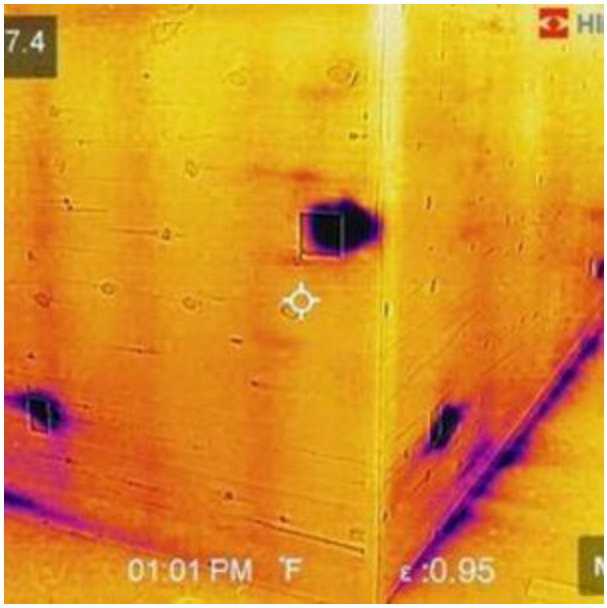


Area (A) = 96 sq. ft. of exterior wall
DeltaT = 50 Degrees F
Density of Air = 1.08
U = 1/R
R = Effective Thermal R-value
Assessed R-value Pre-Insulation = 4

**Formulas:**

**Thermal Heat Loss (Conduction):**

Heat Loss (Q) = U * A * DeltaT

BTU/hr (Q) = (1/R) * A * DeltaT

**Air Leakage Heat Loss (Convection):**

Heat Loss (Q) = 1.08 * CFM(50) * DeltaT

BTU/hr (Q) = 1.08 * CFM(50) * DeltaT

**Example** (Heat Loss = Thermal Loss + Air Leakage Loss) - **Pre-Insulation of Exterior Wall**

Thermal Loss = BTU/hr (Q) = (1/R) * A * DeltaT

= (¼) * 96 * 50

= 0.25 * 96 * 50 = 1,200 BTU/hr.

Air Leakage Loss = BTU/hr (Q) = 1.08 * CFM * DeltaT

A "standard" or typical residential wall assembly, before dedicated air sealing, often exhibits a leakage rate around 0.40 to 0.60 CFM50 per square foot of wall surface area at a pressure difference of 50 Pascals (CFM50/ft²). (delta® academy)

For this example we selected 0.50 CFM(50) as the leakage factor.

CFM = 0.50 * 96 = 48 CFM(50)

Air Leakage Loss = 1.08 * 48 * 50 = 2,582 BTU/hr.

**Total Pre-Insulation BTU/hr Loss = 1,200 + 2,582 = 3,792 BTU/hr**

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**Example (Heat Loss = Thermal Loss + Air Leakage Loss) - Post-Insulation of Exterior Wall**

For this example, based on the IR camera inspection, we have calculated 98% of the wall was dense-packed appropriately, with 2% gaps (voids) around outlets and light switches.

Installed effective R-value = 13.

**Thermal Loss = BTU/hr (Q) = (1/R) * A * DeltaT (Area Dense-Packed)**

= (1/13) * (96*.98) * 50

= 0.077 * 94.08 * 50 = 362.21 BTU/hr.

**Thermal Loss = BTU/hr (Q) = (1/R) * A * DeltaT (Voids/Gaps))**

= (1/4) * (96*.02) * 50

= 0.25 * 1.92 * 50 = 24 BTU/hr.

**Total Thermal (Conduction) Heat Loss =** 362.21 + 24 = **386.21 BTU/hr**.

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**Air Leakage Loss = BTU/hr (Q) = 1.08 * CFM * DeltaT (Convection)**

Air Leakage per Area: Studies indicate that properly dense-packed walls often achieve leakage rates below 0.05 cfm/ft² at 50 Pa. (buildingscience.com)

**Dense-Packed Area**

CFM = 0.05 * (96*.98) = 4.7 CFM(50)

Air Leakage Loss = 1.08 * 4.7 * 50 = 253.8 BTU/hr.

**Voids and Gaps**

CFM = 0.5 * (96*.02) = 0.96 CFM(50)

Air Leakage Loss = 1.08 * 0.96 * 50 = 51.84 BTU/hr.

**Total Post-Insulation BTU/hr Loss = 253.8 + 51.84 = 305.64 BTU/hr (Convection)**

**Total Post-Insulation (Thermal and Air Leakage) BTU/hr =** 386.21 + 305.64

**= 691.85 BTU/hr.**

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**Perfect Insulation Install Vs. Practical Insulation Install**

**Thermal Loss = BTU/hr (Q) = (1/R) * A * DeltaT (100% Area Dense-Packed)**

= (1/13) * (96) * 50

= 0.077 * 96 * 50 = **369.6 BTU/hr.**

**Air Leakage Loss = BTU/hr (Q) = 1.08 * CFM * DeltaT (Convection)**

Air Leakage per Area: Studies indicate that properly dense-packed walls often achieve leakage rates below 0.05 cfm/ft² at 50 Pa. (buildingscience.com)

**Dense-Packed Area**

CFM = 0.05 * (96) = 4.8 CFM(50)

**Air Leakage Loss =** 1.08 * 4.8 * 50 **= 259.2 BTU/hr.**

**Total Leakage (Conduction + Convention) =** 369.6 + 259.2 = **628.8 BTU/hr.**

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**Delta between practical vs. perfect:** 691.85 - 628.8 **= 63 BTU/hr per ~ 100 sq. ft.**

**Saving (BTU/hr):**

**Perfect 100% Dense-Packed Walls: 83%**

**Practical Dense-Packed Walls: 82%**