surface. These drops adhere together to become larger as condensation proceeds.

Apparatus aims at studying Condensation phenomena and calculating the heat transfer coefficient during condensation.

Specifications	Control Panel	Heater	Thermocouples
• Steam Generator: 10 Ltrs. (Approx.) made of Stainless steel with 2 kW (Approx.) heater with Insulation • Pressure Gauge : Standard • Copper tubes (2 Nos.): one with natural finish and other polished. • Diameter : 20 mm • Length : 200 mm	• Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (400W) • Toggle ON/OFF	• Coil Type	• K-type (Cr.Al) • Multi-Channel Temp. Indicator

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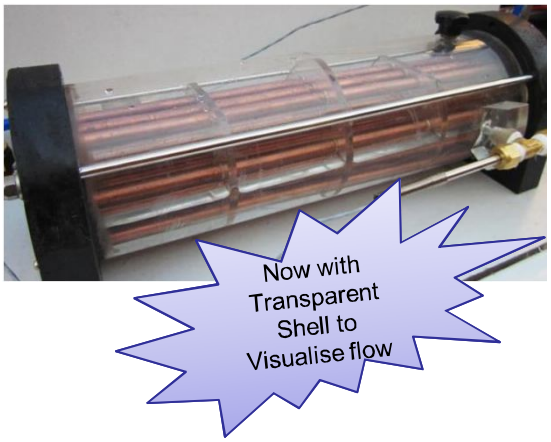
HEAT EXCHANGER TEST RIG (3-in-1)

MODEL HMT.020

PLATE TYPE

SHELL AND TUBE TYPE

PARALLEL AND COUNTER FLOW TYPE



SHELL AND TYPE	PARALLEL /COUNTER FLOW	PLATE TYPE
• Shell Dia. 90 mm • Shell Length: 400 mm • Tube Dia: 6 mm • No. of tubes: 6 • Temp Sensor: 4 Nos	• Outer Tube Dia 25 mm • Inner Tube Dia: 10 mm • Length: 600 mm • Temp Sensor: 4 Nos	• PHE Dimension: 200 x 80 mm • Plates: 14 • Temp Sensor: 4 Nos

OTHER FEATURES:

- Box Dimensions: 1500 mm x 600 mm x 1300 mm
- Hot Water Geyser : 2 Liters Capacity
- Flow Measurement using Rotameter
- Control Panel : Multi-Channel Temp. Indicator; ON/OFF Switch; Mains Indicator
- Detailed Technical Manual and Schematic Diagrams
- Service Requirement: Running Water Supply and 230V AC Power

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