NOREN™
THERMAL SOLUTIONS

PHASE CHANGE TECHNOLOGY

Phase Change Technology utilizes the Latent Heat of Vaporization of a working fluid to absorb thermal energy during the evaporator cycle and release this energy during the condenser cycle.

PHASE CHANGE DEFINED

Transitions between solid, liquid, and gaseous phases of a material. Typically involving large amounts of energy compared to the specific heat.

HEAT

Heat may be defined as energy in transit from a high temperature object to a lower temperature object. An object does not possess "heat"; the appropriate term for the microscopic energy in an object is internal energy. The internal energy may be increased by transferring energy to the object from a higher temperature (hotter) object – this is properly called heating.

SPECIFIC HEAT

The specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius. The relationship between heat and temperature change is usually expressed in the form shown below where c is the specific heat.
Q= cm DeltaT

Where:

Q = Heat Added
c = Specific Heat
m = Mass
DeltaT = Change in Temperature

The specific heat of water is 1 calorie/gram °C = 4.186 joule/gram °C which is higher than any other common substance. As a result, water plays a very important role in temperature regulation. The specific heat per gram for water is much higher than that for a metal.

This relationship does not apply if a phase change is encountered, because the heat added or removed during a phase change does not change the temperature.

LATENT HEAT

The expression latent heat refers to the amount of energy released or absorbed by a chemical substance during a change of state that occurs without changing its temperature, meaning a phase transition such as the melting of ice or the boiling of water.

LATENT HEAT OF FUSION

Form of latent heat where energy flow during the change of phase is from solid to liquid. The change is endothermic, meaning that the system absorbs energy on going from solid to liquid. The change is exothermic (the system releases energy) when the direction is from liquid to solid.

Latent Heat of Vaporization
Form of latent heat where energy flow during the change of phase is from liquid to a gas. The change is endothermic, meaning that the system absorbs energy on going from liquid to gas. The change is exothermic (the system releases energy) when the direction is from gas to liquid.

SPECIFIC LATENT HEAT OF FUSION

The amount of energy required to convert 1 kg (or 1 lb) of a substance from solid to liquid (or vice-versa) without a change in the temperature of the surroundings – all absorbed energy goes into the phase change.

SPECIFIC LATENT HEAT OF VAPORIZATION

The amount of energy required to convert 1 kg (or 1 lb) of a substance from liquid to gas (or vice-versa) without a change in the temperature of the surroundings – all absorbed energy goes into the phase change.

TABLE OF LATENT HEATS

The following table shows the latent heats and change of phase temperatures of some common fluids and gases.

Substance	Latent Heat Fusion kJ/kg	Melting Point °C	Latent Heat Vaporization kJ/kg	Boiling Point °C
Alcohol, ethyl	108	−114	855	78.3
Ammonia	339	−75	1369	−33.34
Hydrogen(2)	58	−259	455	−253
Lead[3]	24.5	327.5	871	1750
Nitrogen	25.7	−210	200	−196
Oxygen	13.9	−219	213	−183
R134a		−101	215.9	−26.6
Toluene		−93	351	110.6
Water	334	0	2260 (at 100oC)	100