

# LATENT HEAT and EVAPORATION

JE2F

For a liquid to evaporate into a gas (vapor), energy must be added to break the molecular bonds of the liquid. This is boiling.

This energy is the "latent heat of evaporation" - it is "latent" meaning "hidden" in that during the phase change the measurable temperature ("sensible" heat) of the liquid does not change. You cannot measure latent heat with a thermometer.

There is the similar effect for melting, called the "latent heat of fusion" for the solid to liquid phase change. This is melting.

The reverse phase changes, condensing (vapor to liquid) and freezing (liquid to solid) have the same latent energies involved, but instead of having to add the latent heat you have to remove it from the material to force the phase change.

Water has the highest latent heat of evaporation of all common substances and the highest latent heat of fusion of all common liquids and most solids.

LATENT HEAT OF EVAPORATION			BOILING (atmospheric)	
WATER	8133 BTU/GAL	8.35 LB/GAL	974 BTU/LB	212°F (100°C)
PROPANE	785	4.24 LB/GAL	185	-44°F (-42°C)
BUTANE	808	4.81 LB/GAL	168	32°F (0°C)
ETHANOL	2421	6.58 LB/GAL	368	173°F (78°C)
LATENT HEAT OF FUSION			MELTING (atmospheric)	
WATER	1202 BTU/GAL	8.35 LB/GAL	144 BTU/LB	32°F (0°C)
ETHANOL	303	6.58 LB/GAL	46	-173°F (-114°C)

Note that it takes much less energy for fusion than for evaporation.

It will take adding about 800-BTU of heat to evaporate a gallon of LPG (liquid to vapor), and that is after having raised the liquid to its boiling temperature (at the current pressure).

Conversely, it will take removal of about 800-BTU of heat to condense a gallon of LPG (vapor to liquid), after the gas has been lowered to its boiling/condensing temperature (at the current pressure).

Note that 800-BTU of heat would melt 2/3 gallon of ice into water (2/3 of 1202 BTU/GAL), although the water would still be at 32°F.

An energy rate of 800-BTU/Hour is 234 Watts = 0.31 HP = about one-third horsepower.

Ice is better than icy water for providing cooling capacity due to the latent heat factor.