



Thermal Conductivity of Liquid



Stefan Boltzman Apparatus



Critical Heat Flux Apparatus



Thermal Conductivity of Metal Rod



Thermal Conductivity of Insulating Powder Apparatus



# HEAT TRANSFER LAB



### 1400 Composite Walls Apparatus

The apparatus consists of a pair of M.S. plates, Bakelite, brass/aluminum. These plates in series on either side of the heater form a composite wall. The whole unit is clamped in a frame, which can be viewed through the Perspex sheet. The thermocouple tapings enables us to find out the conductivity and resistance of the composite walls.

#### SPECIFICATIONS

1. Heater - Mica heater of dia. 250 mm.
2. Plates -
  - M.S. plates of thickness 25mm & dia. 250mm-2 nos.
  - Bakelite plates of thickness 10mm & dia. 250mm-2 nos.
  - Brass / Aluminum plates of thickness 15mm & dia. 250mm-2nos.
3. Dimmerstat - 2 A capacity.
4. Measurements -
  - A Voltmeter and an Ammeter to measure input power.
  - Multichannel digital temperature indicator to measure temperatures at various points.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED

- 230V, A.C. stabilized supply along with earthing connection.
- Bench area 1m x 1m x 0.5m height.

### 1401 Lagged Pipe Apparatus

The apparatus consists of three concentric pipes mounted on suitable stand. The space between innermost and the middle pipe is fixed with a lagging material and the space between the middle and the outer most is filled with another lagging material. The lagged pipe is heated with a cartridge heater inserted at the axle length of the pipe. Voltmeter and ammeter on the panel can measure the input to the heater. The intermediate temperatures can be measured by the thermocouples attached at the surfaces of the pipe. Thus the resultant conductivity of the materials can be found out.

#### SPECIFICATIONS

1. Pipes :
  - GI pipe (innermost) - 6 cm (Outer Diameter).
  - GI Pipe (Middle) - 8.5 cm (Mean Diameter)
  - GI Pipe (Outermost) - 10.7 cm (Inner Diameter)
- Length of pipes 1 Meter.
1. Heater - Nichrome wire cartridge heater placed centrally, of suitable capacity.
2. Control Panel -
  - Single Phase Dimmerstat - 1 No.
  - Voltmeter (0 - 250V) - 1 No.
  - Ammeter (0- 2A) - 1 No.
3. Temperature Indicator - Multichannel Digital Temperature Indicator ranging (0 - 300° C) using Cr/Al Thermocouples.



#### SERVICES REQUIRED

- A.C. Single Phase 230V electric supply.
- Floor Area : 1.5m X 1m X 0.5 m High.

### 1402 Heat Pipe Apparatus

Heat pipe is an interesting device, which is used to transfer heat from one location to another.

The apparatus consists of three pipes, viz. A heat pipe, copper pipe and stainless steel pipe. All the pipes have same physical dimensions. Copper and stainless steel pipes serve the purpose of comparison of heat pipe performance. All pipes are mounted vertically with a band heater at lower end and water filled heat sink at upper end. Nearly isothermal operation of heat pipe is clearly visualized from longitudinal temperature distribution of the pipe.

#### SPECIFICATIONS

1. Heat pipe - Stainless Steel pipe, 25 mm O.D., 450 mm Long. Sealed at both ends, evacuated and filled partially with distilled water - one No.
2. Copper and stainless steel pipe of same size as that of heat pipe - one each.
3. Equal capacity heater at bottom end of each pipe.
4. Water filled heat sinks at upper end of each pipe.
5. Measurements and controls -
  - Dimmerstat to control heat input to all the heaters - 4 amp. Capacity One No.
  - A voltmeter and an ammeter to measure input to heaters One each.
  - Multichannel digital temperature indicator to measure temperatures along the length of pipes. Four thermocouples are provided on each pipe.
  - Thermometers to note down water temperatures in heat sinks - 3 Nos.



#### SERVICES REQUIRED

- 230 VA.C. Single Phase supply.
- Floor Area - 1 m X 0.5 m X 0.5m height.



### 1403 Critical Radius of Insulating Material

At particular radius of insulation over a cylinder, loss of heat is maximum. The unit consists of a G.I. pipe provided with plaster of Paris insulation on out side surface. Four pipes are provided with heater inside having input control. Input to heaters is measured by common voltmeter and ammeter, by controlling input to heaters, it is shown that critical radius of insulation is ratio of thermal conductivity and outside heat transfer co-efficient.

#### SPECIFICATIONS

1. G. I. Pipes with electrical heater inside - 4 Nos.
2. Insulation over the pipes of different thickness.
3. Controls and Measurements -
  - Dimmerstat to control heater input - 4 Nos.
  - A voltmeter and ammeter to measure inputs to heater.
  - Digital temperature indicator to measure temperatures across insulation.
  - Necessary switches and controls.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED

- 230 V, 5 Amp., A.C., Supply with earthing connection.
- Floor Area - 1 m X 1 m X 1.5m height.

### 1404 Pin Fin Apparatus

The apparatus consists of a channel in which the pin fin is tested in both natural as well as forced convection. The channel is connected to the suction of blower. The blower is operated to touch the pin fin in forced convection only. In natural convection, the window above the pin fin is kept open to the atmosphere. Five thermocouple tapings are given along the length of the fin. Thus the temperature distribution along the length can be distinguished. Also natural and forced heat transfer co-efficient, effectiveness, etc. can be found out.

#### SPECIFICATIONS

1. Three pin fins-
  - M. S.
  - Brass
  - Al
2. Channel - 150mm x 100mm x 1000mm
3. Blower - run by FHP motor.
4. Orifice meter along with water manometer to measure airflow.
5. Voltmeter and ammeter to measure power input.
6. Cr- Al thermocouple with 6 tapings along with temperature indicator.
7. Dimmerstat to control power input.
8. A band heater to heat the pin fin.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED

- 220V, stabilized single phase supply along with earthing Connection.
- Floor area 2m x 1m x 1m height.

### 1405 Natural Convection Apparatus

The unit consists of a vertical brass pipe heated by a cartridge heater inside it. The pipe loses heat to atmosphere by natural convection. It is fitted in an enclosure to provide undisturbed natural convection currents. Thermocouples are attached on the pipe to measure local temperatures. Heater input is measured on voltmeter and ammeter. Thus students can determine overall heat transfer coefficient and local transfer coefficients in natural convection at various heat transfer rates.

#### SPECIFICATIONS

1. Pipe - Brass pipe, 38mm dia. (OD) 500mm long, fitted with cartridge heater inside.
2. Thermocouples are fitted along with the length of pipe for Temperature measurement - 7 nos.
3. Enclosure 200mm x 200mm x 800mm size, with one side of Perspex sheet.
4. Measurements & Controls
  - A Dimmerstat for heater input control.
  - Voltmeter and Ammeter for heater input measurement.
  - Multichannel digital temperature indicator.

#### SERVICES REQUIRED

- 230V, 5A, AC, electric supply with earthing connection.
- Bench area of 1.5m x 0.75m at working height.



*A technical manual accompanies the unit.*

### 1406 Forced Convection Apparatus

The unit consists of a circular pipe; losing heat by forced convection to air, being forced through it. Constant heat flux is added to pipe by an electrical heater, provided with input control. The pipe surface temperature is measured at various points along length of pipe. Temperature of air at inlet and outlet of test section are measured. Thus, the students can calculate local and overall heat transfer coefficients in forced convection, at various airflow rates and various heat flux values.

#### SPECIFICATIONS

1. Test pipe - 32mm NB GI pipe, 500 mm long, heated by band heater, outside.
2. Centrifugal blower to force air through test pipe with control valve.
3. Variac 2A, capacity to force air through test pipe with flow control valve.
4. An orifice meter with differential water manometer.
5. Voltmeter and Ammeter to measure heater input.
6. Multichannel digital temperature indicator to measure various temperatures.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED

- Bench area of about 1m x 0.75m at working height.
- 239V, 15A, AC, supply with earthing connection.

### 1407 Specific Heat of Air Apparatus

The apparatus consists of heating element, on which the air is blown. The difference in temperature of air is shown by the temperature indicator. The flow of air is measured by the orifice meter. The input to the heater is measured by voltmeter and ammeter. Thus, the specific heat of air can be found out.

#### SPECIFICATIONS

1. Air blower connected to FHP motor.
2. Orifice meter to measure the air flow,
3. Heater - 1 KW heating coil placed centrally in the test section.
4. Multi channel digital temperature indicator - range 0 to 300°C.
5. Voltmeter and ammeter to measure the heat input.

#### SERVICES REQUIRED:

- 220 volts single phase stabilized AC Electric supply.
- Floor space-2m X 1 m X 2 m Height.

### 1408 Heat Transfer in Agitated Vessel

The unit consists of a vessel with glass wool insulation all around. A helical coil made of copper is fixed inside the vessel. A motorized agitator is fixed at the center of the coil. The vessel is provided with an electric heater and a controller is also provided for vessel. Heater heats water in the jacket while cold water is circulated through coil. Temperature of circulated water and water in vessel is measured and thus, heat transfer coefficient at various agitator speeds can be determined.

#### SPECIFICATIONS

1. Vessel approx. 20 lit. capacity, provided with glass wool insulation all around and electric heater at the bottom.
2. Agitator 150 mm dia, with 1/8 HP motor to drive the agitator.
3. Helical coil - 200 dia, 8 turns, made of 3/8" dia. copper tube.
4. Controllers for heater and agitator motor.
5. Temp. Indicator for vessel water temperature and circulated water inlet and outlet.



#### SERVICES REQUIRED

1. Single phase 230V, 15A stabilized supply.
2. Water flow at the rate of 4 to 5 lit. per min.
3. Suitable drain arrangement for water.
4. Floor area -1.5 mtr X 1 mtr X 1 mtr height.



### 1409 Emissivity Measurement Apparatus

The apparatus consists of a test plate and a comparator. A black plate is used as a comparator for test plate. When all the physical, dimensions and the temperatures are equal, heat losses from both plates will also be the same, except radiation losses. Hence the input difference will be due to difference in emissive. Both the plates are kept in a panel enclosure with perplex front and are given inputs through separate dimmerstats so that temperatures of both can be kept equal. Thus emissivity can determine over a wide range of temperatures.

#### SPECIFICATIONS

1. Test plate and black plates 160mm Dia. Aluminum plates, mounted in Panel with mica heater inside.
2. Instrumental panel consisting of-
  - Voltmeter and ammeter for input measurement to both heaters through a selector switch.
  - Separate dimmers for both the plates.
  - Multichannel digital temperature indicator.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED:

- Space area of 1.5mx1m at working height.
- 230V, 15A, AC supply with earthing connection.

### 1410 Stefan Boltzmans Apparatus

The Stefan Boltzmann constant is an important constant in heat transfer. The apparatus determines Stefan Boltzmann constant. The apparatus consists of a hemisphere surrounded by hot water. Hot water is obtained from a water-heating tank. When the blackened disc is inserted at the center of hemisphere, heat is transferred into the disc from hemisphere by radiation and its temperature begins to rise, and from temperature raise rate. (It is measured at the intervals of 5 sec.) Stefan Boltzmann constant is determined.

#### SPECIFICATIONS:

1. Water heating tank provided with electric immersion heater.
2. Hemisphere made of copper sheet, 200mm dia. Surrounded water jacket of 250mm Dia.
3. Test disc made of copper 20mm dia. provided with thermocouple at the center.
4. Multichannel digital temperature indicator 0-200°C with 0.1°C least counts to measure the temperature of hemisphere and disc.
5. Audible buzzer with timer to ring at every 5 seconds.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED

- Bench area of about 1m x 0.5m at working height.
- 230V, 15A, AC, electric supply with earthing connection.

### 1411 Critical Heat Flux Apparatus

The apparatus demonstrates the regimes of pool boiling. The test section consists of a test wire surrounded by water of constant temperature. The surface temperature of the test wire is heated by passing current through it. Due to the temperature difference between the wire surface and surroundings, the difference regimes are observed till the burnout point.

#### SPECIFICATIONS

1. Test wire -35 gauge or 40 gauges. Length = 10cm.
2. Nichrome heater- 1 KW capacity - 1 nos.
3. Glass trough of sufficient capacity.
4. Table light to observe the test wire.
5. Voltmeter and ammeter to measure the input to the test wire.
6. Dimmerstat to adjust the voltage.

*A technical manual accompanies the unit.*



#### SERVICES REQUIRED

- 220V, ISA, stabilized single-phase supply.
- Floor surface- 1m x 1m at working height.

### 1415 Concentric Tube Heat Exchanger

#### A. PLAIN TUBE ( WATER TO WATER )

The apparatus consists of two concentric tubes. Inner tube consists of copper tube through which hot water flows. While the outer tube consists of GI pipe through which cold water flows. The arrangement enables the parallel and counter flow of the cold water. The inlet and outlet temperatures and the flow measurement enable to find out the heat exchanged LMTD, and effectiveness of the equipment.

##### SPECIFICATIONS

1. Inner copper tube I.D. 12.7mm and outer G. I. Pipe I. D. 15mm approx. and 1.5m length.
2. Thermometers - 4 nos.
3. Measuring flask - 1 Lit. capacity.
4. Geyser-3 KW, Single phase.

#### B. FINNED TUBE ( WATER TO AIR )

The apparatus consists of two concentric tubes. Inner tube consists of copper tube through which hot water flows. It is finned at its outer diameter to increase the heat transfer surface. While the outer tube consists of GI pipe through which cold air flows. The arrangement enables the parallel and counter flow of the air. The inlet and outlet temperatures and the flow measurement enable to find out the heat exchanged LMTD, and effectiveness of the equipment.

##### SPECIFICATIONS

1. Inner copper tube I.D. 12.7mm and outer G. I. Pipe I. D. 25mm approx. and 1m length.
2. Thermometers - 4 nos.
3. Orifice meter along with manometer.
1. Measuring flask - 1 Lit. Capacity.
2. Geyser-3 KW, Single phase.

##### SERVICES REQUIRED

- 220v, 15A, stabilized single-phase AC supply.
- Floor area - 3m x 1m x 1m height.



### 1416 Shell & Tube Heat Exchanger ( Water To Water )

Heat exchanger is the device used to transfer the heat from one fluid to other. The shell and tube heat exchanger is two tube single pass heat exchanger. The hot fluid is hot water obtained from water heater. The coil fluid is cold water. The schematic flow arrangement is shown in figure. Hot water enters the lower side of end box, flows through the tubes in lower half of shell and comes to the other end of the shell. It reverses its direction, flows through tubes in upper half of the shell and leaves out. Cold water enters lower part of the shell passes over the tubes between the baffles and leaves out the shell through outlet at upper surface of shell.

##### SPECIFICATIONS

1. Shell - 150NB, 750 mm long provided with end boxes.
  - One end box with divider plate.
  - 25% cut baffles - 4 Nos. in the shell.
2. Tubes - 4.5mm I.D., 6.35mm O.D., 250 mm length copper tubes with triangular pitch.
3. Instantaneous water heater, 3 KW capacity, to supply hot water.
4. Thermometer for measuring the water temperature.
5. Valves to control hot and cold water flow.

##### SERVICES REQUIRED

- 3 PH, AC supply
- Floor space 1.5m x 1m
- 230V, 15A, AC supply with earthing connection.
- Water supply at the rate of about 10 lit/min at constant heat.



### 1417 Plate Type Heat Exchanger Apparatus

The unit consists of a plate type heat exchanger, in which cold fluid is cold water and hot fluid is hot water, which is obtained from geyser. The inner and outer connections of the fluids are positioned so as to make the exchanger counter flow type. Hot and cold fluids pass between alternate plates various measurements provided enables the students to determine heat transfer rate, LMTD, heat transfer coefficients and effectiveness of the heat exchanger.

##### SPECIFICATIONS

1. Heat Exchanger- S.S. Plate heat exchanger.
2. Geyser to obtain hot water - 3 KW capacity.
3. Calibrated water flow measuring vessel
4. Thermometers to measure inlet and outlet temperatures of fluid.
5. Flow controls valves.

*A technical manual accompanies the unit.*

##### OPTIONAL ACCESSORIES

1. Rotameters to measure water flow rates instead of measuring vessel.
2. Multi channel digital temperature Indicator to measure the temperatures instead of thermometers.

##### SERVICES REQUIRED

- Floor space 1.5m X 1m
- 230V, 15A, AC supply with earthing connection,
- Water supply at the rate of about 10 lit/min at constant heat.



### 1418 Thermal Conductivity of Metal Rod

The apparatus consists of a copper bar, which is heated at one end, a heat sink is provided at other end. The test section of bar is properly insulated and thermocouples are attached along the length of bar. Heat conducted through the section of bar is measured by heat collection in water-cooled heat sink. A panel comprising of controls and measurements is provided, which provides easy operation and sturdy mounting of unit.

#### SPECIFICATIONS

1. Metal Bar - 25mm of adequate length, provided with 8 Thermocouples along the length, Band heater at one end and water-cooled heat sink at other end. Test portion of bar is insulated.
2. Instruments panel comprising of.
  - Voltmeter ... 1No.
  - Ammeter ... 1No.
  - Dimmerstat 0-230V, 2A, capacity.
  - Multichannel Digital temperature Indicator.
3. Measuring flask and stop clock



#### SERVICES REQUIRED

- Bench area of 1.5m x 1m at working height.
- 230V, AC, electric supply with earthing connection.
- Water supply at the rate of 2 lit/mm

### 1419 Thermal Conductivity of Insulating Powder

The apparatus consists of an insulating powder, which is enclosed in a cavity of two concentric spheres. The inner space of the inner sphere contains the mica heater. Input to the heater can be adjusted by the dimmerstat. The tappings on the surfaces of the inner sphere and outer sphere are used to find out the temperature difference between the spheres. This enables to find out the conductivity of powder.

#### SPECIFICATIONS

1. Inner sphere dia. 100mm and outer sphere dia. 200mm.
2. Mica heater to heat the inner sphere surface.
3. Ten thermocouple tappings in the test section.
4. Plaster of Paris / asbestos powder in the test section.
5. Panel comprises of
  - Voltmeter and ammeter
  - Dimmerstat
  - Temperature indicator



#### SERVICES REQUIRED

- 220v stabilized single-phase supply.
- Floor surface 1m x 0.5m at working height.

### 1420 Thermal Conductivity of Liquid

Thermal conductivity of liquid is an important engineering property. The apparatus uses guarded hot plate method for determining thermal conductivity. It consists of hot plate i.e. an electrical heater sandwiched between two plates. The heat loss from hot plate is prevented by using two guard heaters and remove heat from liquid by circulation of water. Input to heaters the temperatures.

#### SPECIFICATIONS

1. Guarded hot plate assembly comprising of main heater, ring guard heater and top guard heater, mounted over the liquid test cavity.
2. Cold plate assembly provided with water connections.
3. The assembly is housed in an enclosure box with glass wool insulation.
4. Instruments panel consisting of :
  - Digital voltmeter and ammeter of suitable range.
  - Dimmerstat for controlling input to the heaters (2 amp. 3 Nos.)
  - Multichannel digital temperature indicator.



#### SERVICES REQUIRED

- Floor space of about 0.75m x 1.5m at working height.
- 230V AC electrical supply with earthing connection.
- Water flow rate of about 10-15 lit/min. at constant head.

### 1421 Thermal Conductivity of Insulating Slabs By Guarded Hot Plate Method

The apparatus consists of a slab assembly. The main Heater and a radial guard heater are sandwiched between copper plates. The specimen in the form of slabs of equal thickness are placed on either sides of heaters and cooling plates through which water is circulated are on the other sides of the specimen. The radial guard heater ensures all heat of the main heater to pass axially through the specimens which is collected by cooling plates. By knowing the temperatures and heat input, thermal conductivity of specimen can be calculated. The test set up is enclosed in an enclosure with insulation inside to provide undisturbed Surroundings. The design style of the apparatus is similar to as recommended in INDIAN standard. The difference is in sizes.

#### SPECIFICATIONS

- Heaters:
  - Main heater plate 110 mm dia. with mica heater Sandwiched between copper plates,
  - Radial guard heater plate I.D. 120mm and OD 200 mm mica heater sandwiched between copper plates.
- Water circulated cooling plates - 2 nos.
- Dimmerstat-2 A capacity - 2 nos. to independently control Inputs to the heaters.
- Measurements :
  - A voltmeter and an Ammeter with selector switches to measure inputs, Multichannel digital temperature indicator to measure temperatures at various points, having 0.1°C least count.

#### SERVICES REQUIRED

- 230 V, A.C. stabilized supply along with earthing connection.
- Water supply of about 4-5 lit/min.
- Bench area 1 m x 1 m x 0.5 m height.

*A technical manual accompanies the unit.*

### 1422 Thermocouple Calibration Test Rig

The Unit helps in calibrating given thermocouple for the range 0°C to 100°C. While calibrating, thermocouple is once dipped in ice for 0°C and then in boiling water for 100°C. This is done till the thermocouple shows the actual temperature of ice (0°C) and boiling wafer (100°C) and a linear calibration is set. A mV meter is provided to know the corresponding voltage.

#### SPECIFICATIONS

- A digital mV Meter and a digital temperature indicator with 2 different type of thermocouples.
- A water container with heater of 1 KW.

#### SERVICES REQUIRED

- Table surface area - 2 m X 1 m X 0.5 m height.
- 220V, 50Hz. Stabilize Electric Power Supply.
- Ice cubes - 0.5Kg. Approx.



*A technical manual accompanies the unit.*

## Mass Transfer Lab

**We Are Also Into Manufacturing Of The Following Mass Transfer Teaching Equipments.  
We Can Provide The Detail Specifications Of The Following Products On Request.**

- |                                                                           |                                                  |
|---------------------------------------------------------------------------|--------------------------------------------------|
| 1. Absorption in Packed Bed.                                              | 15. Natural Draft Tray Dryer.                    |
| 2. Absorption in Sieve Plate Column.                                      | 16. Packed Distillation Column.                  |
| 3. Absorption in Wetted Wall Column.                                      | 17. Rotary Driver.                               |
| 4. Batch Crystallizer.                                                    | 18. Sieve Plate Distillation Column.             |
| 5. Bubble Cap Distillation Column.                                        | 19. Simple Steam Distillation Set-up.            |
| 6. Experimental Water Cooling Tower.                                      | 20. Solid - Liquid Extraction (Bonnoto Type).    |
| 7. Fixed Bed Adsorption with Regeneration.                                | 21. Solid - Liquid Extraction (Packed Bed Type). |
| 8. Fluidized Bed Dryer.                                                   | 22. Solid in Air Diffusion Apparatus.            |
| 9. Forced Draft Ray Dryer.                                                | 23. Spray Extraction.                            |
| 10. Humidification & De-Humidification Apparatus.                         | 24. Swenson Walker Crystallizer.                 |
| 11. Ion Exchanger.                                                        | 25. Vapour - Liquid Equilibrium Set-up.          |
| 12. Liquid in Liquid Diffusion Apparatus.                                 | 26. Vapour In Air Diffusion Apparatus.           |
| 13. Liquid - Liquid Extraction in Packed Bed.                             | 27. Wetted Wall Column.                          |
| 14. Mass Transfer With / Without Chemical Reaction (Solid Liquid System). | 28. York Scheibel's Extraction Column.           |