



$$\frac{AC}{AB'} = .83$$

Sunlight intercepted by a solar collector in two orientations. In position AB it intercepts only a fraction ( $AC/AB'$ ) as much solar energy as it does when it is perpendicular to the sun's rays, as in position AB'. The angle between the rays of sunlight and a line perpendicular to the collector, labelled in the figure, is called the angle of incidence.

The easiest way to find out the effect of the angle of incidence is to go ahead and carry out the computations for the porch roof. The calculation at solar noon is the easiest, since at that time everything points straight south and there's not the complicating factor of the east-west angle of the sun that comes up in the morning and afternoon. We'll only do noontime calculations.

Figure 87 illustrates the first deleterious effect of a large angle of incidence. That is that a collector which is tilted away from the sunlight 'doesn't intercept as much sunlight as one that is perpendicular to it. The line AB in the figure is a cross section of a collector lying on the porch roof. AB' is a cross section of the same collector tilted up so that it is perpendicular to the rays of sunlight. Some of the rays of sunlight which strike the collector in position AB' miss it completely when it is lowered to AB. In fact, the ratio of the amount of sunlight which strikes the collector in position AB to that which strikes it in position AB' is equal to the length of AC divided by the length of AB', as can be seen from the figure. By actual measurement of AC and AB' this ratio is found to be .83 for Figure 87.

The second bad effect of having the sunlight incident at a large angle comes about because of the tendency of common surfaces to reflect light at large angles of incidence. This affects both the transmission through the glass covers (in the Iowa climate two covers should be used rather than one as in the figure) and absorption by the absorber. When sunlight hits the glass at a large angle, more of it is reflected so the amount transmitted is reduced. The absorber also reflects more of the light that hits it at large angles of incidence so there is less absorbed.