Three pyrheliometers have been in wide-spread use to measure normal incident beam radiation.

(i) The Angstrom pyrheliometer

(ii) The Abbot Silver disc pyrheliometer

(iii) Eppley pyrheliometer

The instruments provide Primary and Secondary Standard of Solar radiation measurements.

(i) Angstrom Compensation pyrheliometer:

In this pyrheliometer, a thin blackened shaded manganin strip (Size 20x2x0.1mm) is heated electrically until it is at the same temperature as a similar strip which is exposed to Solar radiation

under steady state Condition (both strips at identical temperature)

The energy used for heating is equal to the absorbed solar energy. The thermocouples on the backs of each strip, connected in opposition through a sensitive galvanometer (or other null detector), are used to test for the equality temperature. The energy H of direct radiation is Calculated by means of the formula.

$$H_{DN} = Ki^2 \quad \text{Watts/cm}^2$$

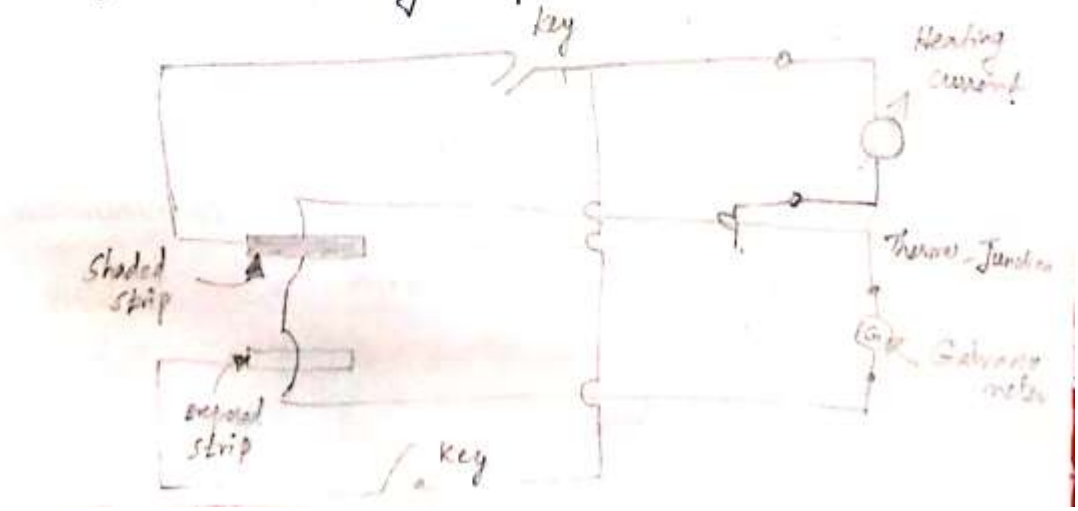
where H_{DN} = Direct radiation incident on an area normal to Sun's rays.

i = Heating Current in amperes

K = Dimension and instrument Constant

$$K = \frac{R}{W\alpha}$$

where R is the resistance per unit length of the absorbing strip (Ω/cm). W is the mean width of the absorbing strip, and α is the absorbing co-efficient of the absorbing strip.



ii) Abbot Silver disk pyrheliometer:

It consists essentially of a blackened Silver disk positioned at the lower end of a tube with diaphrams to limit the whole aperture to 5.7°.

A mercury in glass thermometer is used to measure the temperature at the disk.

They are widely used for calibrating pyranometers.

A shutter made of three polished metal leaves is provided at the upper end of the tube to allow solar radiation to fall on the disk at regular intervals and the corresponding changes in temperature of the disk are measured.

The thermometer stem is bent through 90° so that it lies along the tube to minimize its exposure to the Sun.

(b)

iii). Eppley pyrheliometer:

The Sensitive element is an Eppley pyrheliometer is a temperature compensated 15 junction bismuth Silver thermopile mounted at the base of a brass tube, the limiting diaphrams of which subtend an angle of 5.7°.

A thermopile is basically a series arrangement of thermocouples used to develop a much greater voltage than is possible using only one.

The tube is filled with dry air and is sealed with a crystal quartz window which is removable. A filter wheel is standard.

It is a stable instrument and can be used as a sub-standard. The instrument has found wide acceptance within the USA and many part of the world.

(B) Pyranometers:

A pyranometer is an instrument which measures total or global radiation over a hemispherical field of view. If a shading ring is attached, the beam radiation is prevented from falling on the instrument sensor and in then measures only the diffuse component of radiation.

In most pyranometer, the Sun's radiation is allowed to fall on a black surface to which the hot junctions of a thermopile are attached.

The cold junctions of the thermopile are located in such a way that they do not receive the radiation.

As a result an e.m.f proportional to the solar radiation is generated. This emf which is usually in the range of 0 to 10 mV can be read, recorded or integrated over a period of time with regular calibration of about ± 2% Percent can be obtained.

Types:

(i) Eppley pyranometer (ii) Yellot Solarimeter (Prof)
(iii) Moll - Gorczyheski Solarimeter (iv) Bimetallic Actinographs of the Rabitzsch type (v) Velochme pyranometer
(vi) Thermoelectric pyranometer etc