MEE390. Experiment #07. Measurement of Temperature Distribution in a Radial System.

Objective:

To measure the temperature distribution for steady state conduction of energy through the wall of a cylinder (radial energy flow) and demonstrate the effect of a change in heat flow.

Apparatus Required:

Fig. 1 HT10X Heat Transfer Service Unit.

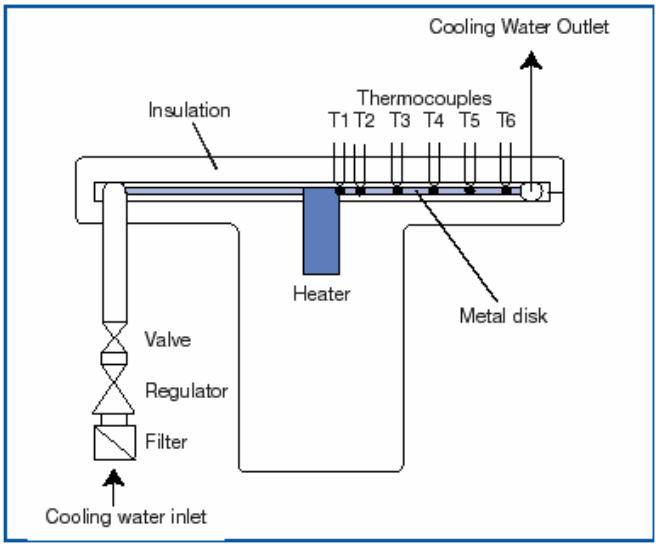


Fig. 2 HT12 Radial Heat Conduction Accessory.

Equipment Set-up:

1. Locate the HT12 Radial Heat Conduction accessory alongside the HT10X Heat Transfer Service Unit on a suitable bench.
2. Connect the six thermocouples on the HT12 to the appropriate sockets on the front of the service unit. Ensure that the labels on the thermocouples leads (T1-T6) match the labels on the sockets.
3. Set the HEATER VOLTAGE potentiometer to minimum (anticlockwise) and the selector switch to MANUAL then connect the heater lead from the HT12 to the socket marked O/P 3 at the rear of the service unit.
4. Ensure that a cold water supply is connected to the inlet of the pressure regulating valve on HT12.
5. Ensure that the flexible cooling water outlet tube is directed to a suitable drain.
6. Ensure that the service unit is connected to an electrical supply.

Theory:

When the inner and outer surfaces of a thick walled cylinder are each at a different uniform temperature, heat flows radially through the cylinder wall. The Disk can be considered as a series of successive layers.

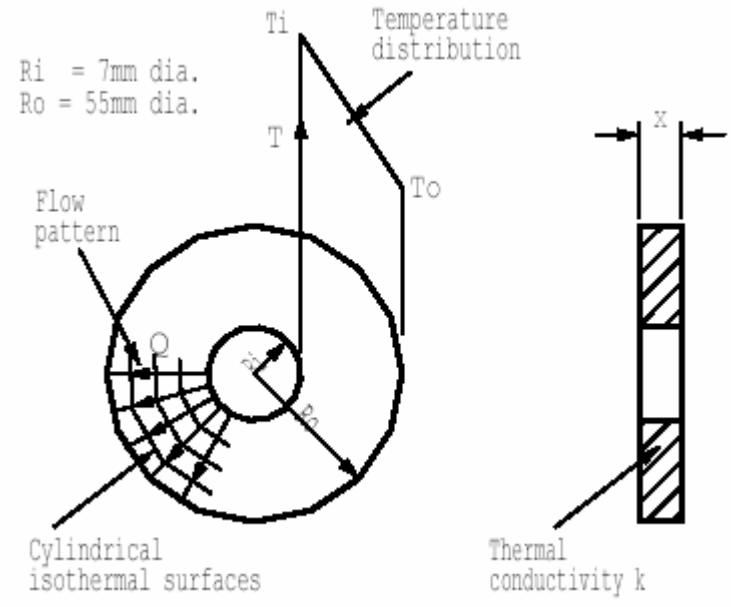


Fig. 3 Temperature Distribution in a Radial Heat Flow

From continuity considerations the radial heat flow through each of the successive layers in the wall must be constant if the flow is steady but since the area of the successive layers increases with the radius, the temperature gradient must decrease with radius.

The radial specimen in the HT12 consists of a disk 3.2mm thick with inside radius R_i = 7mm and outside radius R_o = 55mm with six thermocouples positioned at an uniform intervals of 10mm from the centre of the disk i.e. **T1 @ 7 mm, T2 @10 mm, T3 @ 20 mm, T4 @ 30 mm, T5 @ 40 mm and T6 @ 50 mm radius respectively.**

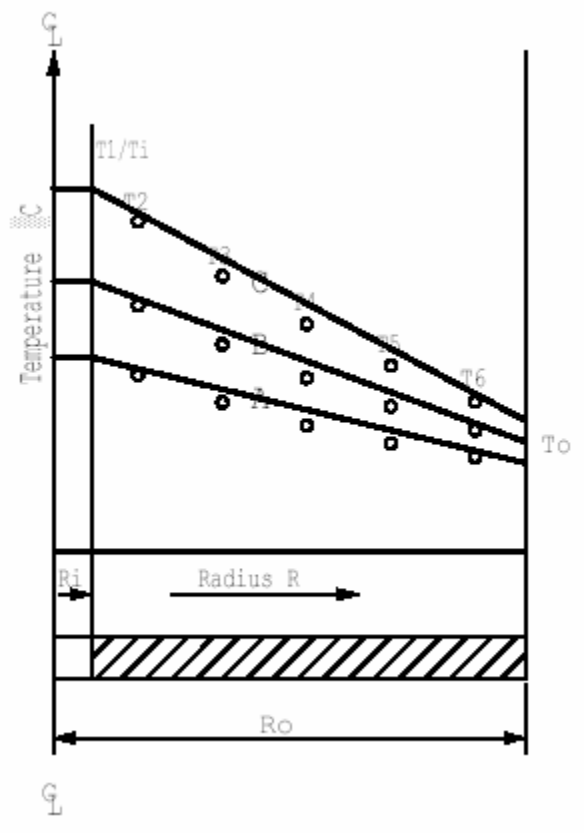
Procedure:

1. Switch on the front Mains switch (if the panel meters don not illuminate check the RCD and circuit breakers at the rear of the service unit, all switches at the rear should be up).
2. Turn on the cooling water and adjust the flow control valve (not the pressure regulator) to give approximately 1.5 liters/min.
3. Set the Heater Voltage to 12 Volts (adjust the **HEATER VOLTAGE** potentiometer to give a reading of 12 Volts on the top panel meter with the selector switch set to position **V**).
4. Allow the HT12 to stabilize (monitor the temperatures using the lower selector switch/meter).
5. When the temperatures are stable record the following:
   a). T1, T2, T3, T4, T5, T6, V, I.
6. Repeat the procedure and note the readings for the above values for the Heater Voltage of 17 V, 21 V and 24 V.

Observations and Results:

S. No	Heater Voltage (V)	Heater Current (I)	T1 (^oC)	T2 (^oC)	T3 (^oC)	T4 (^oC)	T5 (^oC)	T6 (^oC)
1	12							
2	17							
3	21							
4	24							

1. For each set of readings plot a graph of temperature against radius which should be as shown below:



2. Comment on the change in T_1 with respect to power.
3. Calculate change in $\frac{\Delta T}{\Delta R}$ at different points of the plot.