**Calculating Envelope Energy Loss Worksheet**

**Definitions:**

*U Factor* - Btu transferred through one ft2 of building material in one hour with a temperature difference of 1 º F. U-factors can’t be added together.

*R-Value* - Resistance to heat transfer; the reciprocal of U. R-values can be added together.

U = 1/R R=1/U

*Assembly R-Value* = R-Value of insulation – 10%

**Formulas:**

Heat Loss through surface area

* (A x ΔT x 1 BTU/hr) / R
* A x ∆T x t x U

Air transported heat loss

Air-transported heat loss is calculated in BTU per ***cubic foot of air per hour***.

* V x ACH x 0.0182[[1]](#footnote-1) x ΔT

Where

* A = Area in square feet
* R = R-value of assembly
* t = Time in hours
* T = Temperature in degrees Fahrenheit
* U = U-factor
* V = conditioned volume
* ACH = Air Changes per Hour

To calculate BTU per heating season, insert “HDD x 24 hours” in place of “∆T x t.”

**Problems:**

*Wall Section – Surface losses*: Calculate the BTU transferred in one hour through 300 ft2 of sidewall with R-11 batt insulation. The interior temperature is 70ºF and the outdoor temperature is 30ºF.

*Entire Home – Surface losses*: Calculate how many BTU/heating season are lost through the surface area, and how much could be saved by increasing wall insulation to R-19, ceiling insulation to R-38.

Remember, R-value of assemblies is insulation R-value minus 10%.

* Wall area = 1,200 square feet (no windows and doors for this example)
* Wall insulation R-value = 11
* Ceiling area = 1,250 square feet
* Ceiling R-value = 19
* ΔT = 40°F
* ACH = 1.25
* HDD = 7,200
* Volume = 10,000 ft3

How many BTU/heating season are lost through surface area?

Formula: (A x HDD x 24 hrs) / R

* Walls =
* Ceiling =
* Total =

How many would be lost with increased R-values?

* Walls =
* Ceiling =
* Total =

What would the savings be?

Total 1 – Total 2 = Savings

*Entire Home – Air Transported Losses*: In this same home, how many BTU/heating season are lost through air infiltration?

Formula: V x ACH x 0.0182 x HDD x 24 hrs

How many BTU/heating season could be saved by reducing air infiltration to .75 ACH?

1. This number, in BTU/cu. ft., °F, is the specific heat of air. [↑](#footnote-ref-1)