What Grade?

What Grade?

What Grade?

What Grade ?

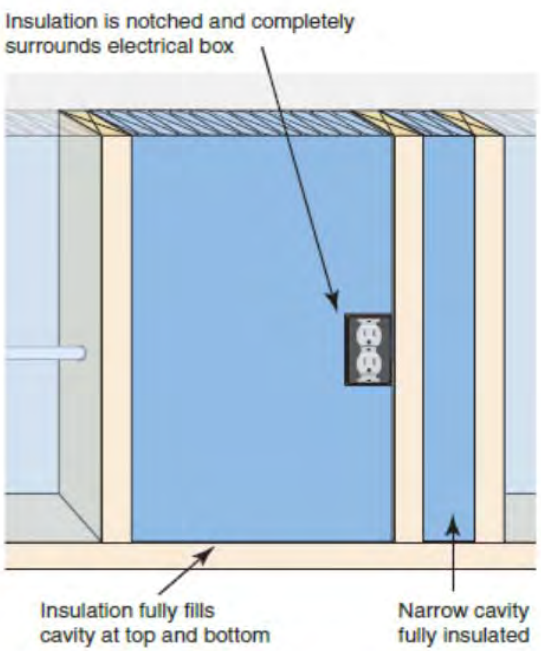
What Grade?

Voids & Gaps

Wall Insulation key points

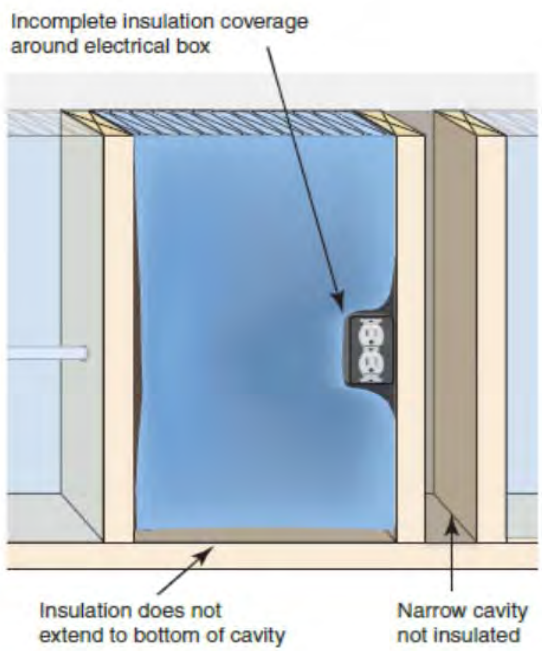
Voids / Gaps

Passing Grade



Good!!!

Unacceptable Installation



Bad!!!

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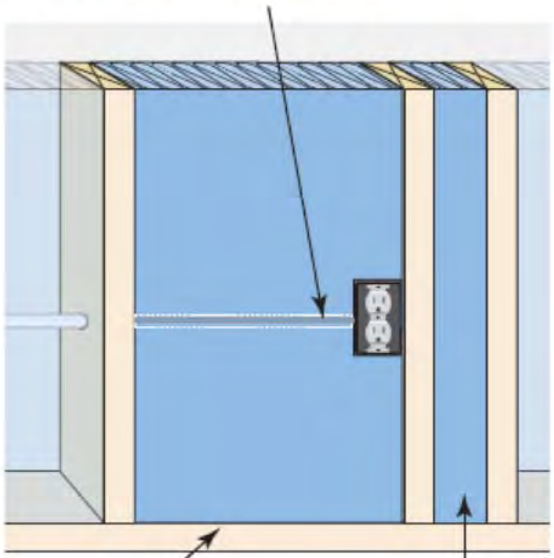
Compression & Incomplete Fill

Passing Grade

Insulation is slit around electrical wire



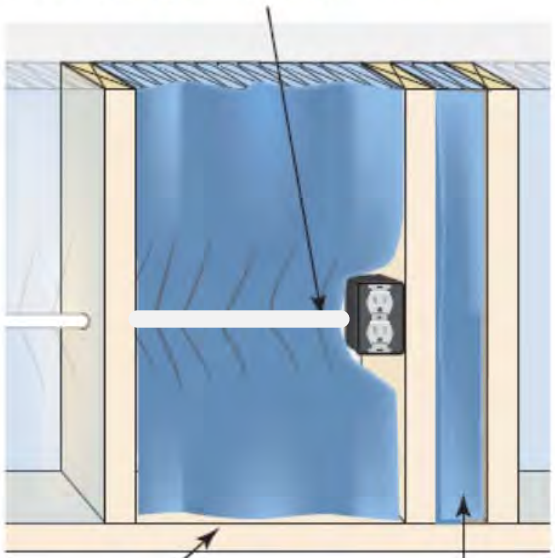
Insulation extends from front to back and fully fills entire cavity

Proper width insulation fully fills narrow cavity

Good!

Unacceptable Installation

Insulation is compressed behind electrical wire



Insulation does not fully fill entire cavity

Improper width insulation is compressed into narrow cavity

Bad!

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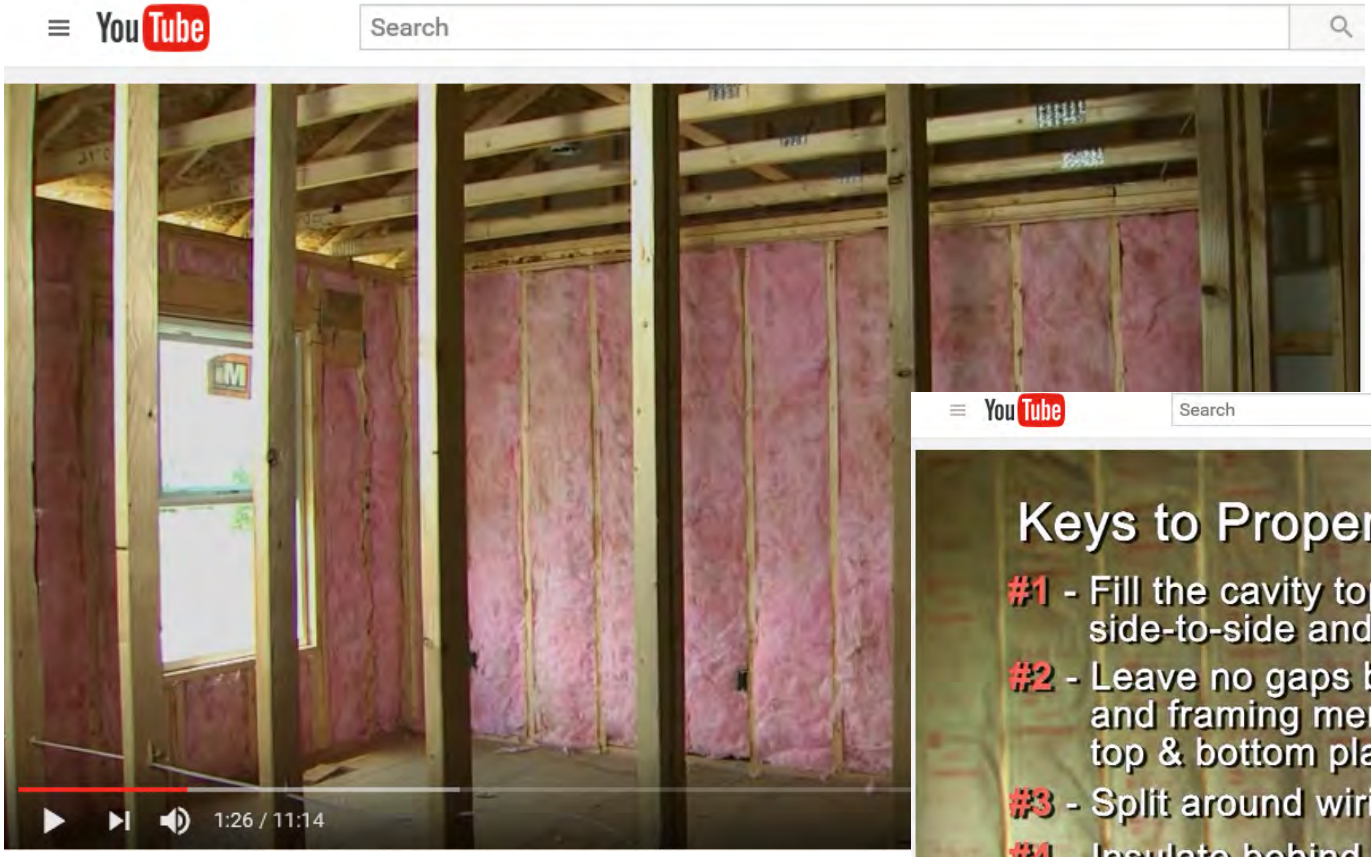
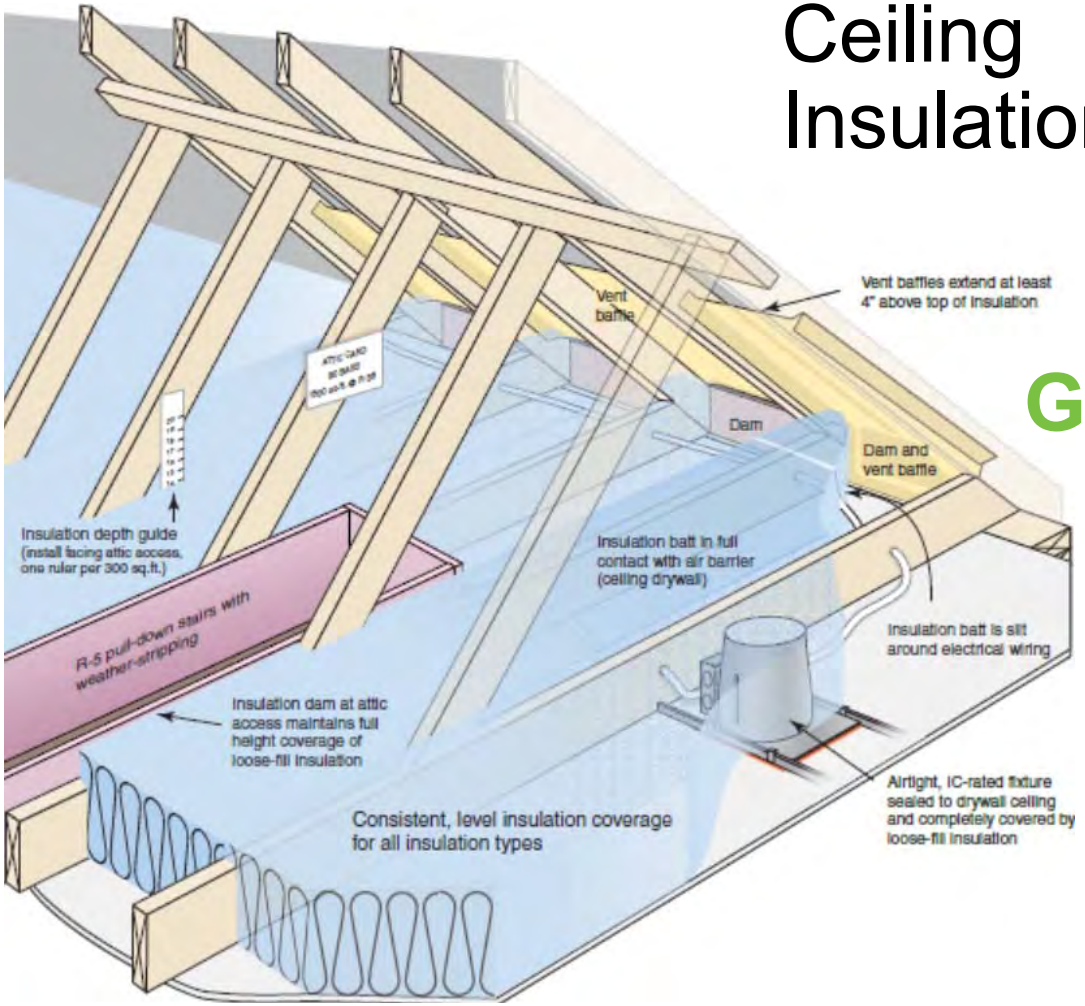
Installation Videos

Installation Videos



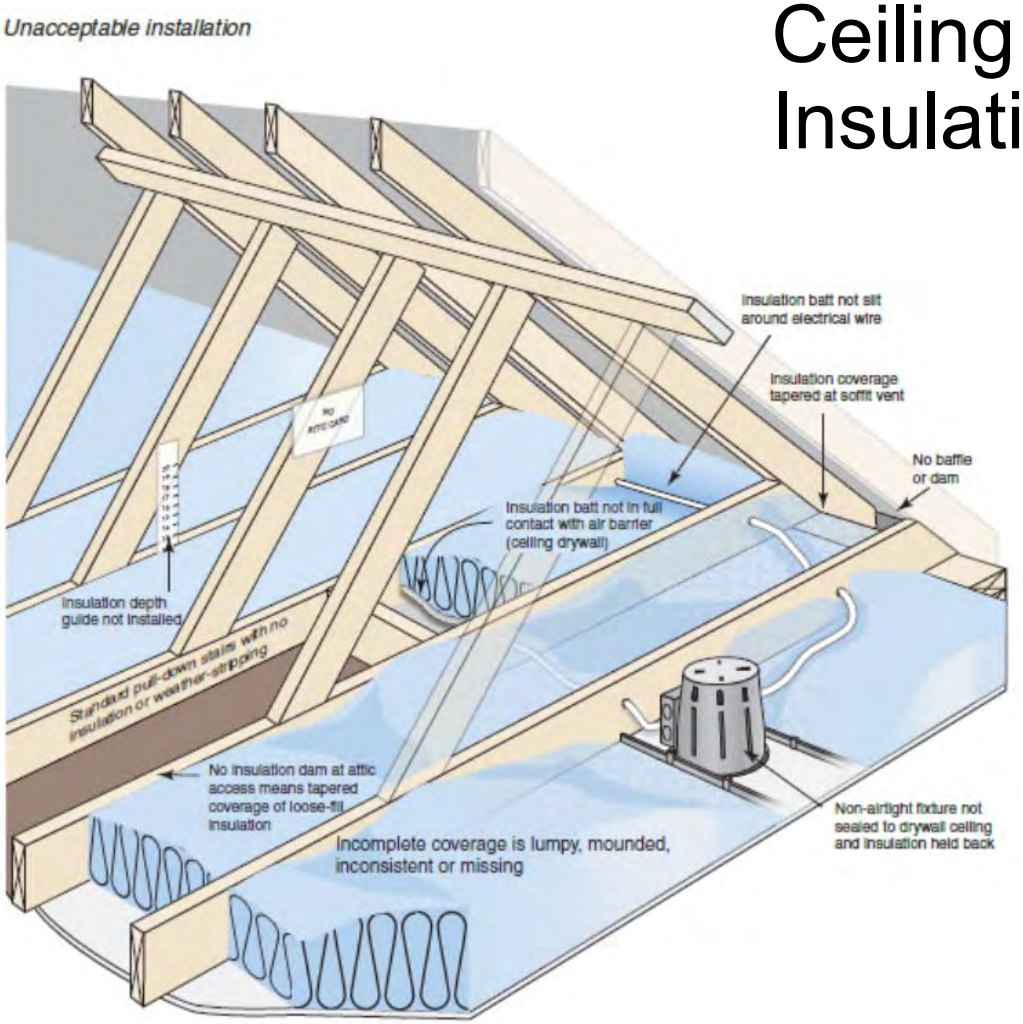
Ceiling Insulation



GOOD!

See IECC R303.1

Ceiling Insulation



BAD!

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Ugly Ceiling Insulation

Conduction Heat Flow

Heat transfer through a solid object: the formula for calculating conduction heat transfer is q = U x A x ΔT

q = heat flow (Btu/hr)

U = inverse of R-Value [U=1/R, R=1/U] (Btu/hr ft^2 °F)

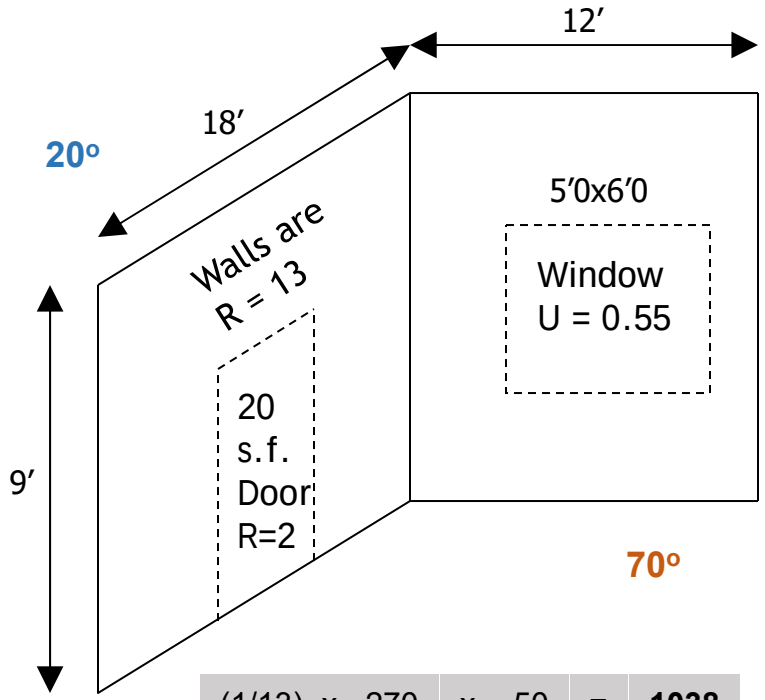
A = area (square feet)

ΔT = temperature difference across component (°F)

$$q = U \times A \times \Delta T$$

Manual J: q = A x HTM

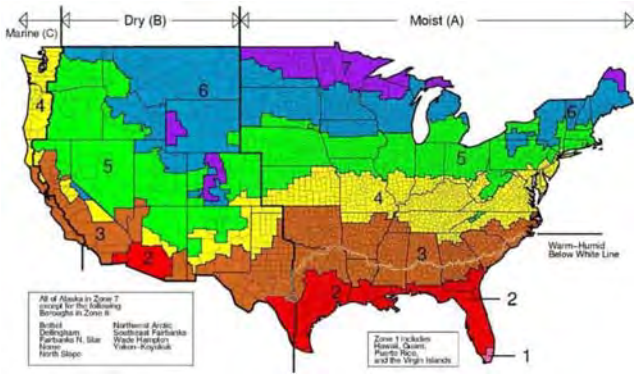
where HTM = UxΔT



	(1/13) x	270	x 50 =	**1038**
R	**U**	**Area**	**Delta T**	**q**
13	1/13	220	50	846
2	½	20	50	500
-	0.55	30	50	825
				2171

Climate and Energy Efficiency

Design Temps	W / S
Atlanta	24/92
St. Louis	14/91
Fairbanks	-40/78
Miami	51/90



- **Design Temperatures**
  - Heating, for 99% of the season the outdoor temperature is above this value
  - Only 1% of the Cooling season is hotter than this temperature value
- *Design Temp Example*
  - St. Louis Winter 70 – 14 = 56 F ΔT
  - St. Louis Summer 91 – 75 = 16 F ΔT
- **Load Calcs & Energy Code**
  - IECC 2009 Section 302.1: Interior design temperatures (72°F heating, 75°F cooling)
  - **MUST BE ACCURATE**

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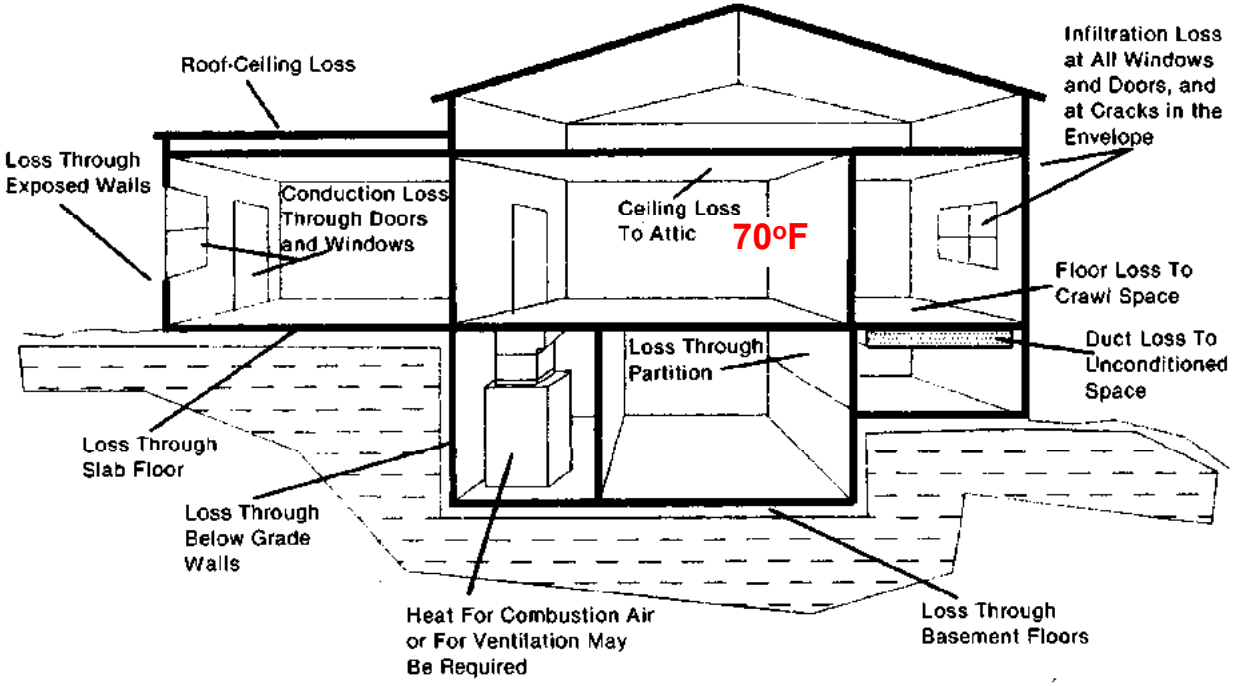
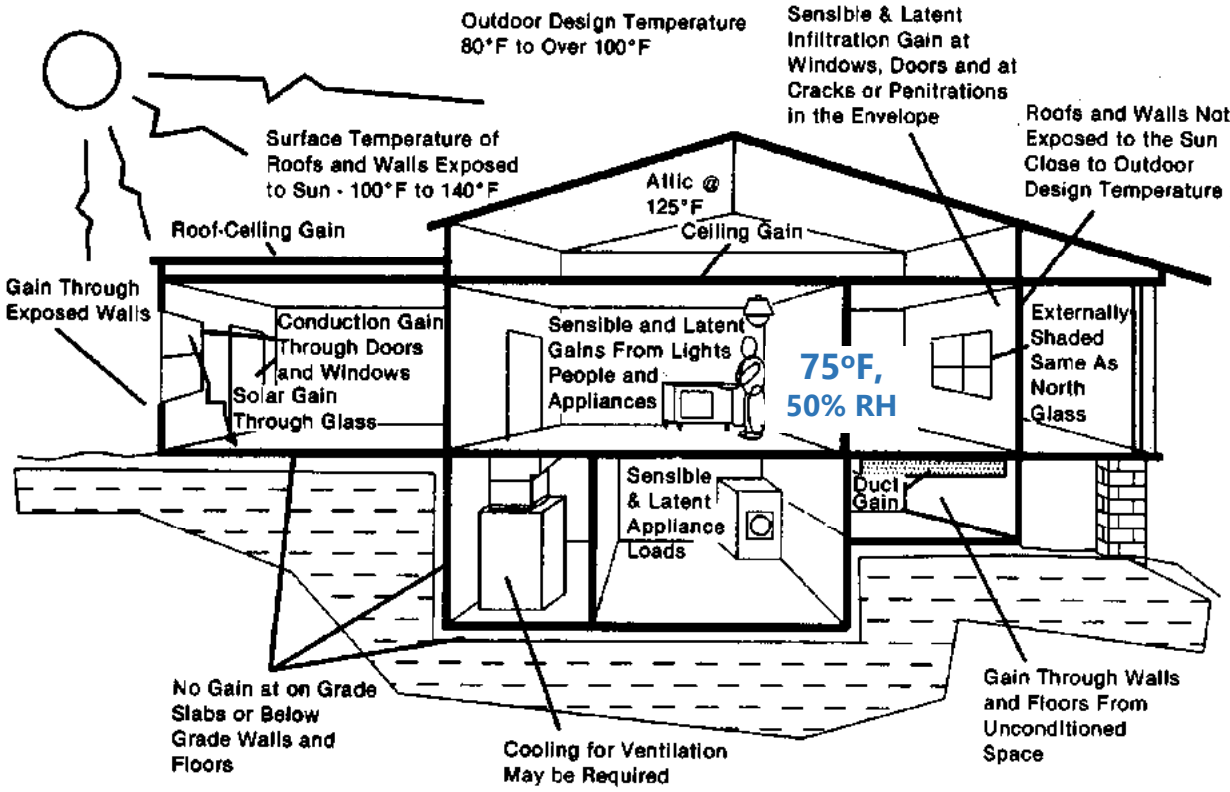
Manual J - Winter Loads



Winter Outdoor Design Temp

14°F

Manual J- Summer Loads



Summer Outdoor Design Temp

91°F

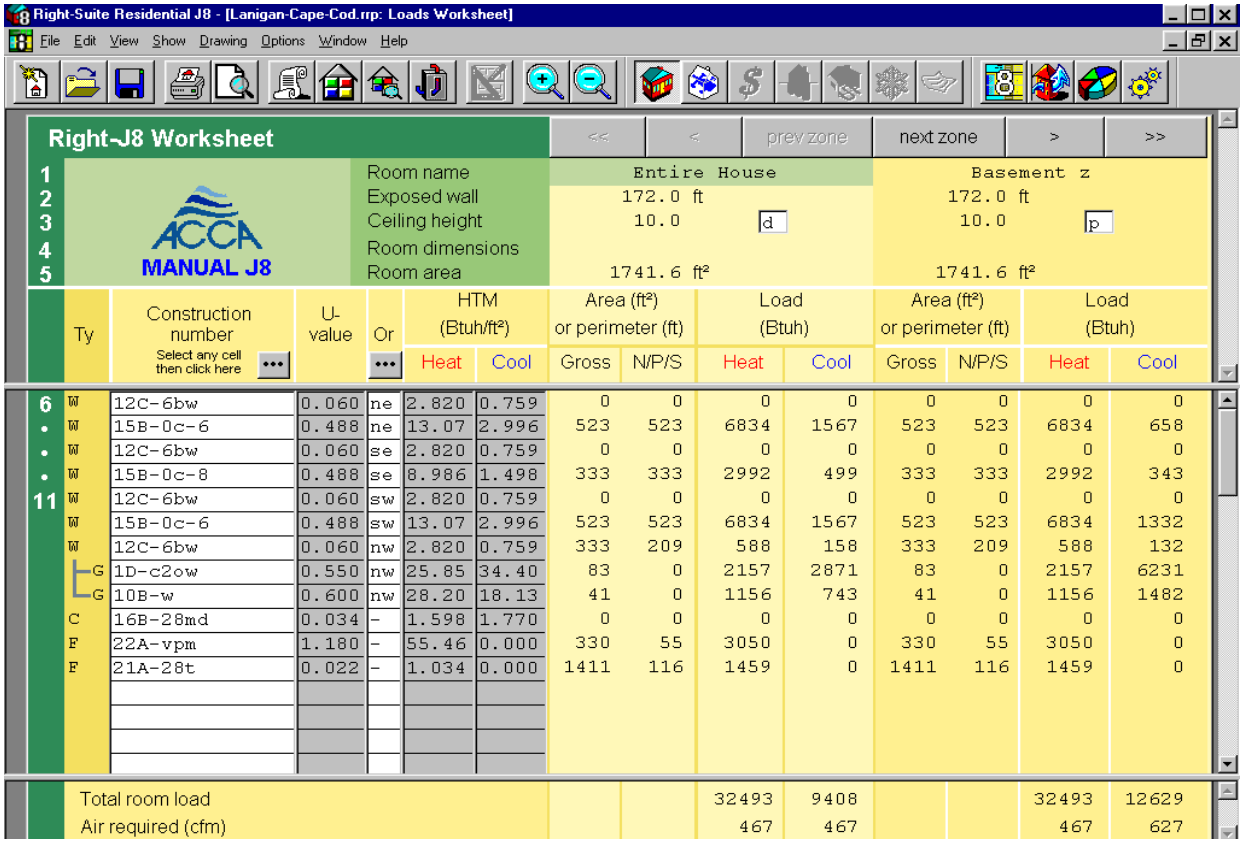
Sizing the System

"Heating and cooling equipment shall be sized in accordance with Section M1401.3"

"Heating and cooling equipment shall be sized in accordance with **ACCA Manual S** based on building loads calculated in accordance with **ACCA Manual J** or other approved heating and cooling calculation methodologies."
- 2015 IECC R403.7

- **Building orientation**
- **Glazing, walls, foundation & roof**
- **Design conditions**
- **Infiltration**
- **Internal loads**
- **Ventilation load**

Manual J Software



Why is proper equipment sizing important?

- Equipment first-cost
- Longer/more efficient run times
- Limits equipment cycling
- Better dehumidification

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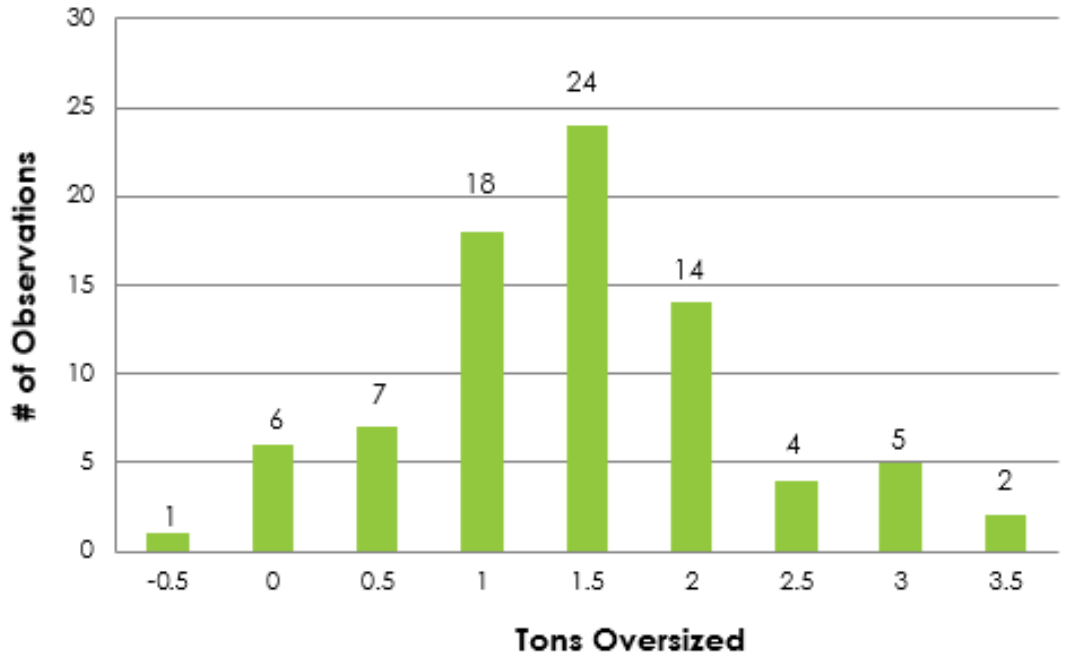
MO Equipment Sizing Study

Installed AC Units

Tons Oversized



4 Factors Affecting Comfort

- Air Temperature – around the person
- Relative Humidity – ~50% is best
- Air flow - affects how easily evaporative cooling occurs
- Mean Radiant Temperature – the temperature of the surfaces surrounding people

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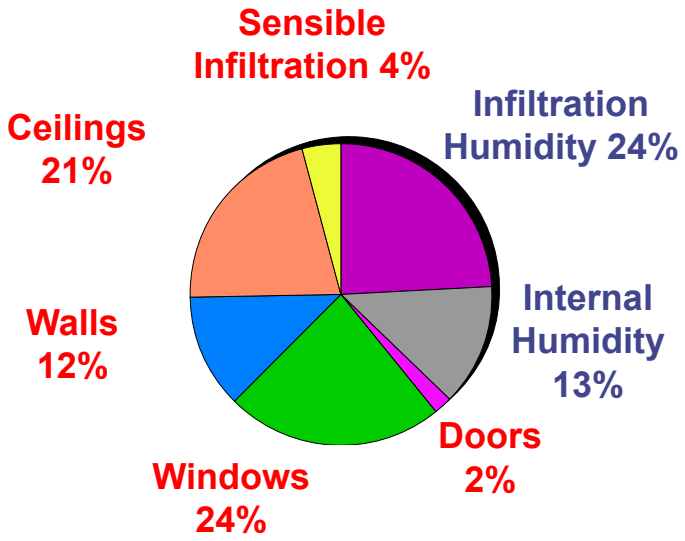
Cooling Load Breakdown



- Sensible = Δ Temperature
- Latent = Δ Moisture
- Total = Sensible + Latent
- **SHF = S / Total**

Variable Speed Blowers

- Allow slower fan speeds in A/C mode to improve dehumidification
- Utilize ECM motors
  - Reduce fan wattage up to 1/10 at low speeds
  - Must operate most of the time at low for energy savings
  - Will consume more energy to satisfy flow if duct restrictions are high
- Permit modest upsizing
  - *Moisture removal is a function of the condensing unit, indoor coil, & fan speed (airflow)*
  - *Proper refrigerant charge is also critical*

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Equipment Location

- Locate the air handler within conditioned space to reduce energy penalty from leakage.
- Don’t have leaky air handler next to an atmospheric combustion appliance!!!

- Design Goal:
  Get all the ducts and the air handler within conditioned space so no energy penalty from leakage

How does duct leakage affect combustion safety?

Ductwork

- Types
- Design
- Sealing
- Insulation