



RESNET

Infrared Inspection Standard and Certification

Rogge Miller

Guaranteed Watt Savers

John Snell

Snell Infrared

Why create a new standard?

“I don't know!”

- The Standard is in Draft form.
- It has just been presented to the Technical Committee.
- It took 3 years for the Energy Audit Standard. We are just starting.
- There will be numerous comment periods in the future.

Why create a new standard?



- Existing standards and certifications don't fit RESNET needs
- Infrared is being more and more widely used by Raters
 - Cost effective
 - Essential for many new home inspections and most retrofit inspections
- The qualifications of the thermographer and the quality of the inspection both needed to be clearly defined.

Why create a new standard?

- A committee was formed from interested RESNET associates, many of whom are thermographers, to create the draft standard:
 - Kelly Parker, Chair
 - Rogge Miller
 - John Snell
 - Barb Yankie
 - Bret Monroe.
 - Tony Woods
 - John Krigger
 - Lee O'Neal
 - Mike Haskins

Why create a new standard?

- **Scope:** “These standards are RESNET requirements for inspecting a building enclosure using an infrared imaging system to locate defective insulation installations, air leakage, moisture intrusion, or thermal bypasses”
- Standard will also provide for Advanced Rater Certification for Infrared Thermography.

How are new standards created?

- ❑ Determine the purpose and need for the new standard.
- ❑ Identify current infrared Standards their applicability to building inspections.
- ❑ Adapt the current Standards to meet RESNET Standards and inspection needs within the rating community.

How are new standards created?

- ❑ RESNET accepts proposals for new or revised Standards provisions from any interested party
- ❑ Proposed Standard provisions are reviewed by appropriate RESNET Standing Committee with recommendations to Board of Directors to accept, accept with modification or deny
- ❑ Proposed standards provisions are posted to RESNET web site for public comment for a minimum of 30 days.

How are new standards created?

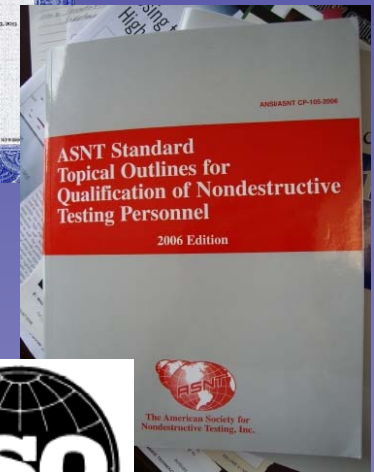
- Public comment reconciled by appropriate RESNET Standing Committee with recommendation to Board of Directors
- Board of Directors votes on recommendations of Standing Committee
- Proposed Standards provisions put before the RESNET Standards revision committee for approval or denial.

Existing standards

- ❑ ASTM 1060, Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
- ❑ ASTM E 1186-03: Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
- ❑ ISO 6781: Thermal Insulation---Qualitative Detection of Thermal Irregularities in Building Envelopes---Infrared Method
- ❑ Canadian General Standards Board, Document 149-GP-2MP, Manual for Thermographic Analysis of Building Enclosures
- ❑ Canadian National Master Specifications (NMS), Section 02 27 13, Thermographic Assessment; Building Envelope.
- ❑ British Standard: Thermal performance of buildings. Qualitative detection of thermal irregularities in building envelopes. Infrared method. ISO6781:1983 modified

Existing Certifications

- ❑ Issued by a training company
 - ❑ Not well defined
 - ❑ Not particularly meaningful
- ❑ ASNT-based
 - ❑ Poorly understood by public
- ❑ ISO-based
 - ❑ Not yet relevant in the USA.

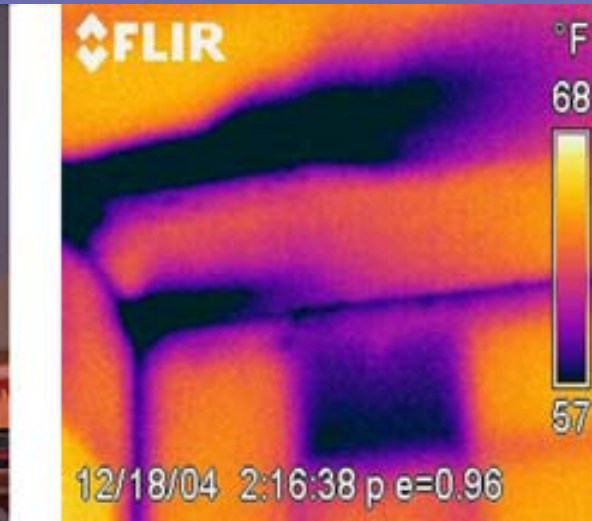


Air & insulation inspections

- Thermography provides an excellent alternative means of:
 - Verifying placement of insulation
 - Testing insulation performance
 - Locating air leakage sites
- It can be faster & more accurate than other methods
- The one NEGATIVE: It is weather dependent!



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Infrared Standard & certification

Adopted by RESNET

- The new Standard, if adopted, will be Chapter 8 of the RESNET 2006 Mortgage Industry Home Energy Rating System Standards.
- The IR Standard will help provide further certifications for those in the rating community and a higher level of inspection techniques.

A “plain language” standard

Federal Plain Language Guidelines



Plain Language.gov
Improving Communication from
the Federal Government to the Public

- This is the first Standard written according to Federal Plain Language Standards
- Though technically accurate, the Standard has diminished the “technical” language of the past documents
- The bottom line: technically written but with simplicity.

The best of other standards

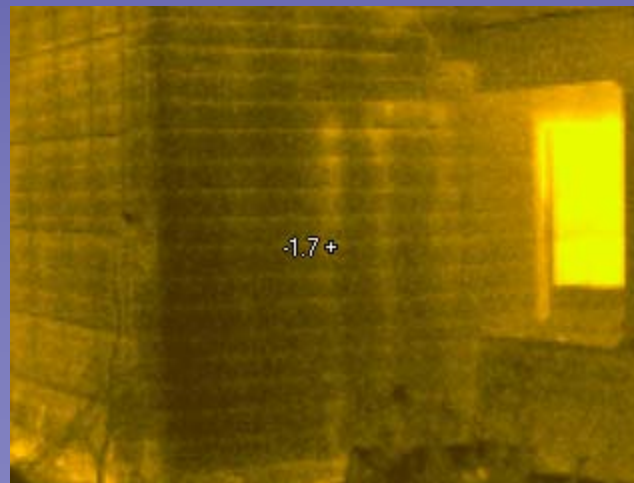
- Minimum specifications for camera
 - Thermal sensitivity
 - Spatial resolution
- Conditions defined for each type of inspection
- Conducting the inspection
 - Insulation: Guidelines for grading the insulation per RESNET Standards
 - Air leakage
 - Some information included on recognizing moisture.

Thermographer qualifications

- ❑ Qualification is essential to good results
- ❑ Certifying qualified thermographers will have value for all parties
- ❑ Two pathways are available to achieve certification.



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Infrared Standard & certification

Method 1

- HERS rater certification and...
- Level I, II, or III infrared training or...
- Building Science Thermography (FLIR/ITC) and...
- Two reports submitted for evaluation.
- Additional evidence of qualification may be required if concerns are raised during the evaluation of the reports:
 - Knowledge of camera use
 - Interpretation of data
 - Understanding of limitations of the test method.

Method 2

- HERS rater certification and...
- RESNET approved online or attended training with classroom and fieldwork and...
- Pass a RESNET online, timed, open book test of 20 questions and...
- Have or complete one year of field work and...
- Submit 10 reports for review
- Additional evidence of qualification may be required if concerns are raised during the evaluation of the reports:
 - Knowledge of camera use
 - Interpretation of data
 - Understanding of limitations of the test method.

Camera requirements

- Spectral range: between 2-15 microns
- Manual adjustment of Level & Span
- Radiometric system recommended
 - Must allow for adjustment of emissivity and background temperature
- Non-radiometric systems allowed
- Capable of recording and storing digital or video images.

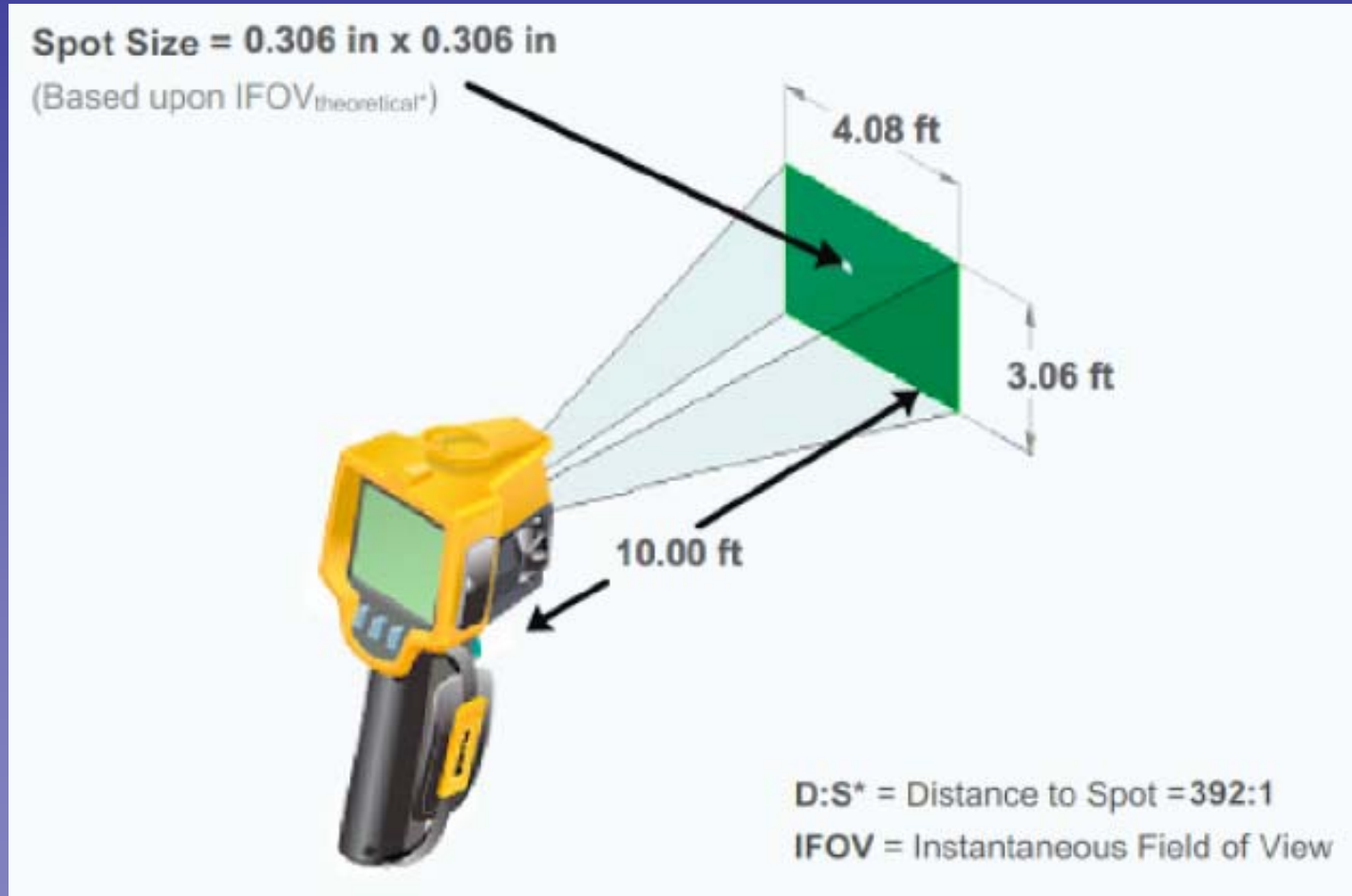
Camera requirements

- Thermal sensitivity of 100mK@30C or better
- More sensitive systems will allow you to work more days/year and more hours/day
- 70mK cameras are now commonly used for building work.

Camera requirements

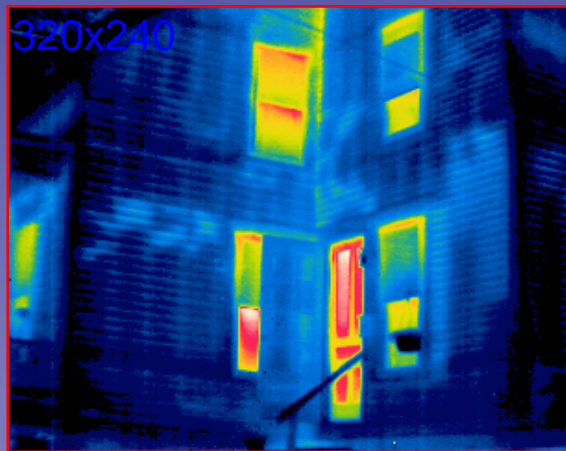
- Spatial resolution of 3mRad or better
 - Can resolve 1.5" framing at 42'
 - Can resolve .75" void at 21'
 - Can resolve a sheetrock screw at 10'
- Field of view
 - Capable of showing at least two wall framing cavities across while distinguishing individual framing members
 - An FOV of ≈ 20 degrees is suggested
- 120x120 detector array or greater.

Field of View

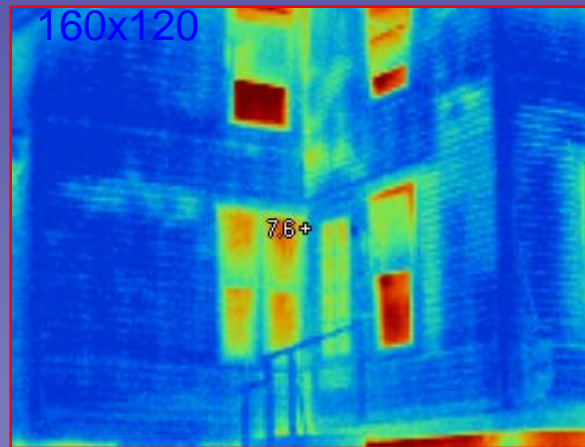


Different size arrays

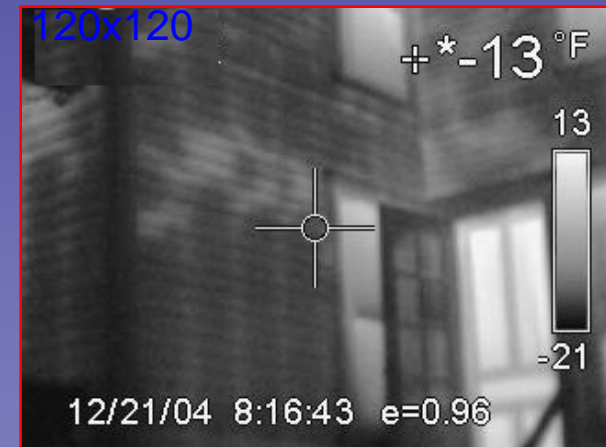
- Arrays of various sizes can all work.



320x240



160x120



120x120

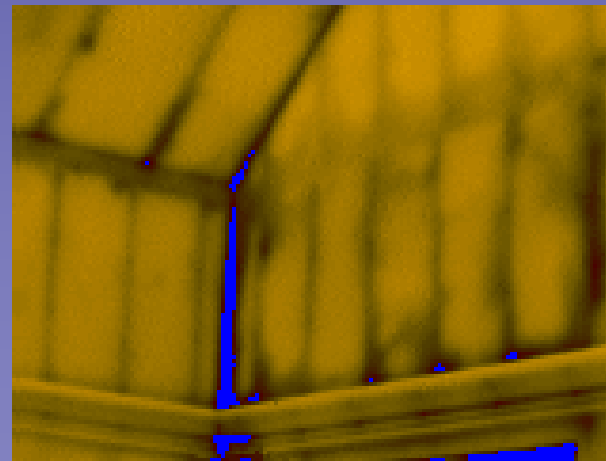
General Requirements

- ❑ Sampling of areas of the building both with and without anomalies
- ❑ Catalog the anomalies for ease of locating
- ❑ Obtain thermal images as close to perpendicular to the surface as possible.



General Requirements

- ❑ Change positions to insure what you are viewing is not reflected radiation
- ❑ The minimum criterion: ability to distinguish framing materials from wall cavities
- ❑ Minimum ΔT inside to outside of 18°F (10C) for 4 hours or more.



General Requirements

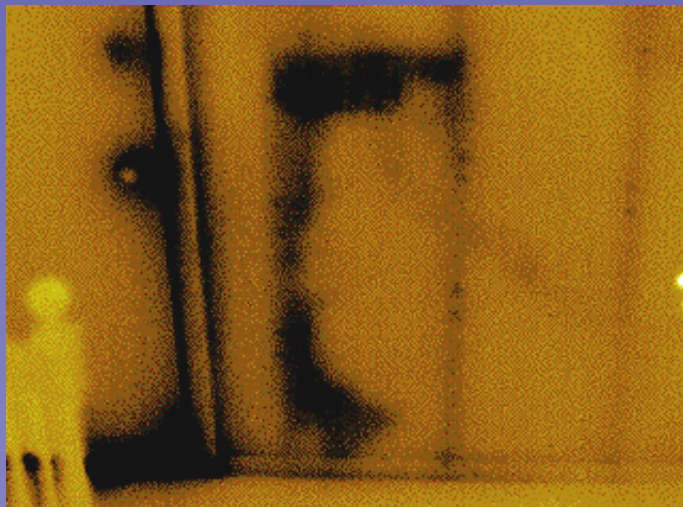
- For exterior inspections:
 - Specific requirements for limited solar radiation on both frame and masonry walls
 - Early morning, evening or cloudy days are often best
 - Wind speed less than 8 mph
 - Exterior surfaces are dry
 - Check and record test parameters.

General Requirements

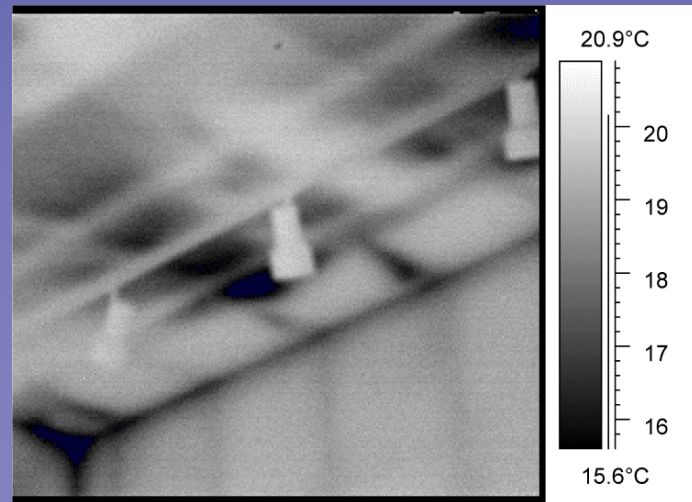
- For interior inspections:
 - Check for false positives (interior walls connected to a buffer zone)
 - Scan obscured walls from both sides
 - Be aware of components mimicking anomalies (plumbing, ducts, electrical, etc)
 - Document and locate all anomalies.

Qualitative insulation inspection

- ❑ “Inspection used for determining ‘general areas’ of the inspected surfaces having anomalies without quantification”
- ❑ *Recommended* ΔT : 18°F for 4 hours
- ❑ *Allowed* ΔT of 12°F with blower door use.



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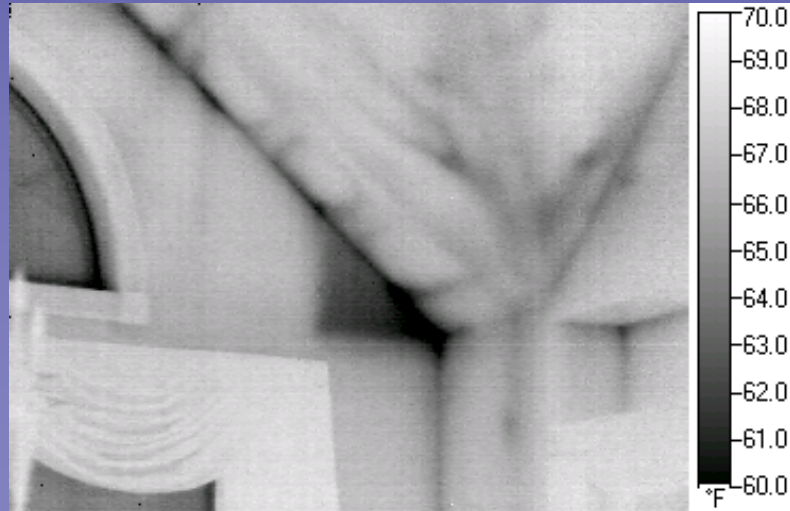
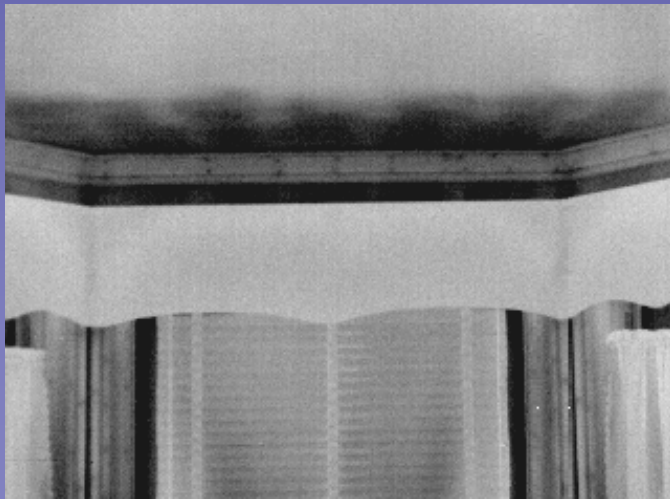


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Infrared Standard & certification

Quantitative insulation inspection

- ❑ “Determining the total square footage of anomalies as a percentage of the total surface area of installed insulation”
- ❑ Required ΔT : 18°F for 4 hours
- ❑ *If ΔT is not met, reschedule the inspection.*



Quantitative insulation inspection

- ❑ Use of a blower door is not allowed
- ❑ Grading of insulation is according to the RESNET 2006 Mortgage Industry HERS Standards
- ❑ May be used to grade insulation where a visual inspection was not performed if allowed by the Rater Provider.



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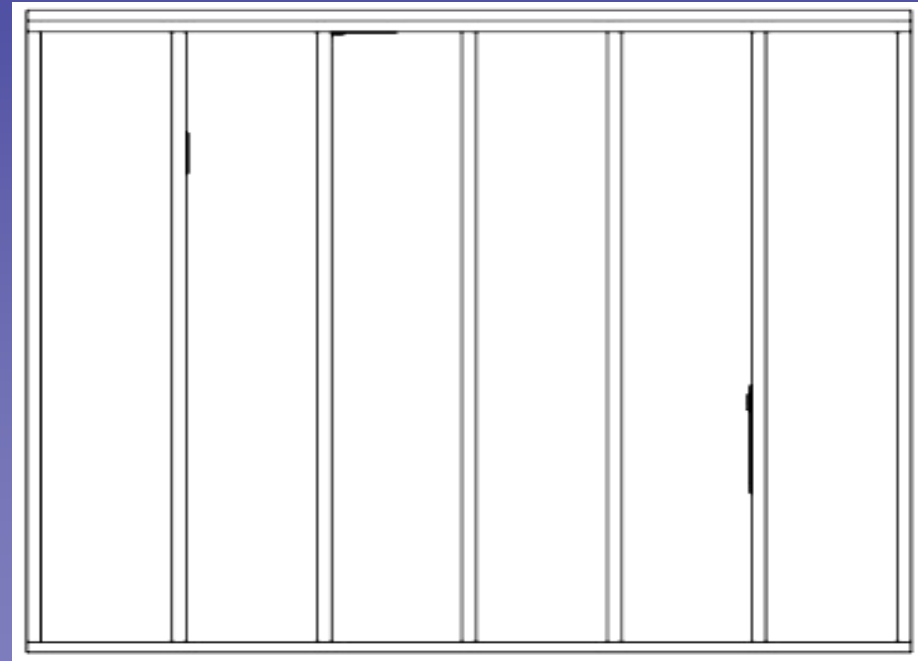
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Infrared Standard & certification

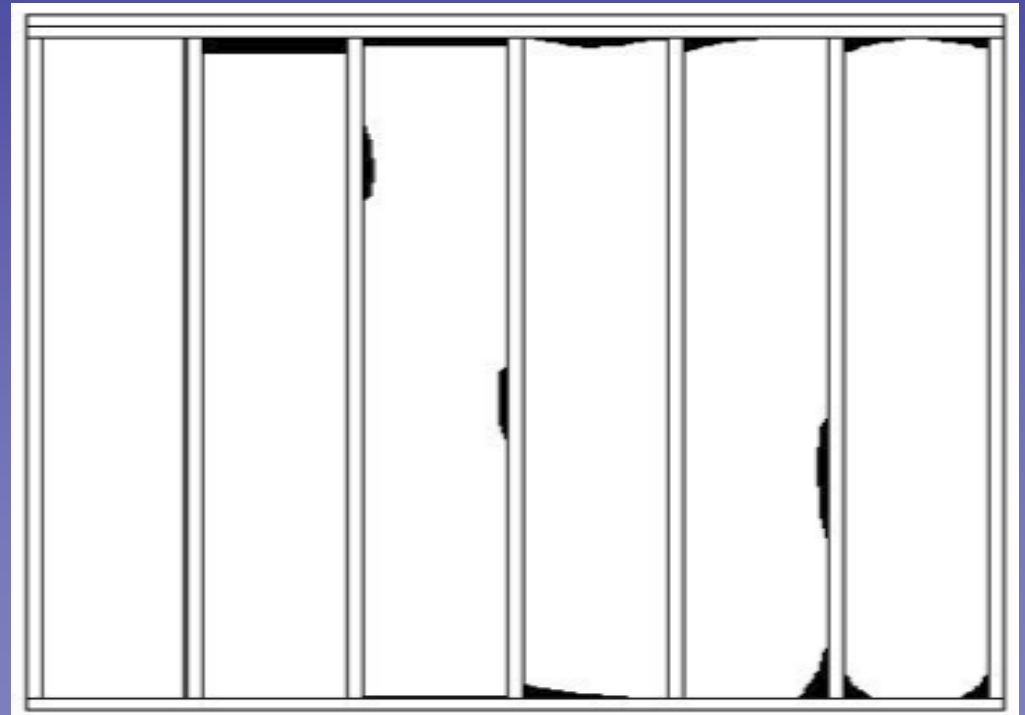
Quantitative insulation inspection

- ❑ Grade I: less than 0.5% anomalies
- ❑ Grade I cannot be verified using this Infrared Standard.



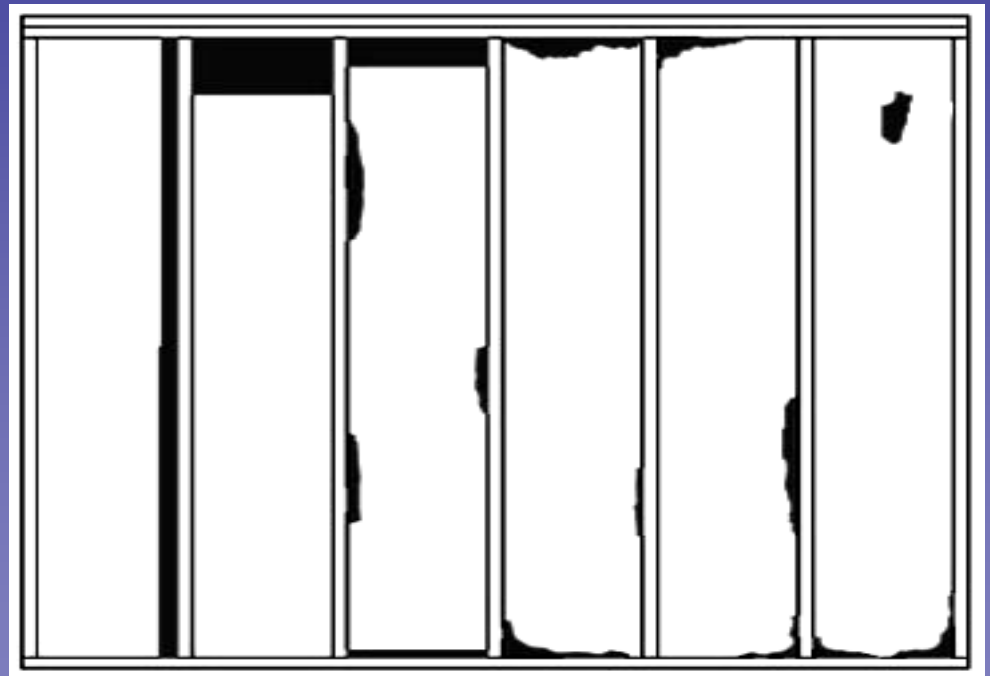
Quantitative insulation inspection

- Grade II: between 0.5% and 2.0% anomalies.



Quantitative insulation inspection

- Grade III: between 2.0% and 5.0% anomalies.



Quantitative insulation inspection

- Method for converting infrared insulation inspection to grading:
 - Measure surface area of insulated areas
 - Measure all anomalies to the nearest square foot
 - Divide the measured anomalies by the total of the surface area
 - $50\text{sf} / 3100\text{sf} = 1.61\%$ anomalies or Grade II.

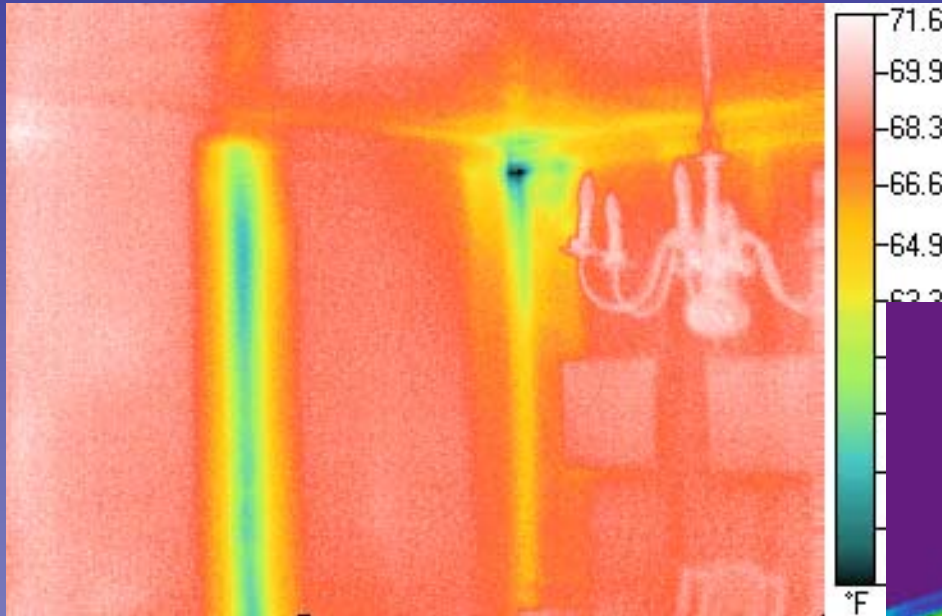
Thermal bypass & bridging

- ❑ Meet the required ΔT
- ❑ Make an initial insulation scan of the building noting locations of anomalies
- ❑ Start blower door and allow to run for 10 minutes at approximately 20 Pascals
- ❑ Note changes to anomalies and record
- ❑ *If allowed by the Rater Provider as a "more stringent protocol", this inspection may substitute for a visual inspection.*

Thermal bypass & bridging

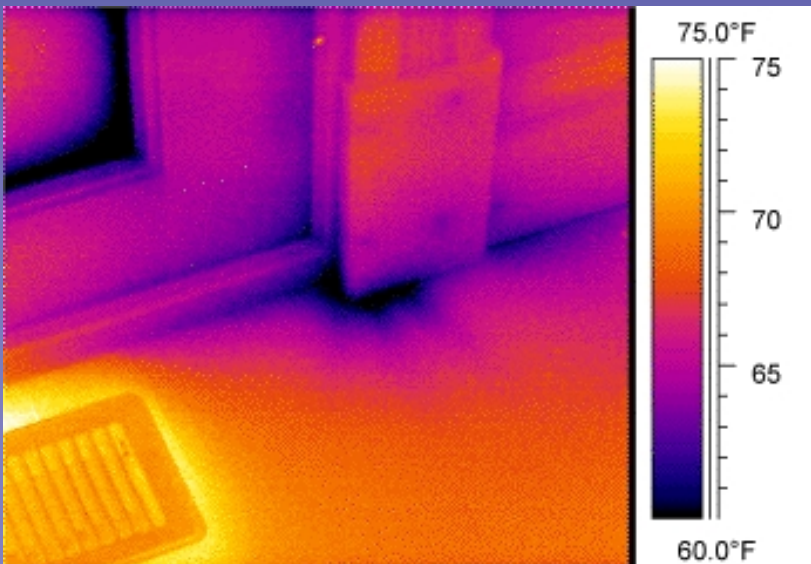


Thermal bypass & bridging



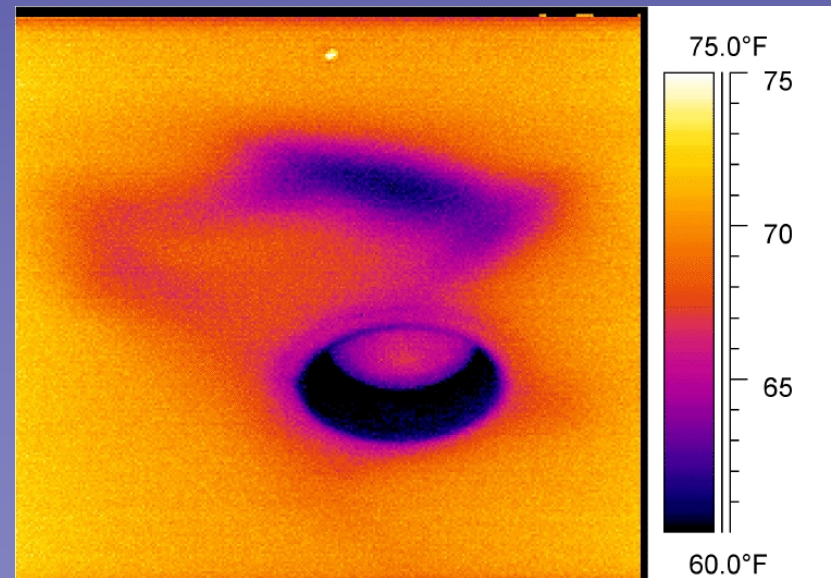
Air leakage inspection

- This Standard provides for the qualitative locating of air leakage sites
- A minimum ΔT of 3°F (1.7°C)
- Identification of buffer zones with air temperatures different from either outside or inside is important.



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Infrared Standard & certification

Air leakage inspection

- The blower door or the building's mechanical or ventilation systems are used to pressurize or depressurize the building.



Air leakage inspection

- Depressurization is used for interior inspections
- Pressurization is preferred for exterior inspections, if necessary.



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Infrared Standard & certification

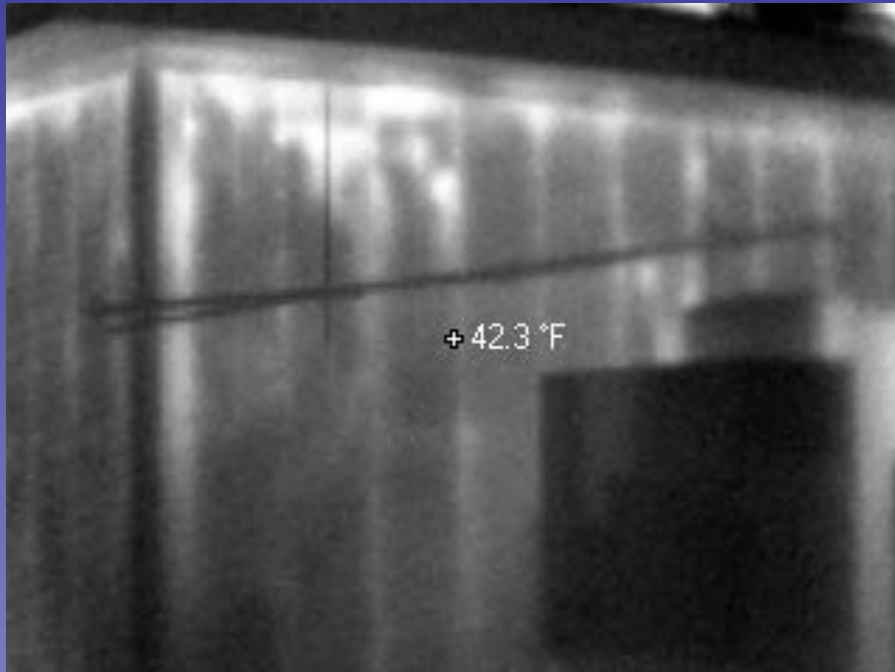
Air leakage inspection

- Inside inspections provide more accurate data
- Exterior inspections can be influenced by both solar radiation and wind.



**QuickTime™ and a
BMP decompressor
are needed to see this picture.**

Air leakage inspection



Air leakage inspection

- Employ the blower door to depressurize the building
- Run to 50 Pascals ΔP when possible, drop to 30 Pascals after 30 minutes. Normal ΔP is 10 to 50 Pascals
- Note that extreme outdoor temperatures can quickly change interior temperatures and the ΔT .

Air leakage inspection



- Take precautions for combustion appliances in conditioned space as for any blower door test
- Note both exterior and interior walls and floors for this procedure
- Thermal bridging sites should not change size or shape.

Interpreting thermal images



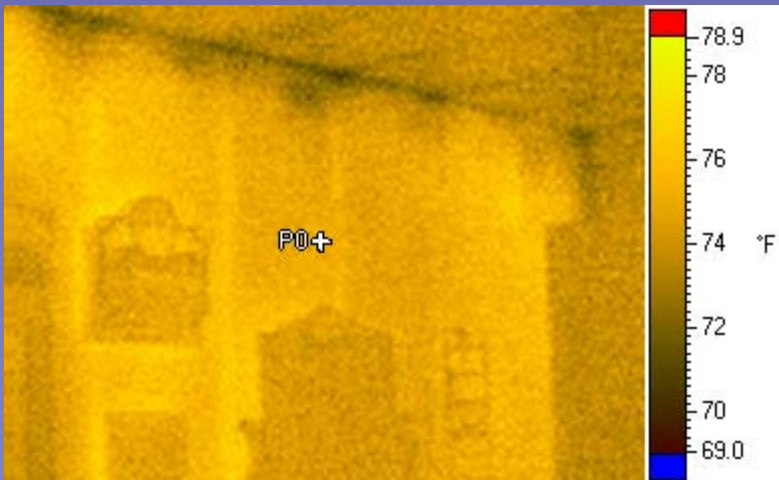
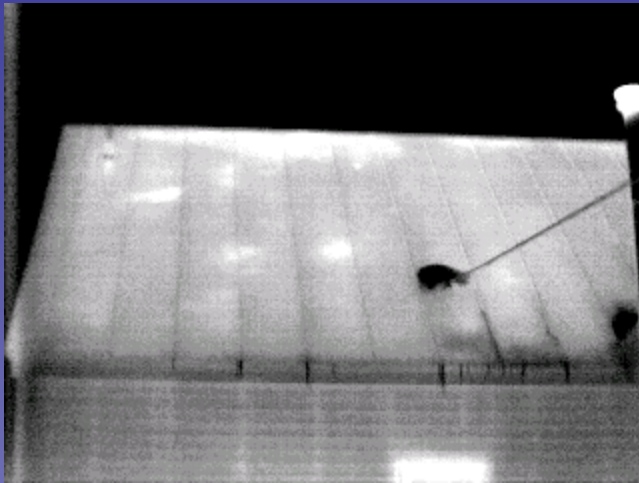
- A gray scale or monochromatic color palette is generally recommended
- Typical insulation and air leakage inspections do not require identification of specific temperatures.

Interpreting thermal images



- Be aware of specific emissivity values of viewed materials
- Be aware of emittance changes due to angle of view

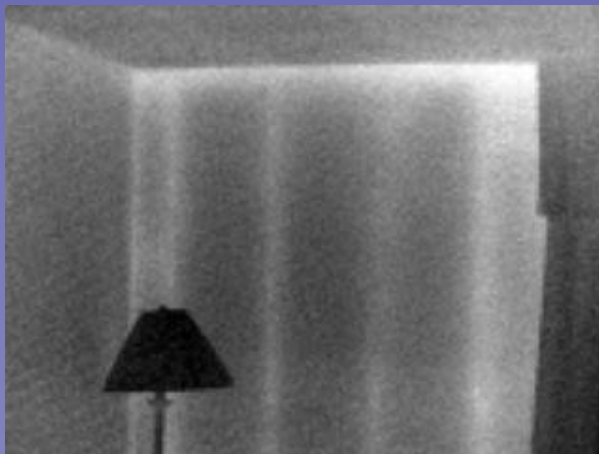
Interpreting thermal images



- Secondary methods of verifying anomalies:
 - Experience
 - Other devices (spot radiometer, moisture meter, etc.)
 - Comparison to reference thermal images of walls with/without anomalies.

Interpreting thermal images

- The basic defining factor for correct interpretation: "If the temperature distribution differs from that expected for the type of construction being viewed with the infrared imaging system."



Reports

- ❑ Reports should be generated for each type of investigation:
 - ❑ Insulation
 - ❑ Air leakage
 - ❑ Thermal bypass.

Report Content

- ❑ Description of the building specifications
- ❑ Interior and exterior components
- ❑ Geographical orientation
- ❑ Exterior surroundings
- ❑ Camera brand, model, serial number.

Report Content

- ❑ Names of thermographers and investigators present
- ❑ Date and hour of tests
- ❑ Inside and ambient air temperatures
- ❑ Buffer zone temperatures.

Report Content

- ❑ Indoor and outdoor relative humidity
- ❑ Outdoor weather conditions for the last 12 hours (solar radiation, precipitation, wind direction and speed, etc)
- ❑ Reference to any building portions not being inspected.

Report Content

- ❑ Record any building areas obstructed from inspection
- ❑ Drawings, sketches, photographs, thermograms detailing and locating anomalies.

Report Content

- ❑ Identify the aspects or components of the building being examined
- ❑ Include analysis of the type and extent of each construction defect observed
- ❑ Any results from other measurements.

Definitions and Acronyms

Abnormal	Gaps	Thermal image
Air barrier	Infrared imaging system	Thermal resolution
Air exfiltration	Infrared imaging system	Thermogram
Air leakage site	Infrared thermography	Thermography
Air wash	Instantaneous field of view	Vapor barrier/ retarder
Anomaly (defect)	ISO	Voids
ANSI	Level I Thermographer	Wind wash(ing)
ASNT	Misalignment	
ASTM	Normal	
Blackbody	Qualitative	
Building envelope	Quantitative	
Compression	Spectral wavelength	
Emissivity	Thermal boundary	
Field-of-view	Thermal bridging	
Framing spacing	Thermal bypass	

The Appendix

- Appendix A: Sample Report
- Appendix B: Method for Converting Anomalies to Insulation Grading
- Appendix C: Moisture Intrusion
- Appendix D: Thermal Patterns
- Appendix E: Further Visual Evaluation Possibilities for Use in Diagnostics.

Please give us feedback



- Helpful or not?
- Go forward or go back?
- Questions or comments?
- Additions or deletions?
- Thank you!