FABRIC COMFORT

Measurement:

Transmission of heat through a fabric mainly occurs both by *conduction* through the fibre and the entrapped air and by *radiation*.

Thermal Conductivity: Total heat transmitted through fabric per unit time with unit temperature difference

Thermal Resistance: Reciprocal of thermal conductivity

In practice it is very difficult to measure the rate of heat flow in a particular direction, as the heater dissipates heat in all direction.

Two methods are in use to overcome this problem:

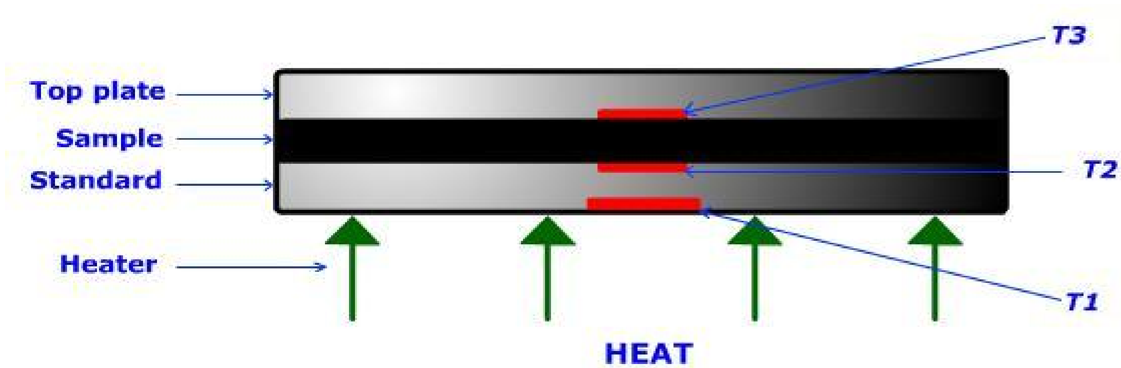
(a) To compare with a sample with known thermal conductivity value (Togmeter)

(b) To reduce the heat loss (Guarded hot plate method)

Togmeter:

(i) Two-plate method:

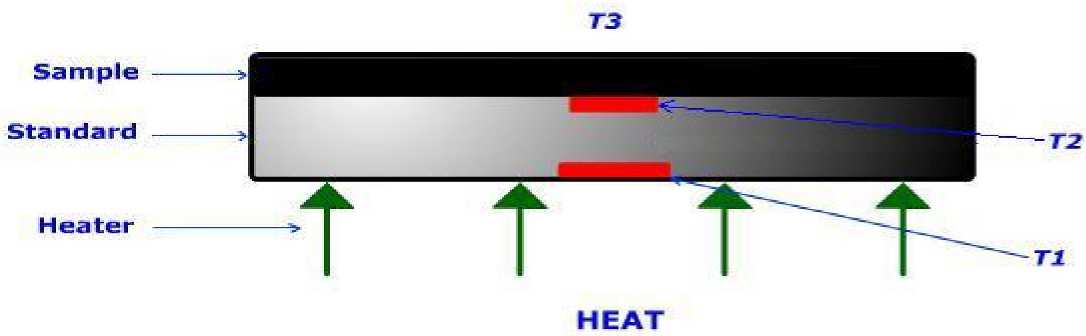
- **Specimen is placed between heated lower plate and an insulated top plate.**



- **Top plate has low mass, so that it does not compress the fabric.**
- **T_1,T_2,T_3 are measured.**

(ii) Single-plate method:

- The specimen under test is placed on heated lower plate as two-plate method, but is left uncovered
- Air temperature just above the test specimen is T_3



SINGLE PLATE METHOD

- The air above the test specimen has a considerable thermal resistance itself, so that the method is in fact measuring the sum of the specimen thermal resistance and the air thermal resistance.
- A separate experiment is therefore performed without the specimen (i.e. *a bare-plate test*) to measure the resistance of the air (R_{air})

To determine the air resistance:

In a single plate system , the heater is switched on and the apparatus is switched on and the apparatus is allowed is to reach thermal equilibrium with no specimen present

The temperature should remain steady at each thermocouple for 30min.

$$R_{air} = R_{stand} [(T_2 - T_3) / (T_1 - T_2)]$$

R stand is the thermal resistance the standard plate

To determine the thermal resistance of specimen:

$$R_{sample} = R_{stand} [(T_2 - T_3) / (T_1 - T_2)] - R_{air}$$

In the plate method $R_{air} \sim 0$

Gaurded Hot Plate Method:

Works on principle “b” i.e., by reducing the changes of heat loss.

It is measures the “*thermal transmittance*” which is reciprocal of thermal resistance

Consist of three plates:

- ✓ Heated test plate
- ✓ Surrounded guard plate &

- ✓ Bottom plate

Therefore the test is repeated without any fabric samples present to give the bare plate transmittance.

Combined transmittance of specimen and air, U_1

$$U_1 = P/[A.(T_p - T_a)]\ W/(m^2\ {}^0C)$$

Where

Tp & Ta are temperature of test plate and air respectively

P= power loss from test plate (W)

A= Area of the test plate (m^2)

The bare plate transmittance U_{bp} is calculated similarly.

The intrinsic transmittance of the fabric alone, U_2 is calculated as,

$$1/U_2 = 1/U_1 - 1/U_{bp}$$

Table: Some key comfort variables

Thermal	**Sensory**
Clothing insulation Air permeability Perceived and actual weight Vapour permeability Absorbency Metabolic rate Roughness/abrasiveness Macro-environment Rigidity • Humidity Human mood • Radiant heat gain/loss Other non-clothing comfort factors • *Convective heat gain/loss* Aesthetics/social expectations • *Conductive heat gain/loss Stretch* • *External convection Cling* Micro-environment • *Clothing fit* • *Internal convection* • *Sweat rates*	Pressure Perceived and actual weight Absorbency Roughness/abrasiveness Rigidity Human mood Other non-clothing comfort factors Aesthetics/social expectations Stretch Cling Prior experiences

Internal blood circulation (convection)	
Environmental stability	