

# Hair Guardian Technology Fundamentals

## Cooling method

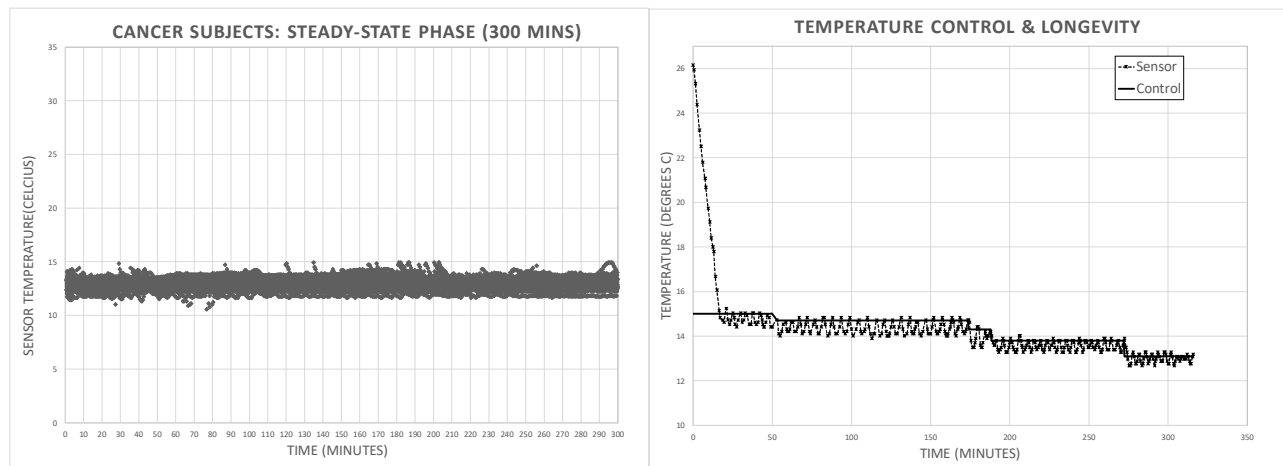
Hair Guardian takes advantage of an inherent material property known as '*latent heat of fusion*'. This is the term used for when a material captures energy so it can transition from a solid phase to a liquid phase. For Hair Guardian, the material chosen is water which has a latent heat of fusion of 334 J/g to go from ice to liquid and the melting occurs at a constant temperature of 0°C. The heat required to melt the ice is gotten from the user's scalp by circulating ice water through a head conforming cap worn by the user. The ice water is kept chilled by transferring its energy absorbed from the scalp to melt the ice stored in an ice-filled cooler nearby.

## Cooling transfer path

Prior to the user's first session, a conforming cap is constructed by the user and (without any modifications, on-going fiddling or adjusting) is used for all sessions. Circulating ice water through the cap achieves the desired scalp temperature to keep hair follicles from dying because, in part, a water-soluble hair gel is used throughout the user's hair which greatly reduces the insulation effect of one's hair. Even a small presence of gel can reduce the insulation effect sufficiently.

## Cooling longevity

Five hours of scalp temperature sensor data for cancer subjects are shown below (left figure). The data confirmed scalp temperature can be maintained over time and at multiple use locations such as in a car or at home besides at the clinic.



The right-hand figure above shows a duration example of a single charge of ice obtained from a convenience combined with one gallon of water. A step change decrease in control temperature is followed by a decrease in scalp temperature. The data shows that even at five hours of cooling, the circulating ice water had enough cooling strength to follow the control point to a colder operating temperature. Of course, ice can be added to the cooler at anytime which, in effect, allows Hair Guardian to cool indefinitely.