Advanced Studies in Unvented Attics

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Presentation Overview

1. Brief Introduction to Icynene
2. Unvented/Sealed Attic Background & Research
3. Cost Savings, Energy Efficiency and HVAC Benefits for Builders
4. Unvented Attic Application Details

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Icynene Spray Foam Insulation

- Around for 26 Years
- 350,000 Projects
- Classic Max™ - Low density open cell, ½ lb. foam
- MD-C-200™ - Medium density closed cell, 2 lb. foam
- Renewable-based & recycled content spray foams
- ICC-ES Evaluation Reports
- 16 Year History in Unvented Attics

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Icynene = Air Barrier and Insulation in One System

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Icynene Low Density Insulation is Unique for Unvented Attics

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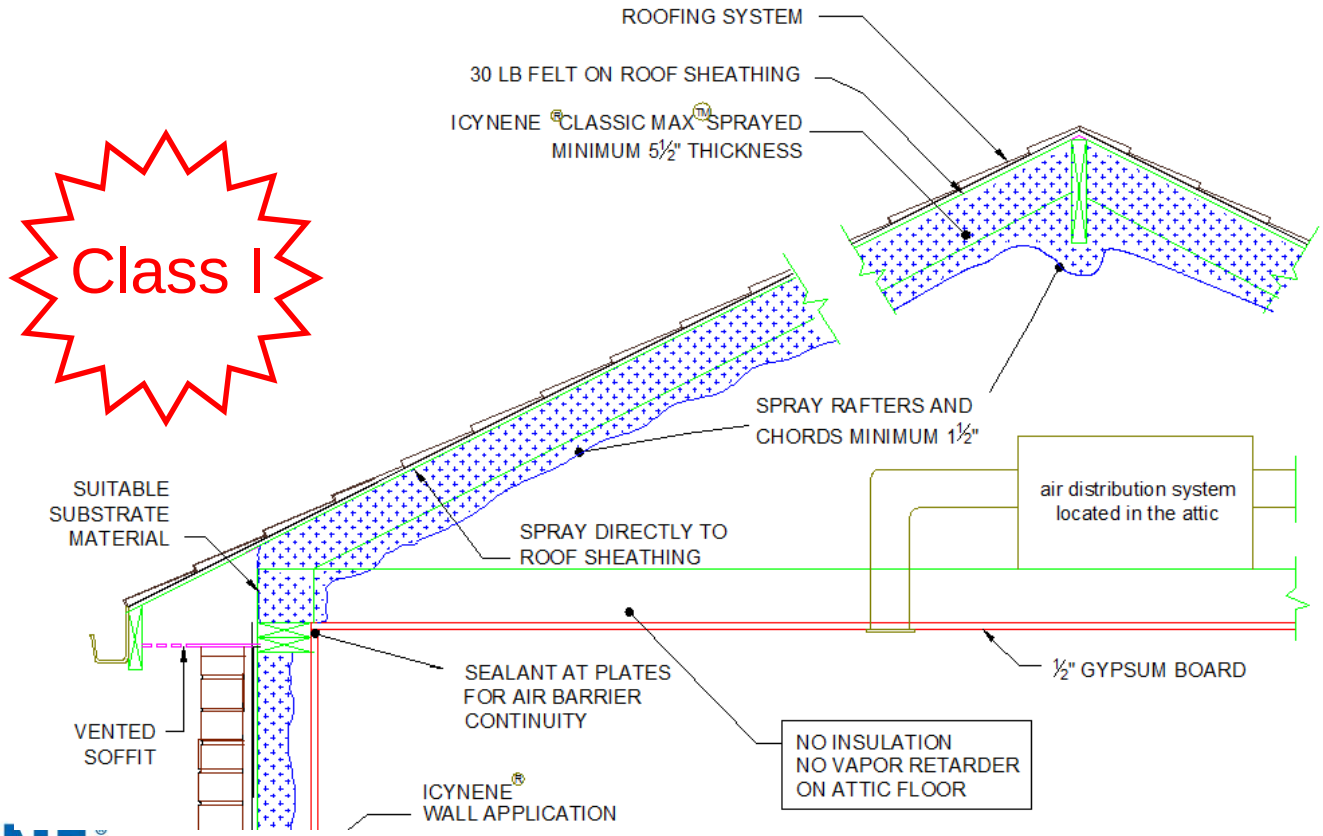
An ignition barrier can be a fire protective coating designed to inhibit or prevent the start and spread of fire from a spark or direct heat on the spray foam surface.

Spray at Interior Surface of Roof Sheathing & Attic Walls



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Why Have an Unvented Attic?

- Air handlers & ducts operate more efficiently in a more temperate, partially conditioned space
- Energy savings & improved comfort for occupants due to greater building airtightness
- Lower HERS Scores resulting from energy savings
- Potential for wind uplift on sheathing may be reduced since the soffit and ridge vents are no longer allowing pressure gradient within the attic
- Penetrations through the ceiling (below the attic) do not compromise the building envelope air tightness
- Eliminates condensation on cool duct and ceiling drywall surfaces (vented attic dew point up to 85˚ F)

Research on Unvented Attics Temperature and Relative Humidity Levels

- Study by IBACOS as part of US DOE Building America Program research
- Unvented attic in house in Orlando Florida
- Studied in 2006 & 2007

IBACOS®
| Home Quality + Performance |

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Building AMERICA™
U.S. Department of Energy

Temperature Measurement

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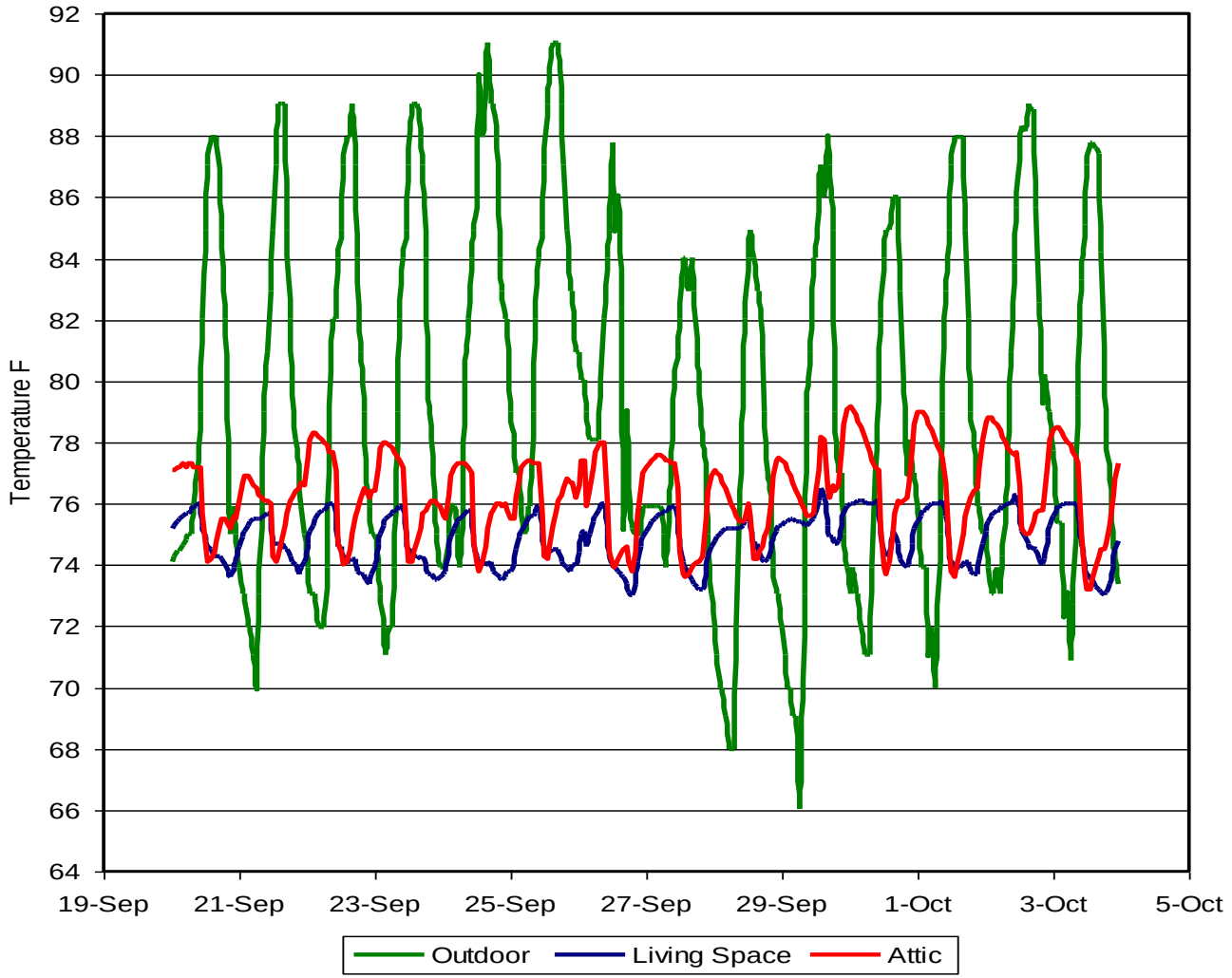
Unvented Attic Temperatures over Two Week Period

Unvented
Attic Temp
Avg = 76.3F



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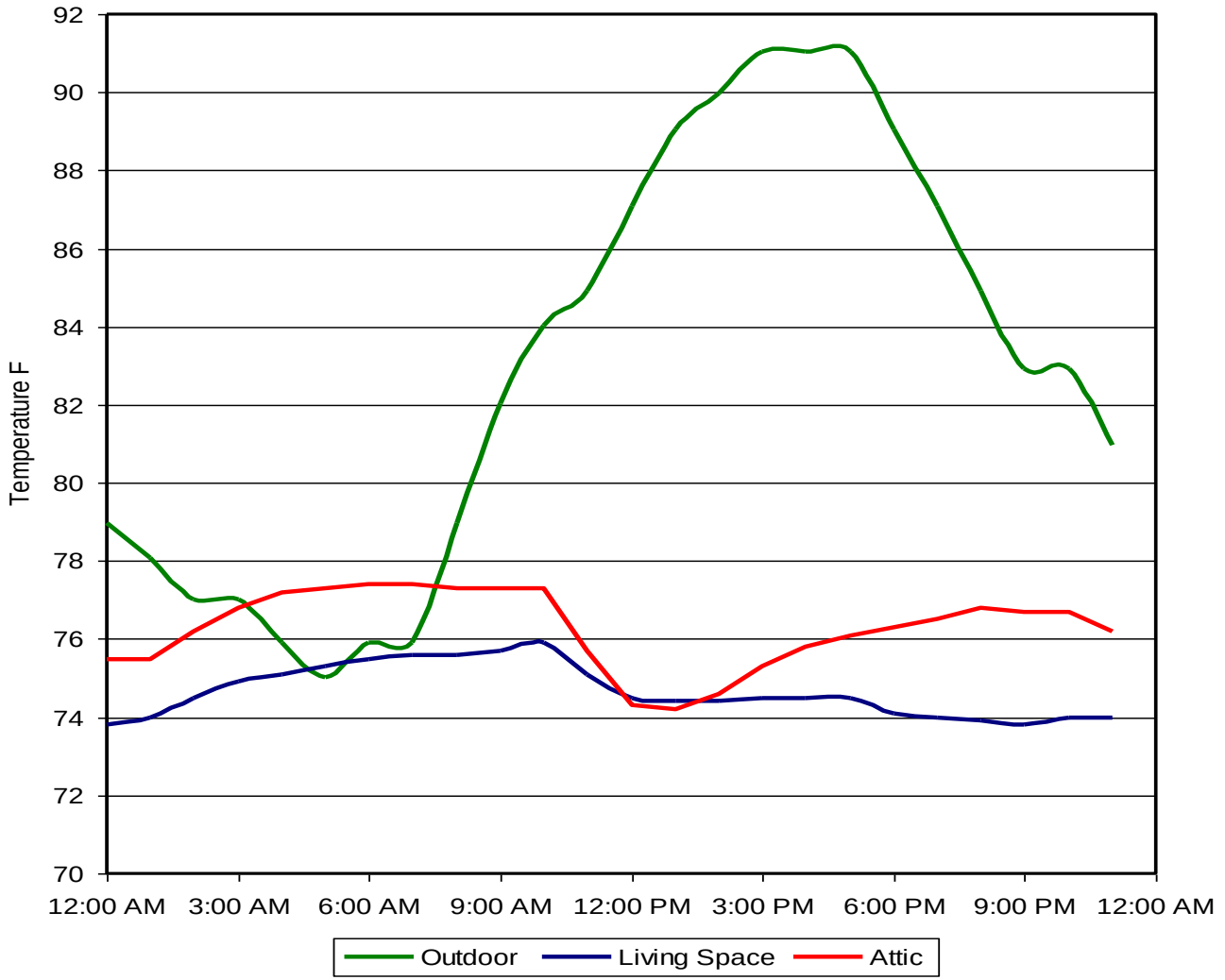
Unvented Attic Temperatures on Hottest Day



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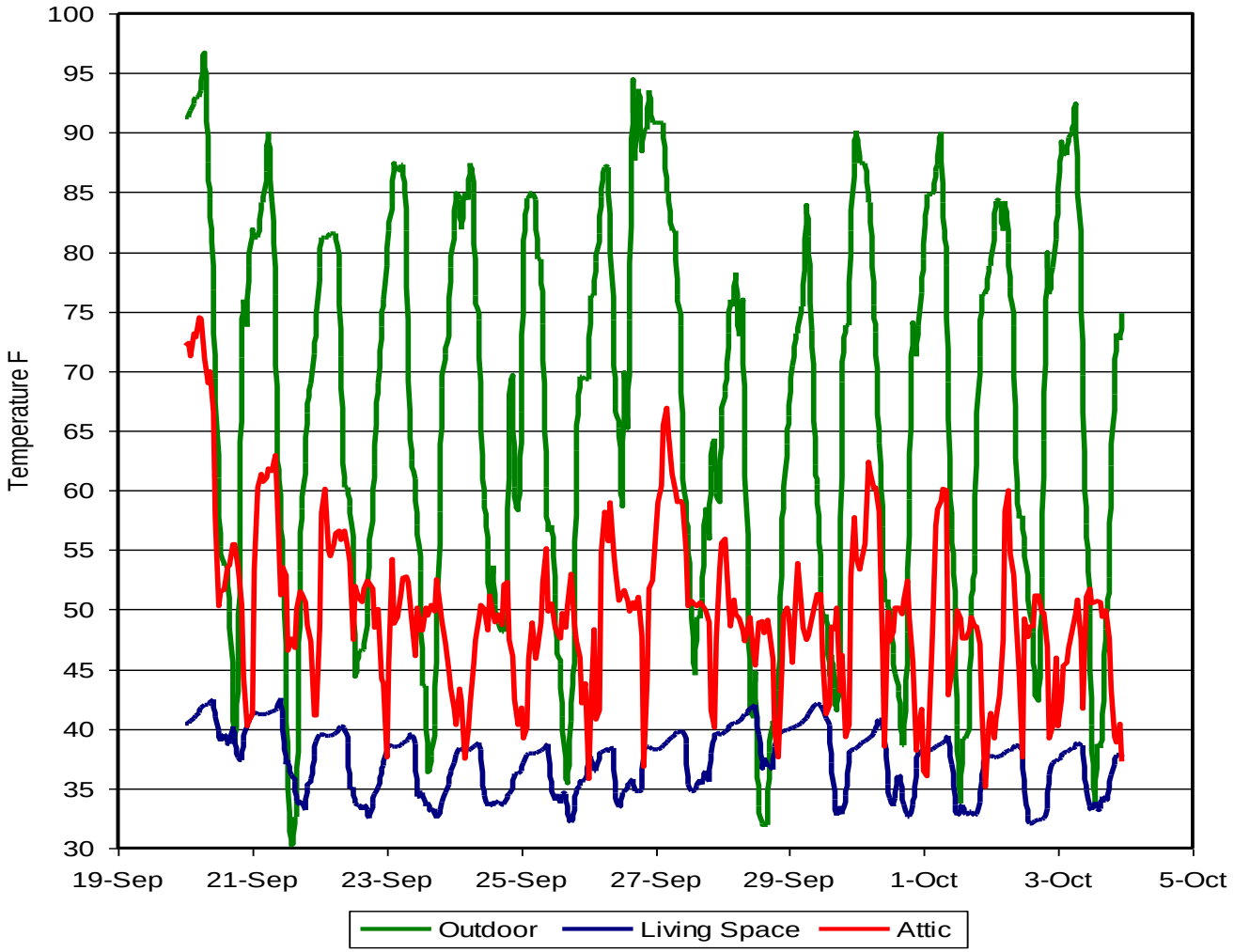
Relative Humidity over Same Two Week Period

Unvented Attic RH Avg = 50.0%

Dew Point Avg = 56.3F



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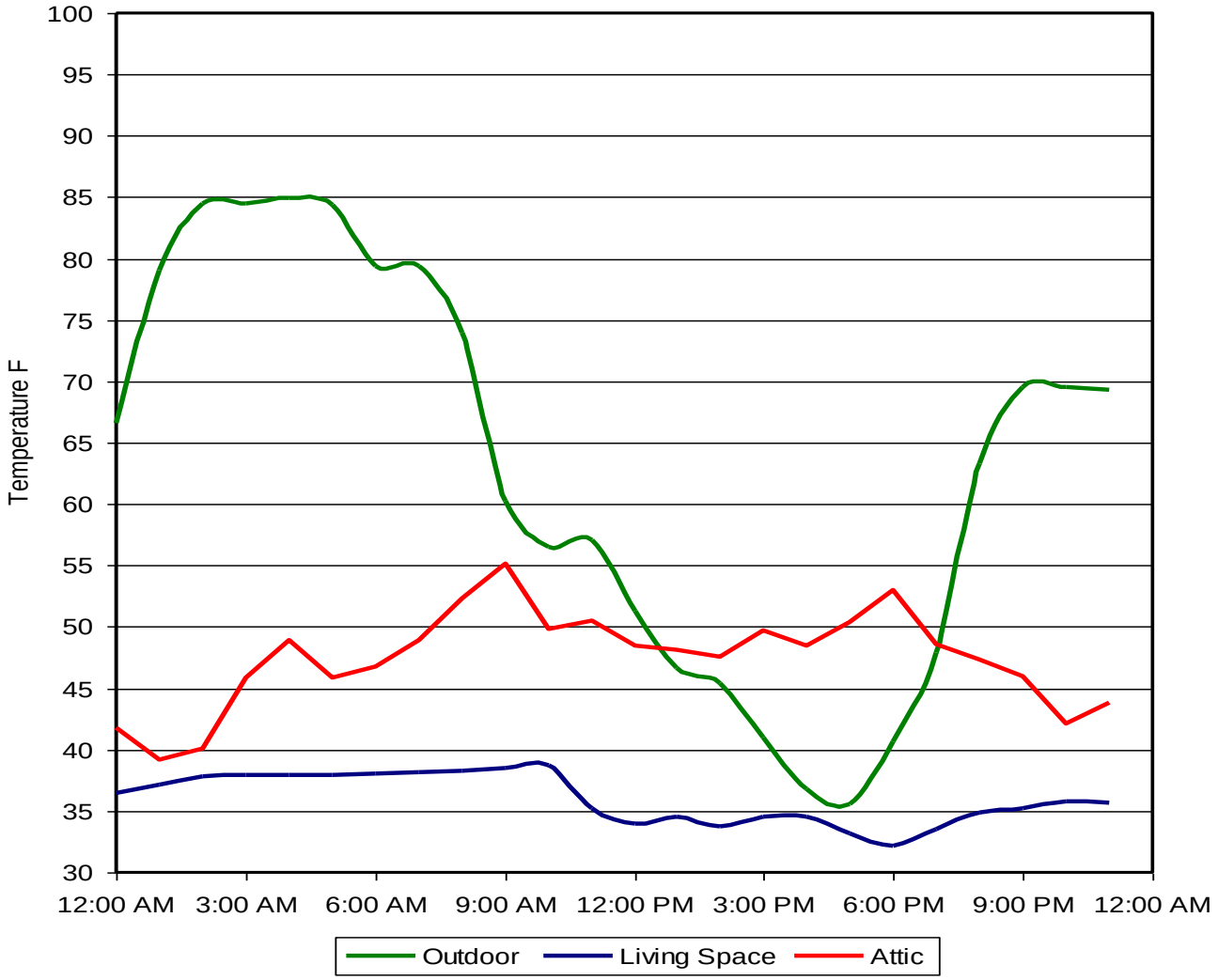
Relative Humidity on Hottest Day



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Unvented Attic & Shingles

Composition Shingles:

- Studies have shown only a 1-3 degree increase in roof sheathing temperatures with unvented roofs above those with vented roofs
- Numerous other studies have shown that unvented attics do not cause shingle failure
- Shingle color is the key factor in deterioration
- Elk, GAF, CertainTeed offer warranties for asphalt shingles applied over unvented attic assemblies with air-impermeable insulation

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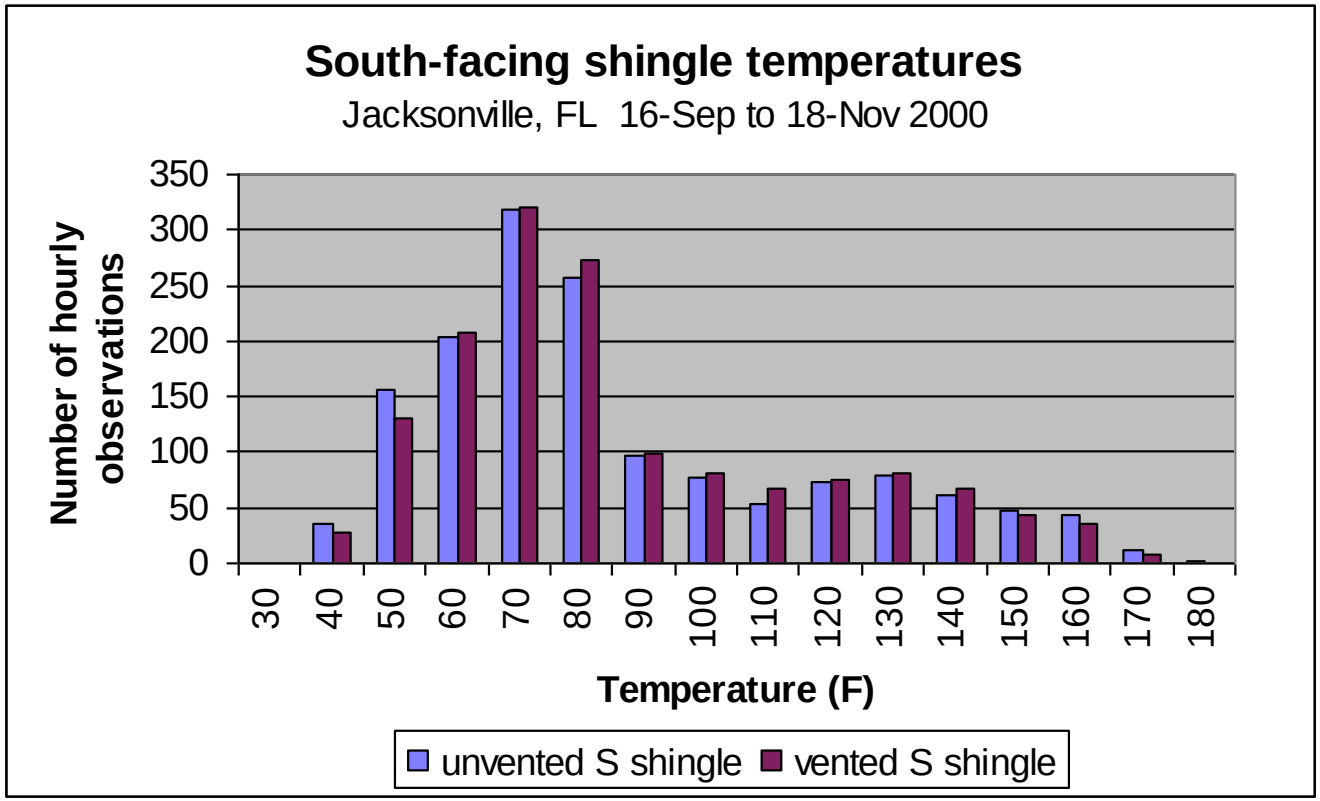
Vented vs. Unvented Attic & Shingle Temperatures



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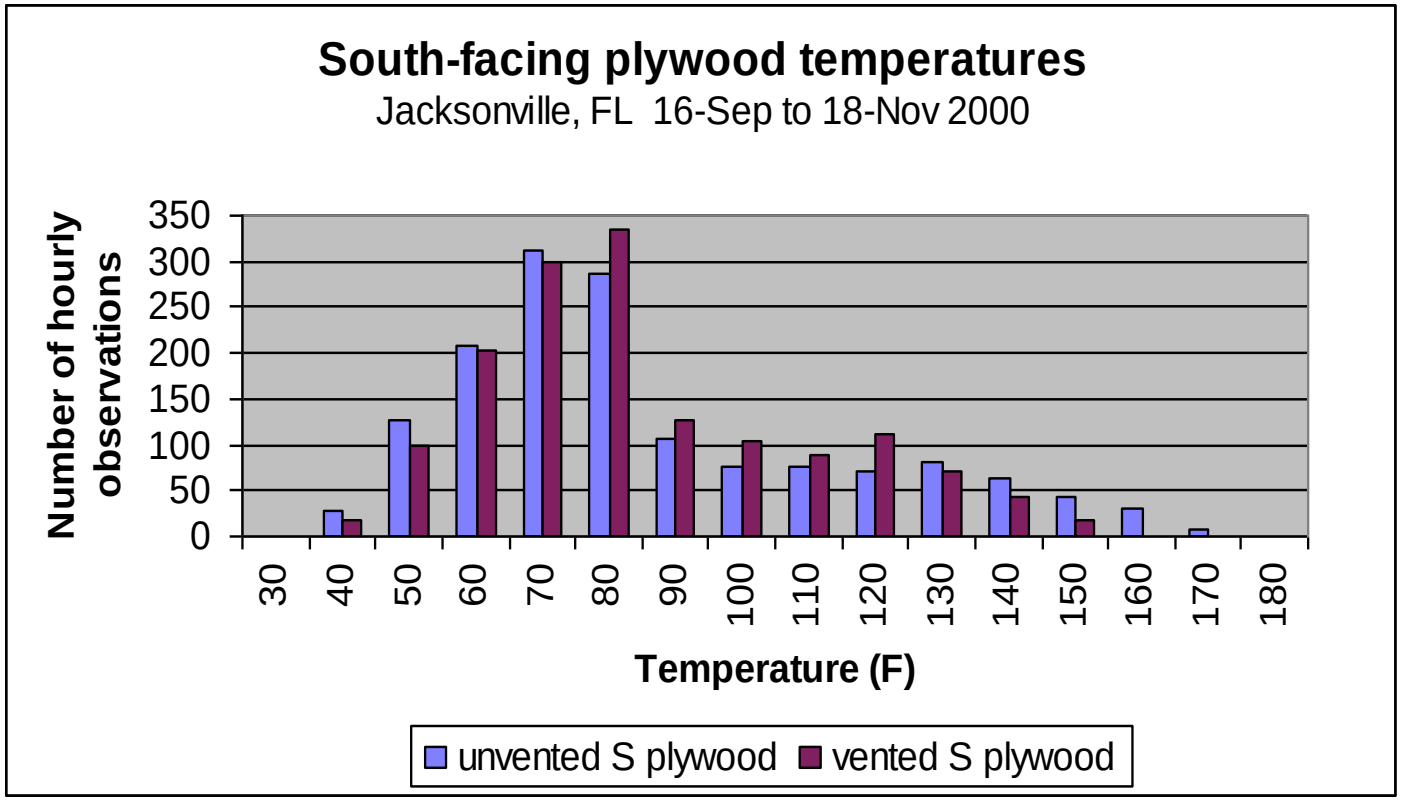
Vented vs. Unvented Attic & Sheathing Temperatures



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Unvented Attics in the Code since 2007

R806.5 Unvented attic and unvented enclosed rafter assemblies. Unvented *attic* assemblies (spaces between the ceiling joists of the top *story* and the roof rafters) and unvented enclosed rafter assemblies (spaces between ceilings that are applied directly to the underside of roof framing members/rafters and the structural roof sheathing at the top of the roof framing members/rafters) shall be permitted if all the following conditions are met:

1. The unvented *attic* space is completely contained within the *building thermal envelope*.
2. No interior Class I vapor retarders are installed on the ceiling side (*attic* floor) of the unvented *attic* assembly or on the ceiling side of the unvented enclosed rafter assembly.
3. Where wood shingles or shakes are used, a minimum $^1/_4$-inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.
4. In Climate Zones 5, 6, 7 and 8, any *air-impermeable insulation* shall be a Class II vapor retarder, or shall have a Class III vapor retarder coating or covering in direct contact with the underside of the insulation.
5. Either Items 5.1, 5.2 or 5.3 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.
   - 5.1. *Air-impermeable insulation* only. Insulation shall be applied in direct contact with the underside of the structural roof sheathing.
   - 5.2. Air-permeable insulation only. In addition to

5	R-20
6	R-25
7	R-30
8	R-35

a. Contributes to but does not supersede the requirements in Section N1103.2.1.

SECTION R807
ATTIC ACCESS

R807.1 Attic access. Buildings with combustible ceiling or roof construction shall have an *attic* access opening to *attic* areas that exceed 30 square feet (2.8 m^2) and have a vertical height of 30 inches (762 mm) or greater. The vertical height shall be measured from the top of the ceiling framing members to the underside of the roof framing members.

The rough-framed opening shall not be less than 22 inches by 30 inches (559 mm by 762 mm) and shall be located in a hallway or other readily accessible location. When located in a wall, the opening shall be a minimum of 22 inches wide by 30 inches high (559 mm wide by 762 mm high). When the access is located in a ceiling, minimum unobstructed headroom in the *attic* space shall be 30 inches (762 mm) at some point above the access measured vertically from the bottom of ceiling framing members. See Section M1305.1.3 for access requirements where mechanical *equipment* is located in *attics*.

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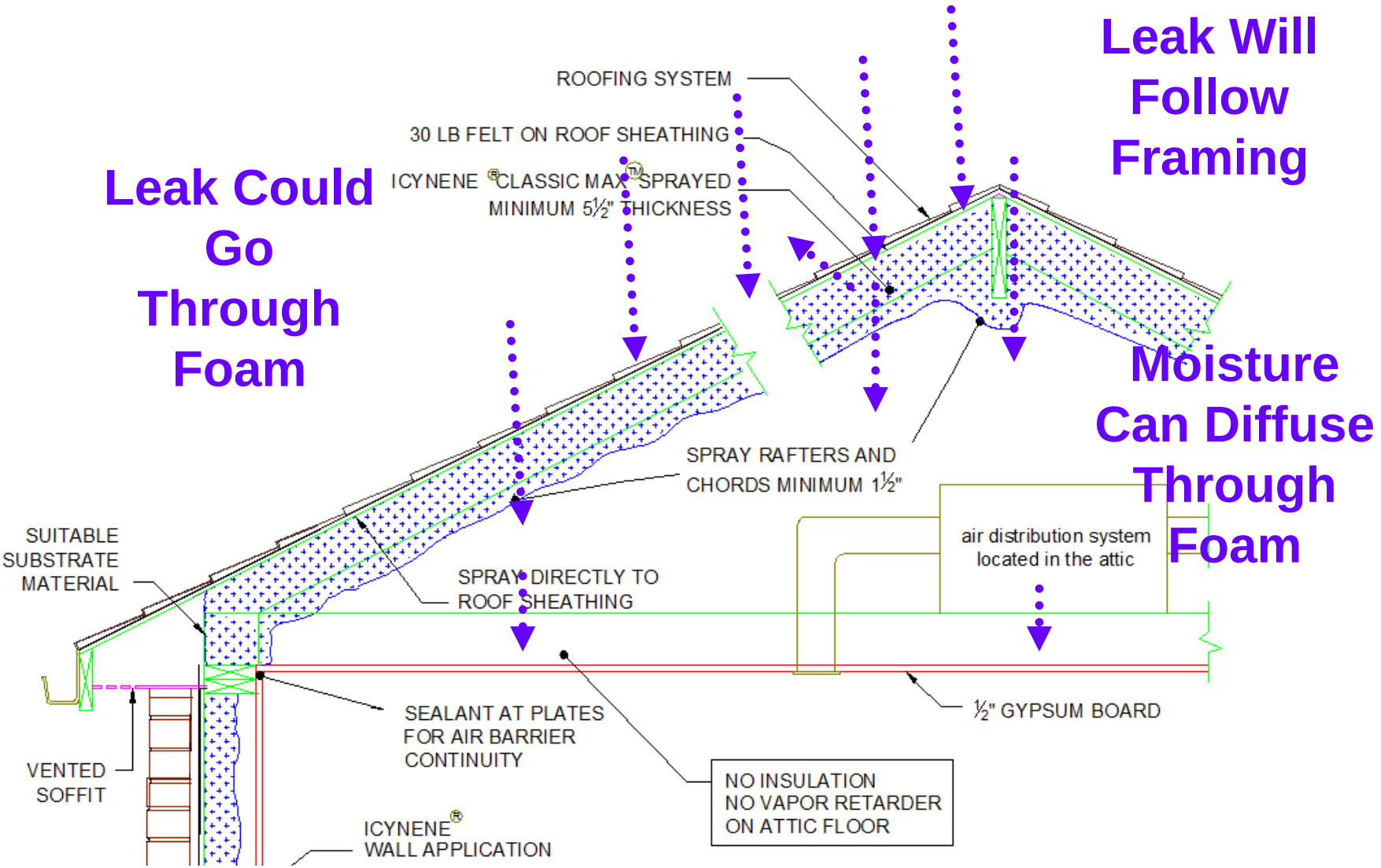
Roof Leaks, Moisture and Icynene Low Density Foam



Benefit – Building Airtightness Enhanced

- Blower door test values usually between 1.5 & 4.0 ACH50
- Building airtightness level varies depending if only unvented attic is sprayed or if balance of building walls, floors etc are sprayed too
- Energy code and Energy Star compliance target levels routinely met – peace of mind for builders

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The Impact on Building Envelope & Mechanical Systems

- Well-insulated, airtight attics and buildings result and require
  - Smaller heating/cooling systems
  - Mechanical ventilation

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The Impact on Building Envelope & Mechanical Systems

- Smaller “right sized” HVAC reduces system costs
  - Lower equipment cost at approximately $500 per ton, this will vary depending on house location and the SEER rating of the AC unit.
  - Increased moisture removal, providing increased comfort level during the cooling season and reducing the potential for moisture buildup in the structure
  - Reduces short cycling (improved efficiency) which reduces wear and increases the life of the fan motor and compressor
- Tightness of envelope improves evenness of heat transfer thereby reducing hot/cold spots

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Duct Sizes Can Be Reduced

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HVAC Load Calculation Example

FIBERGLASS LOAD ANALYSIS

Client Name:	D. R. Horton
Client City:	Birmingham, AL
Client Comment:	Per Tim Comstock-Icynene
Company Name:	Advanced Design Systems
Company Representative:	Lewis Cooley
Company Address:	3 Holland East Court
Company City:	Simpsonville, SC 29681.5817
Company Phone:	864.270.5727
Company Fax:	864.963.2978
Company E-Mail Address:	lecooley@charter.net
Company Comment:	Average infiltration

Design Data

Reference City:		Birmingham, Alabama
Building Orientation:		Front door faces East
Daily Temperature Range:		Medium
Latitude:	33	Degrees
Elevation:	620	ft.
Altitude Factor:	0.978	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	21	19.48	80%	n/a	70	n/a
Summer:	94	75	42%	50%	75	37

Check Figures

Total Building Supply CFM:	[illegible]	CFM Per Square ft.:	0.726
Square ft. of Room Area:	2,491	Square ft. Per Ton:	682
Volume (ft³) of Cond. Space:	[illegible]		

Building Loads

Total Heating Required Including Ventilation Air:	50,821 Btuh	50.821	MBH
Total Sensible Gain:	38,907 Btuh	89	%
Total Latent Gain:	4,946 Btuh	11	%
Total Cooling Required Including Ventilation Air:	43,853 Btuh	3.65	Tons (Based On Sensible + Latent)

4 Tons

Icynene Unvented Attic Saved 1 Ton

Project Comment:	Foam in roof deck (sealed attic, walls
floor slab on grade	
Client Name:	D. R. Horton
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Company Name:	Advanced Design Systems
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Company Phone:	864.270.5727
Company Fax:	864.963.2978
Company E-Mail Address:	lecooley@charter.net
Company Comment:	0.1 ac/h-n

Design Data

Reference City:		Birmingham, Alabama
Building Orientation:		Front door faces East
Daily Temperature Range:		Medium
Latitude:	33	Degrees
Elevation:	620	ft.
Altitude Factor:	0.978	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel Hum	Indoor Rel Hum	Indoor Dry Bulb	Grains Difference
Winter:	21	19.48	80%	n/a	70	n/a
Summer:	94	75	42%	50%	75	37

Check Figures

Total Building Supply CFM:	1,700	CFM Per Square ft.:	0.682
Square ft. of Room Area:	2,491	Square ft. Per Ton:	936
Volume (ft³) of Cond. Space:	24,677		

Building Loads

Total Heating Required Including Ventilation Air:	35,328	Btu/h	35.328	MBH
Total Sensible Gain:	28,845	Btu/h	90	%
Total Latent Gain:	3,087	Btu/h	10	%
Total Cooling Required Including Ventilation Air:	31,932	Btu/h	2.66	Tons (Based On Sensible + Latent)

3 Tons

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Builder Cost Savings Example

- Elimination of Ridge Vent; Save $100
- Right-Size HVAC (1 ton to 1½ ton reduction); Save $750+
- Solid Soffit vs Vented Soffit; Save $50
- Eliminate Attic Floor Insulation; Save $800
- No High Heel Trusses; Save $200

2009 IECC Energy Code & Energy Star Requirements:

- 402.2.3 Attic access. Require weather-stripping & insulation to surrounding insulation level. Save $300
- 402.4.1 Building thermal envelope. All penetrations in the envelope must be air-sealed. Save $400
- 402.4.2.1 Building Envelope Testing for Energy Star. Blower door tested air leakage needs to be <5 or 6 ACH50. PRICELESS (failing test is extremely expensive)

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Builder Cost Savings Example

- 402.4.5 Recessed lighting. Must be sealed, air-tight and IC-Rated. Save $100
- 403.2.1 – Duct insulation. Supply ducts in attics must be insulated to R-8 and return ducts to R-6 unless they are considered inside conditioned space. Save $150
- 403.2.2 Duct testing. Ducts located inside the thermal envelope do not have to be tested. Save $150
- 402.2.1.1 Wind wash baffle and air-permeable insulation dam. Unvented attics do not need baffles. Save $150

Other Possibilities:

- Radiant barrier elimination. Save $400
- Duct downsizing savings. Save $150

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→ $3,700 in Potential Deductions

The Effect of the Performance Path in Meeting the Energy Code

Prescriptive Values				
Zone	Ceiling	Main Walls	Floors	Crawl Space Walls
3	30	13	19	5/13
Typical Performance Values with Icynene				
Zone	Unvented Attic	Main Walls	Floors	Crawl Space Walls
3	20	13	13	5

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Location Effects Whether LD or MD is Preferred Choice

- Per Code, houses in Southern Climates (Zones 1 to 4) do not require the spray foam insulation to be a vapor retarder or have a vapor retarder coating
- Low density spray foam favored in Southern Climates

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Houses Being Built in Savannah with Unvented Attics are Typical SE Houses

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Application Considerations for Builders

- Some builders choose to only use spray foam for unvented attic application - an important step in building energy efficient houses
- Complete spray foam application = greater airtightness, HERS score, energy savings and occupant comfort benefits could be realized

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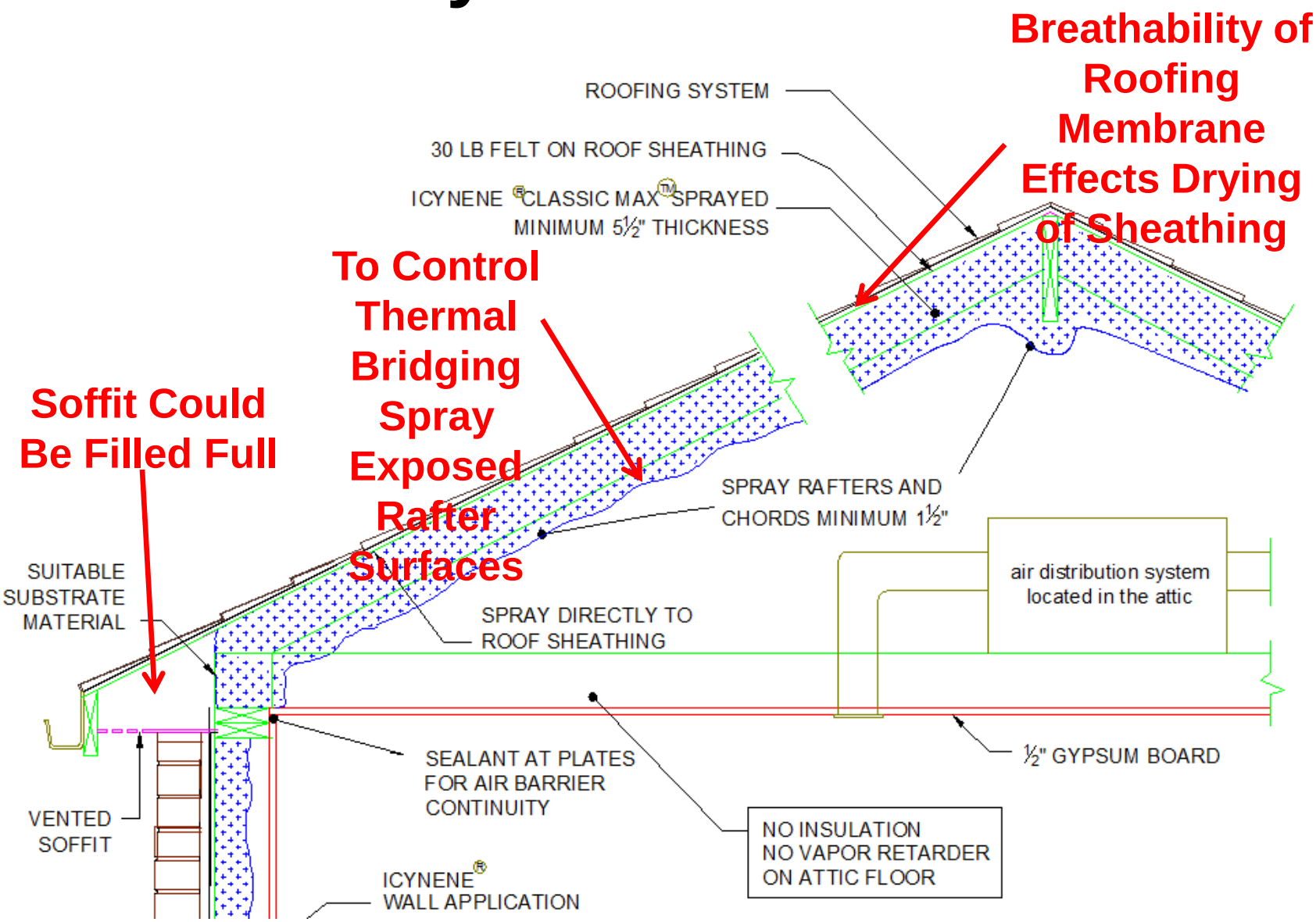
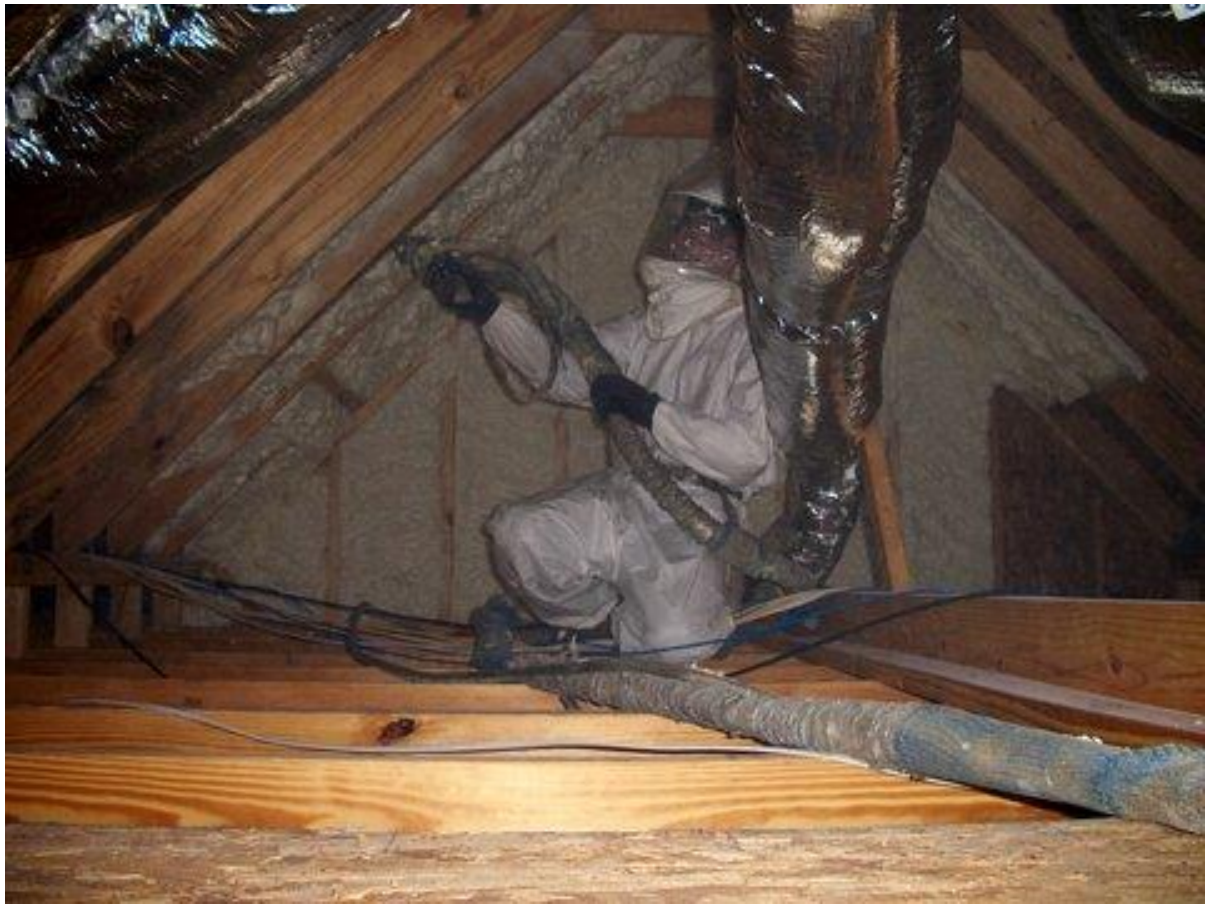
Application Considerations for All Icynene Foams



Gable Ends of Roof Require Application



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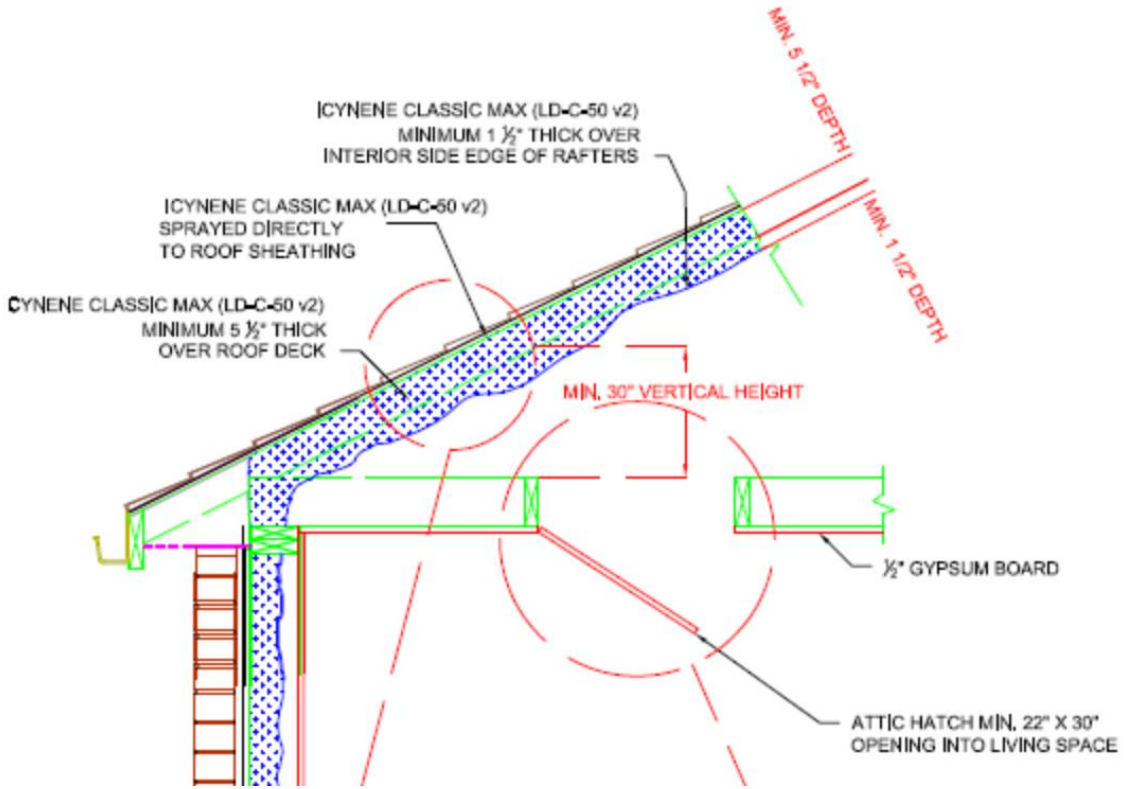
Application Considerations for Classic Max™



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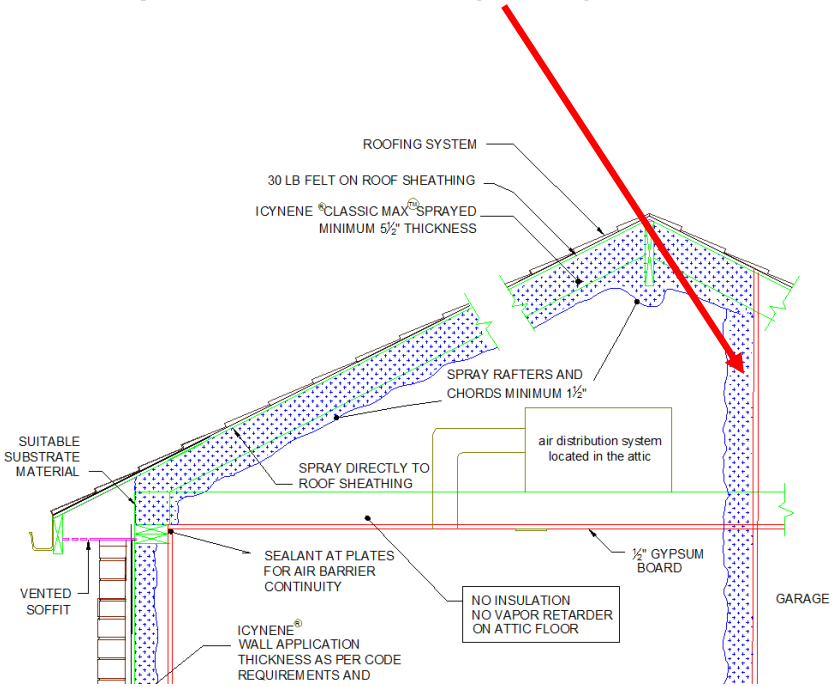
Application Considerations - Garage

Attic above living space needs separation from garage attic



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Health and Safety Implications

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Health and Safety Implications

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Summary

- Unvented attics temperature and relative humidity closer to living space levels than outside
- Icynene spray foam insulation products have a long track record of unvented attics applications resulting in improved house performance:
  - Unvented attics increase overall house energy efficiency
  - HVAC system size typically reduced
  - House more airtight ⇨ Energy Ratings & Targets More Easily Met
  - Attic and roofing system performance not changed at all or very little; shingle color biggest factor

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Summary

- Once all cost deductions are considered, unvented attic applications with Icynene spray foam insulation are cost effective; $3,700 in SouthEast house example
- Application is straightforward

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Questions?

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