

“Introduction to Infrared Thermography Online Video Course: Training for Home Inspectors”

Including understanding of how to perform infrared thermography inspections, including attaining knowledge about thermal imaging; building science; thermal imaging applications; thermal image interpretation; performing infrared thermal inspection at actual on-site locations; certified inspector education; discovering and recognizing defects related to moisture, insulation, structure, electric, air infiltration; energy loss factors.



International Association of Certified Home Inspectors (InterNACHI)
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Course title: “Introduction to Infrared Thermography Online Video Course”

Course objective: To obtain an understanding of how to perform infrared thermography inspections, including attaining knowledge about thermal imaging; building science; thermal imaging applications; thermal image interpretation; performing infrared thermal inspection at actual on-site locations; certified inspector education; discovering and recognizing defects related to moisture, insulation, structure, electric, air infiltration; energy loss factors.



A. Course Title:

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B. Course Location:

The online video course is available at <http://www.nachi.org/StateCE>

C. Admission policy, fees, charge, and cancellation policies:

The course admission is open to all. Every student is required to sign in and identify themselves. (See attached document regarding student attendance and identification techniques.) The fee for the online course is \$29.95. There are no other charges.

D. Learning Objectives and Skills:

Completing this course should enable a home inspector to attain an introductory understanding of all of the concepts and issues of applying infrared thermal imaging, building science, and inspection techniques.

Follow along with the video course, and read and study your downloadable printed course materials. The course materials can be downloaded from <http://www.nachi.org/StateCE>.

E. Hourly Agenda:

Course Section 1

John McKenna

Education, Building Science, Thermal Imaging, Image Interpretations

1 hour 20 minutes

Course Section 2

Ben Gromicko

Performing On-Site Inspections With Infrared Thermography Camera

30 minutes

Course Section 3

John McKenna

Defect Recognition, Moisture, Insulation, Structure, Electric, and Energy Loss Defects

1 hour

Video Course: 3 hours

Study of Course Material: 1 hour

Exam: 60 questions: 1 hour

Total Course Hours: 5 hours

F. Instructor Information:

John McKenna

InterNACHI Course Instructor

Certified Master Inspector (CMI)

Licensed Texas Home Inspector & Instructor (TREC #4565)

FLIR-ITC Certified Thermographer

President Of The Master Inspector Certification Board (CMI)

25 Years Experience In Construction

InterNACHI Staff

InterNACHI Thermal Imaging Trainer

Author Of The TV Report "A Consumers Guide To Infrared Thermography".

G. Number of hours: 5 CE hours

H. Additional Information Attached

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Energy – Emissivity - Temperature:

- Understanding what infrared images represent.
- Understanding the factors that affect Emissivity.
- Knowing the meaning of apparent temperature.

Emitted **ENERGY** increases with temperature.

What factors influence emissivity?

ANSWER: Type of materials, such as wood, concrete, rubber, ice, porcelain, metal, formica, ect.

Non metals usually have fairly high emissivity and little variations.

Metals that are pure, smooth and un-oxidized have very low emissivity. But thick metal oxides have high emissivity.

Also surface structure, geometry, smooth, rough, polished, sanded, shiny, etc...

The rougher the surfaces, the more emissivity.

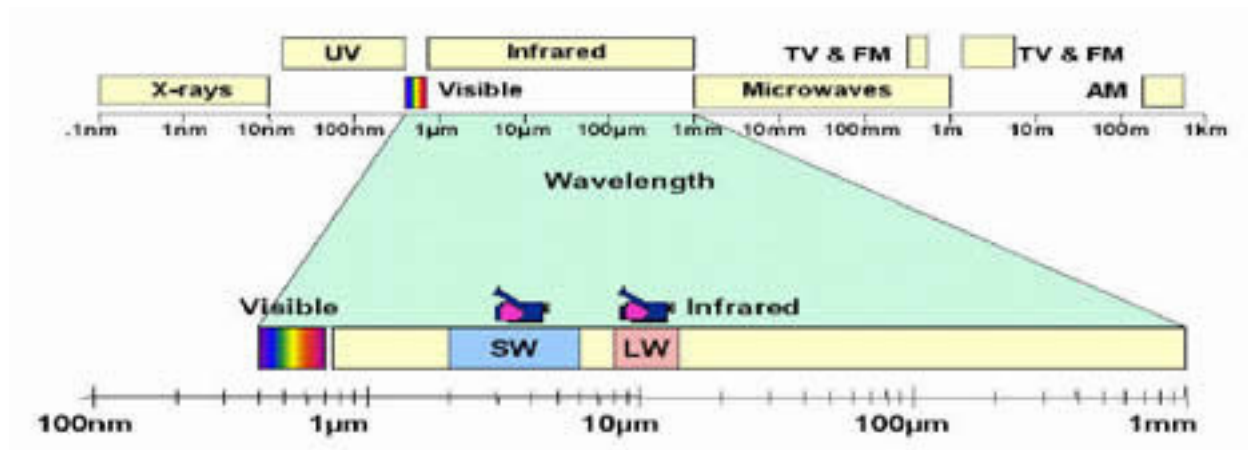
Cavities, angles, holes, resemble darker areas in thermal images.

Viewing from different **ANGELS** can affect effective emissivity. At a 90 degree angle you may reflect yourself !!!!

TIP

Walls can look cooler viewed at an angle.
For best results, view from various angles, when possible.

Wavelength of the camera can affect the the emissivity reading of an image.
(long and short wavelength cameras vary)



Temperature can affect the surface emissivity.

Different colors absorb and emit different degrees of temperature.

Emissivity Effects

- High emissivity will be more true (trust).
- Low emissivity can be affected by surrounding objects and will have just a close “APPARENT temperature” (do not trust).

Example: Formica, smooth metal or glass may reflect the hot light bulb near the counter top or the cold AC vent in ceiling.

Also consider a painted surface vs. a non painted surface will affect the same material and cause different emissivity.

Atomosphere can absorb, and distort a certain amount of emitted radiation.

Because of so many factors that can affect the thermal image, the temperature displayed by the IR camera is “APPARENT Temperature”, unless the proper settings are adjusted.

Can Apparent Temperature Be Used?



**For the home inspector the answer is YES.
Keep Reading...**

Qualitative or Quantitative?

There are basically TWO different methods to measure Infrared Thermography.

Compare:

Qualitative

- Analysis of image
- Apparent temperature
- Find Anomaly
- Find location
- Analyze PATTERNS

Quantitative

- Temperature measurement
- Compensation made
- Classify seriousness of anomaly

Qualitative or Quantitative?

Which one does the average building inspector need for regular inspections?

ANSWER: Qualitative

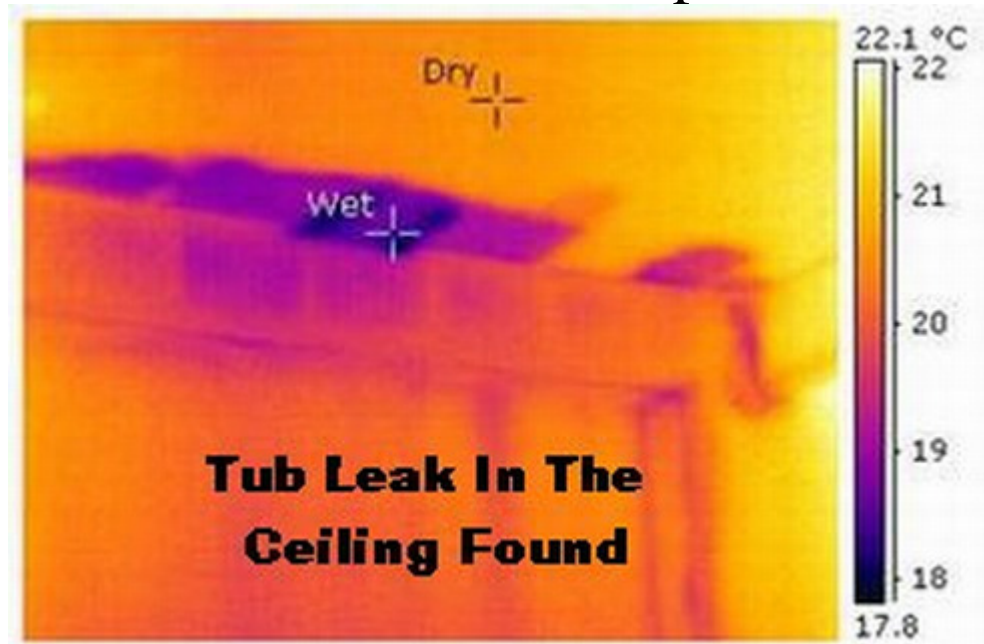
In other words, if you find a moisture spot in the ceiling from the pattern shown on your IR camera, the temperature of the moisture is irrelevant. The pattern is relevant.

Remember:

Temperature = Irrelevant

Pattern = Relevant

Where is the moisture problem?



Look at the pattern, not the temperature.

This is why the “apparent temperature” is all the home inspector will need for locating defects.

TIP – always confirm moisture with a dual function moisture meter, when possible. The infrared camera must be used in conjunction with other tools to confirm accuracy when reporting defects.



Confirming the findings of the IR camera is especially important while a person is still new to the field of thermography.

How Should You Adjust The Emissivity And Look At The Temperature Reference In The IR Camera?

"Emissivity and Tref are ONLY necessary if you are measuring temperatures (spot, average etc.) and want a good NUMBER.

Since you NEVER look at the specific temperature of the cold water spot when you are just looking for wet areas you will not need to adjust the E or Tref.

That said, it's usually good to set the E value high (80 plus) and the Tref at a typical room temperature setting, not high, not low."

Principle Instructor/Consultant

Building Science Institute

XXXXXm@buildingscienceinstitute.com

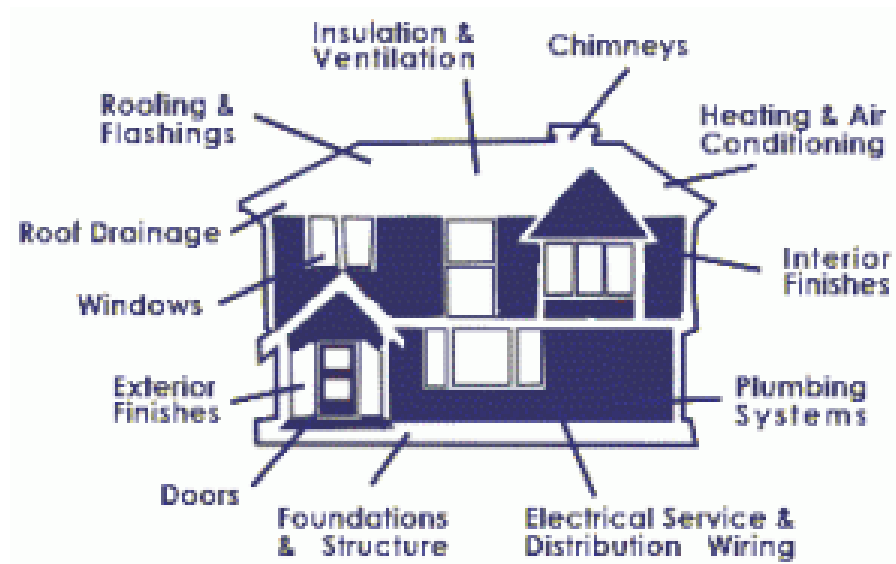
Director Building Sciences

National Association of Certified Thermographers

Building Science:

In this section we will study the components of a building and the defects you may find while while inspecting with an infrared camera. We will also seek to understand what your camera sees and what it really means (or dosen't mean), along with ways to verify your findings.

The Building:



Buildings help keep us comfortable **INDOORS** by keeping the environment **OUTDOORS**.

What are some of the factors that must be regulated to preserve the indoor environment?

- Air Movement
- Humidity
- Rain
- Snow
- Light
- Dust
- Odors
- Noise
- Pest
- Temperature

What must be controlled?

- Heat Flow
- Air Flow (Humidity?)
- Moisture Flow



The STACK AFFECT – Warming Air Rises Through The Dwelling. Plus... Warm Exterior Air Seeks Cool Interior Crawl Space Area. (Soil Moisture?)

Because of modern demands, building methods seek to provide comfort and yet resist against the climate more than ever.

As new methods and materials are introduced, the inspector must stay updated on current information about these developments.

There are several factors that can cause degrading in a building. Three of the main factors are:

- Moisture
- Heat
- Ultra-Violet Radiation

All of these factors add **ENERGY** to a building.

As you increase the **ENERGY** on materials, you increase the **DEGRADING** affect.

Plus Other Problems

Add more MOISTURE and you cause conditions that are conducive to fungi-mold, decay, and rust (not to mention wood destroying insects).

Moisture can degrade what materials?

- Wood
- Shingles
- Sheetrock
- Insulation
- Various Metals
- Flooring Materials
- etc...

Heat and Ultra-Violet Radiation can degrade what materials? Look at the list again... Hmmm.

What is the one of the biggest problems that causes building materials to degrade?

ANSWER – Water

In fact, one of the biggest problems with some buildings is that once water has penetrated the materials in a building, it will retain that water, thus compounding the problem.

To prevent **WOOD ROT** from occurring and **FUNGI-MOLD** from starting, what level should the moisture be kept below?

To prevent **wood decay** – keep moisture below
20%

To prevent **fungi-mold** – keep moisture below
16%

What about relative **HUMIDITY**?

If a building has relative humidity at 80% then what will be the moisture levels that may be present in some materials?

ANSWER – **16%** moisture content in some wood products at approx. **80%** RH.

By keeping the relative humidity in a building **lower** ... it will help prevent mold amplification.

If you find moisture content in some building materials that reach 16% - 20%, should you see this as a potential problem?

ANSWER - Yes

What common system in our a modern buildings reduce humidity in the indoor environment?

ANSWER – Central AC/Heating System
(and Dehumidifiers)

If the AC/Heating system reduces humidity in the building, is it wise to turn it off during the day to save money?

ANSWER – NO...!!! Mold can sometimes start growing in the duct system, as well as the building, if humidity gets too high.

Can dead and dry mold areas be reactivated if moisture is introduced?

ANSWER: Yes

Can moisture damage and mold growth expand rapidly and sometimes without visible signs?



ANSWER - Yes

Moisture must be stopped..!!!

Before any repairs can be done properly, all moisture problems must be found and repaired.



MOISTURE
Control is the Key to
Mold Control

Mold growing on the surface of a unit ventilator.

The slide features a light blue header with the word 'MOISTURE' in large, blue, dripping letters. Below the header, on the left, is a photograph of a white unit ventilator under a window with mold growing on its surface. On the right, the text 'Control is the Key to Mold Control' is displayed in black, with 'MOISTURE' and 'Mold Control' in bold. Below this, a smaller text block reads 'Mold growing on the surface of a unit ventilator.'



Moisture related defects are enemy number **#1**

Can mold become a health problem for some people?

ANSWER – Yes

Do you have to be licensed in to be a mold inspector?
(Health Dept.)

ANSWER – Yes

Does it help a TREC Inspector to be educated and understand the conditions that are conducive to mold growth and prevention?

ANSWER – Yes

There are over 100,000 breeds of fungi... and mold is just one of the terms used to describe a percentage of these organic growths. Some fungi appear to be harmful to certain people and some do not. It would be wise to learn more.

To Learn More, See The Following EPA Link



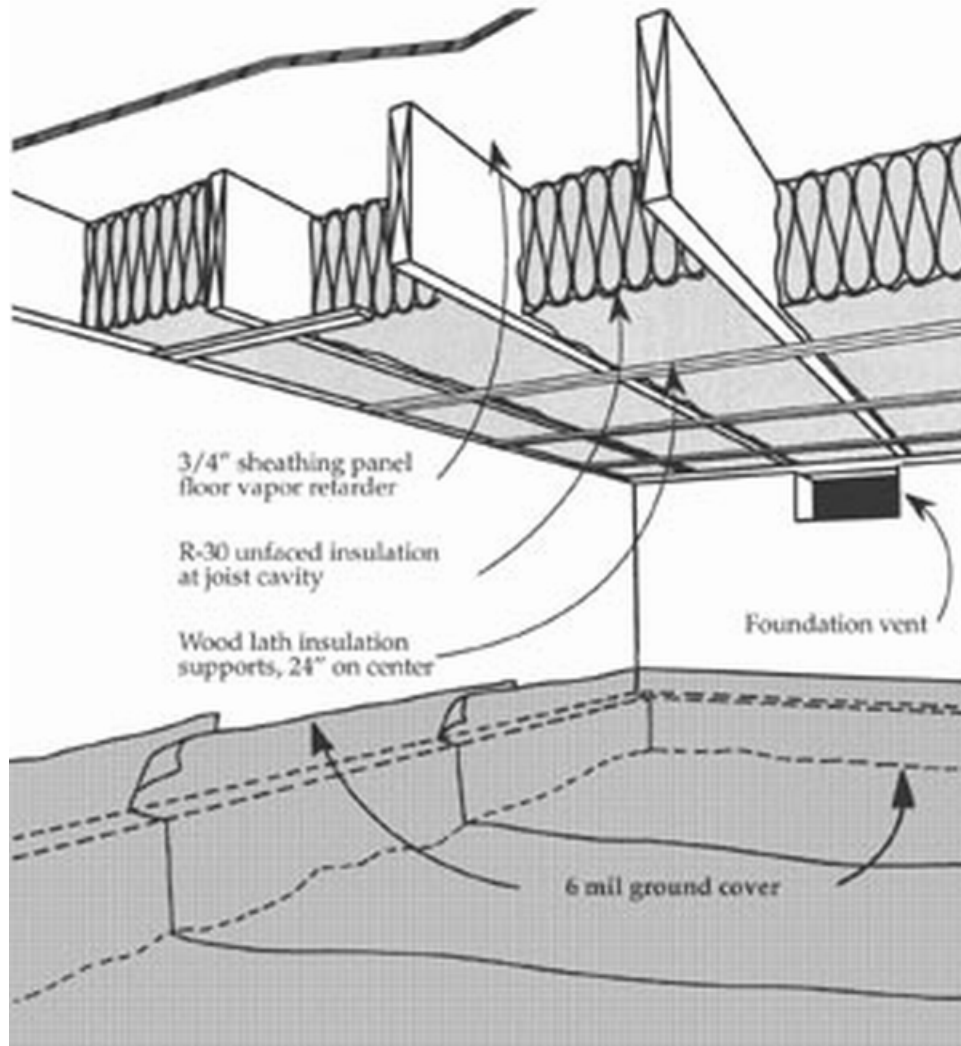
<http://www.epa.gov/mold/moldguide.html>

SOURCES OF MOISTURE:



Breathing, laundry, soil in the crawl space, lack of venting in crawl space and attic, mopping floor, cooking, dishwasher, dryer vent, condensation on windows, humidity from bathing, air leaks around windows and doors, leaking roof, roof vents, flashing's, porch connections, improper drainage, leaks around windows and doors, any penetration in walls or roof, plumbing system, drain system, AC condensation, duct system condensation, previous repairs that fail, rain, snow, ice, sprinkler system, swimming pool uphill from house, defects in gutters, water hose and cleaning, windows left open, condensation on window, top of chimney, whirly vents on roof, fans in bathrooms vented to the attic, lack of weep holes in exterior bricks, washing machine drain, masonry, acts of God (storms), etc... **WOW!**

Crawl Spaces:



Crawl Space Moisture Problems & Solutions

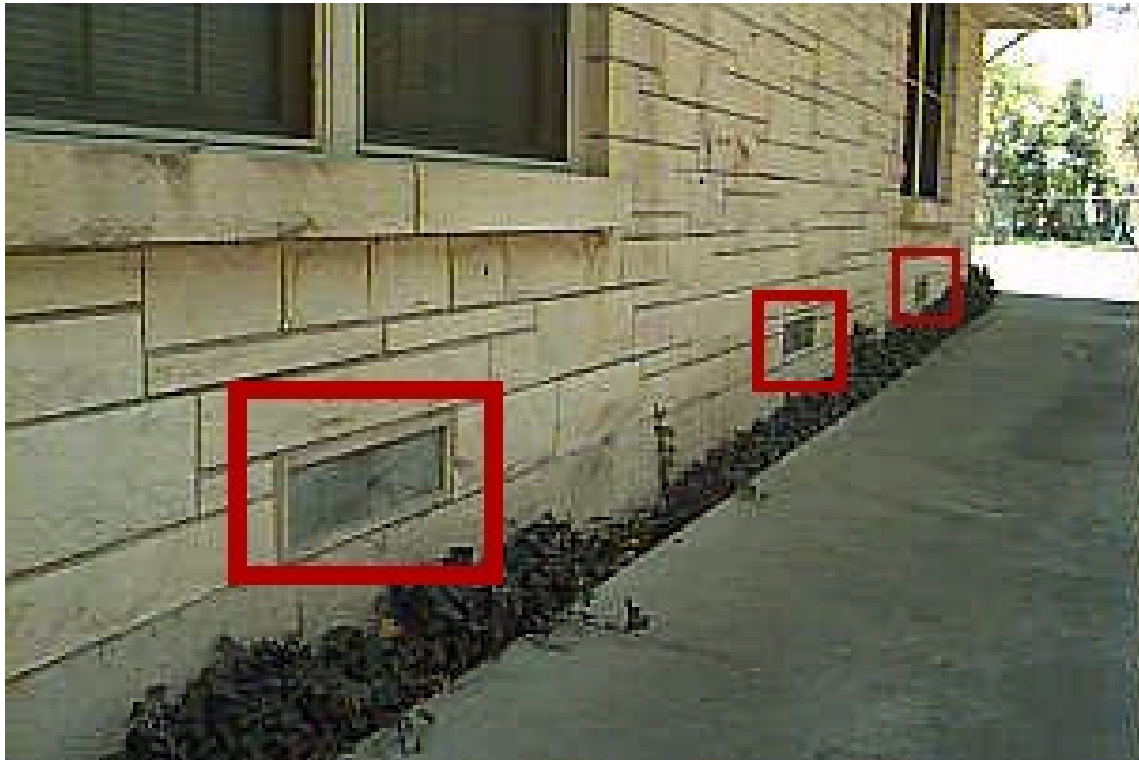
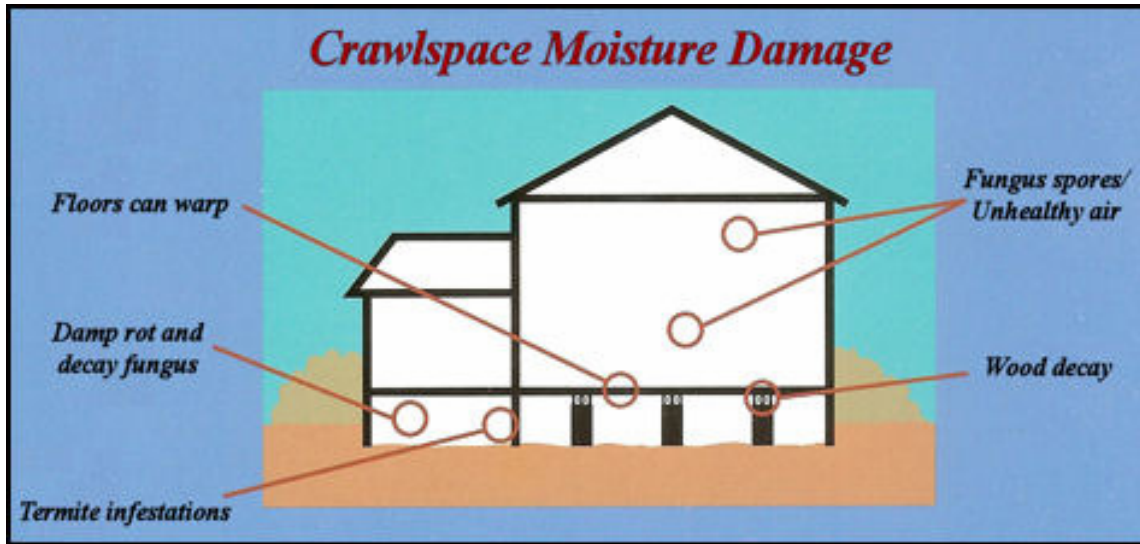
Moisture problems can be conducive to fungi-mold, decay and wood destroying insects that are not always visible.



Can Some Of The Crawl Space Air
Rise Into the Indoor Dwelling? ... YES.



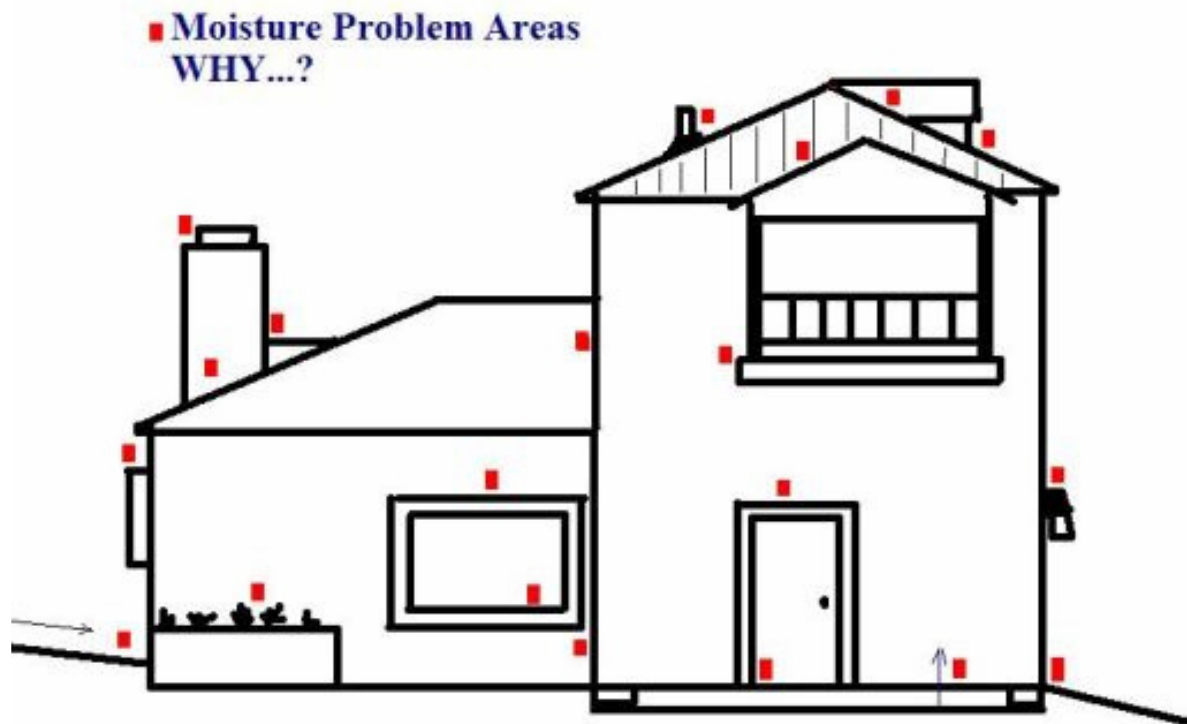
To vent or not to vent? Plastic ground cover?



Venting? (Code vs Science vs Location)
It would be wise to learn more.

Potential Moisture Sources In A Building:

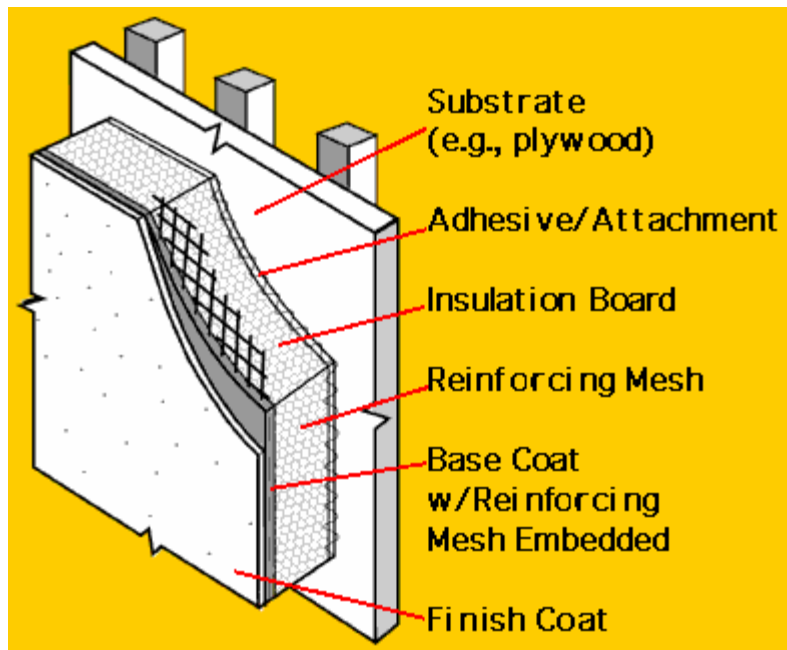
- **Roofing, flashing's, sky lights, vents, roof jacks...**
- **Intersection of different materials...**
- **Doors, windows, fixtures, horizontal trim, flashing's...**
- **Lack of proper moisture barrier on walls...**
- **Moisture in crawl space area...**
- **Moisture from concrete foundation...**
- **Poor grading, flooding, flower beds...**
- **Connection of railings, porches, add-ons...**
- **Plumbing & drain leaks (foundation movement)...**
- **Exterior porch or garage at same level as interior...**
- **AC drip pan, drip line, condensation, freon line...**
- **AC-Heater not conditioning humidity air**
- **Duct air leaks, loose insulation, condensation...**
- **Poor venting in attic, ridge gaps allowing in air...**
- **Seepage from around or under shower, tubs, sinks...**
- **Washer connections and drains...**
- **Window ledges, flat spot in front of doors, garage...**
- **Poorly functioning french drains, clogged gutters...**
- **Window AC condensation and gaps by unit...**
- **Sprinkler systems, septic systems...**
- **Poor drain system design in roof, walls and site...**



Common Moisture Related Issues:

- Flashings (roof, valley, chimney, wall, porch, ect...)
- Roof design, materials, gutters, leaves on roof...
- Caulk, tar, silicone, rubber gasket, foam sealer, ect...
- Landscaping and grading...
- Trim and various materials that intersect...
- Window and door installation
- Types of wall coverings (stucco, EIFS, wood, brick...)
- Porch and add-on intersections...

Exterior Insulation Finishing System:



EIFS (Synthetic Stucco) vs. Traditional Stucco

- Synthetic stucco is soft and sounds hollow when tapped.
- Traditional stucco is hard and brittle & sounds solid when tapped.

Note: It is very difficult to see temperature anomalies (moisture) behind the insulation board of the EIFS system. A deep probe moisture meter and proper training is required to properly inspect EIFS.

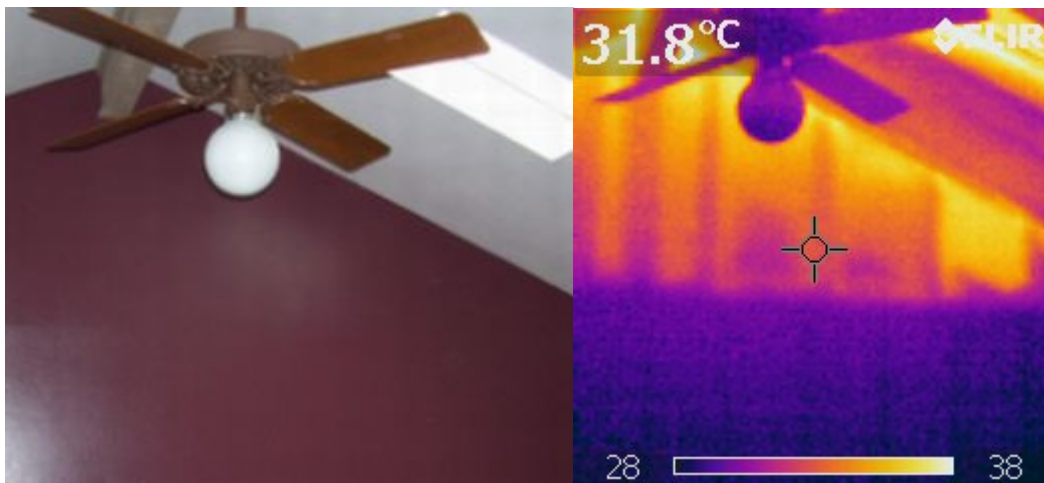
Understanding Thermal Images

(what they mean and do not mean)

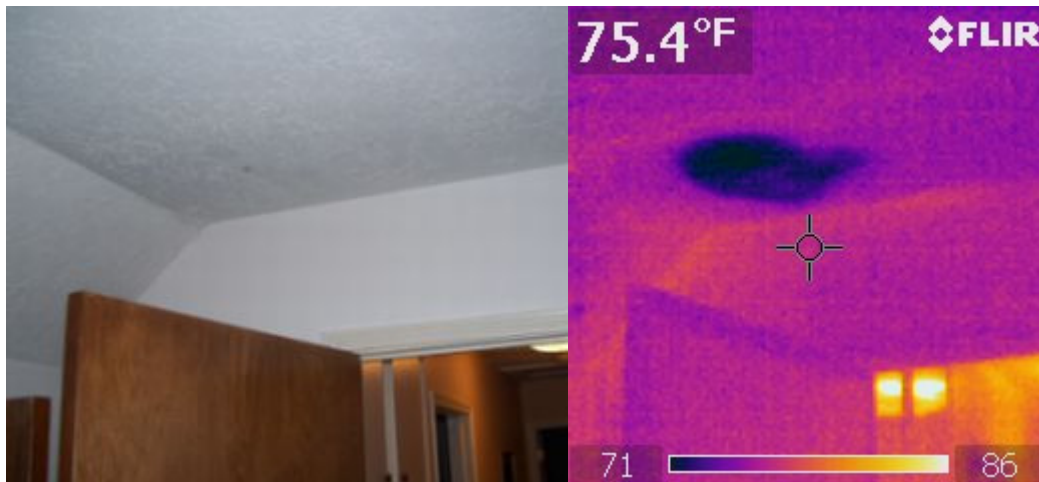
In this section we will seek to understand how to interpret the anomalies seen in the thermal images.

Not all dark areas mean there is moisture present. Not all lighter areas mean something is too hot. The camera adjust itself (in auto mode) to compensate for the area within the view of the sensors.

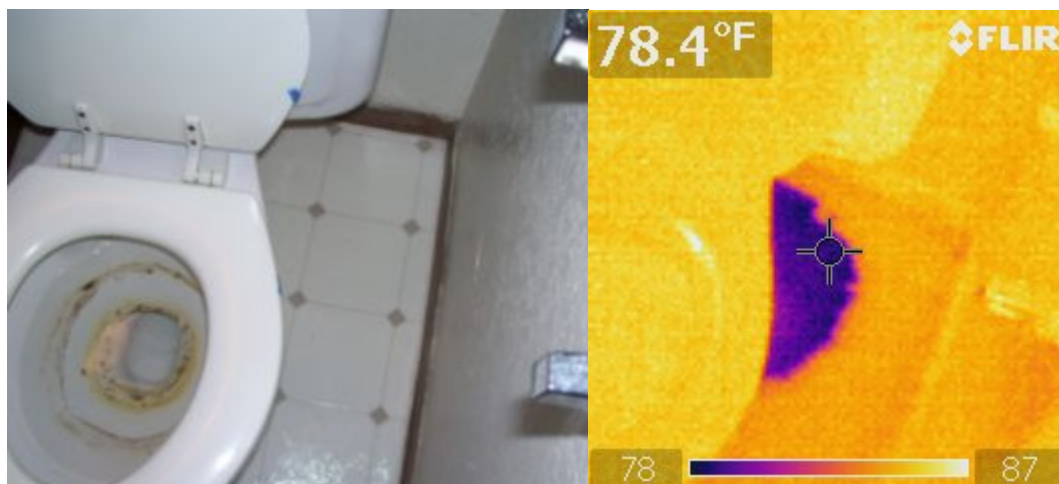
The images must be verified and understood in relationship to what the building is telling you vs. what you think you see.



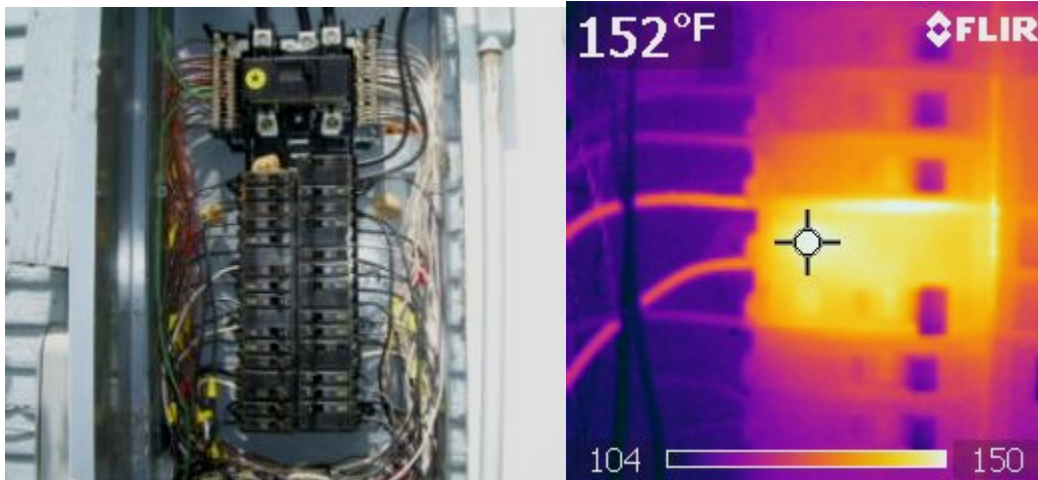
Lack of insulation or air gaps in insulation?



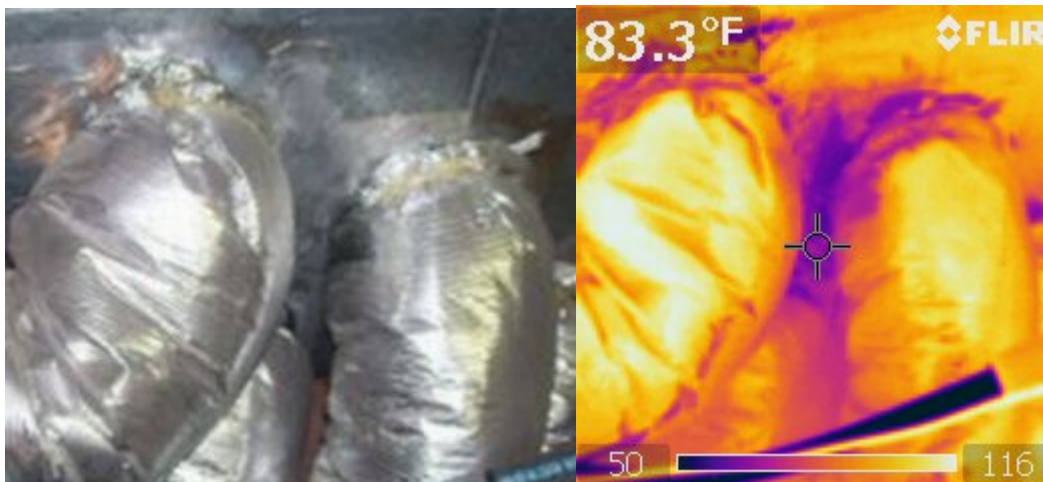
Moisture spot in ceiling (what is the cause?)



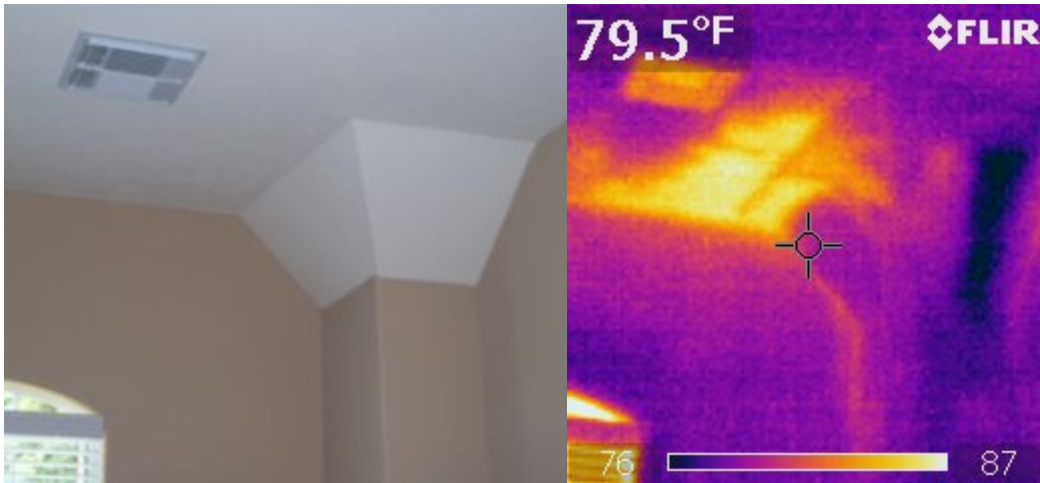
Moisture by toilet (wood floor? wall wet?)



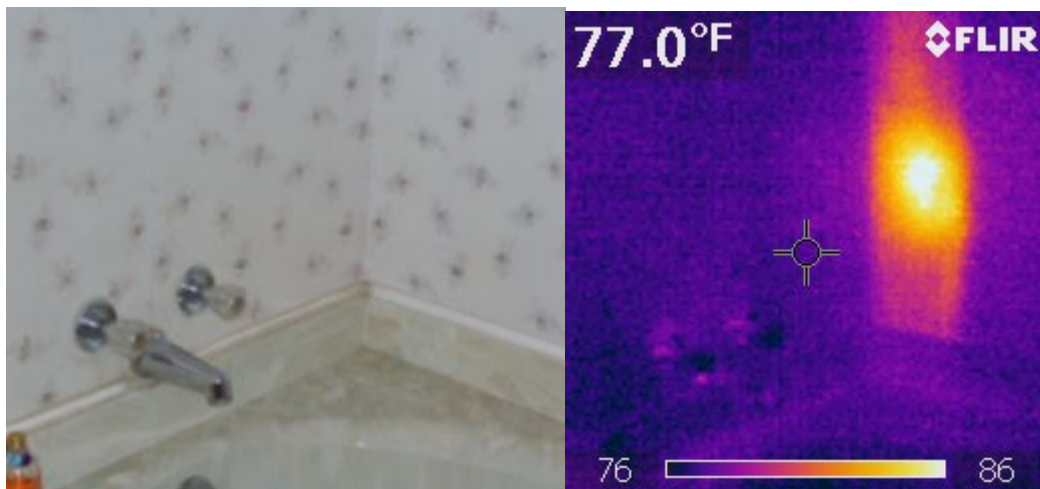
Electrical hot spot (what is the cause?)



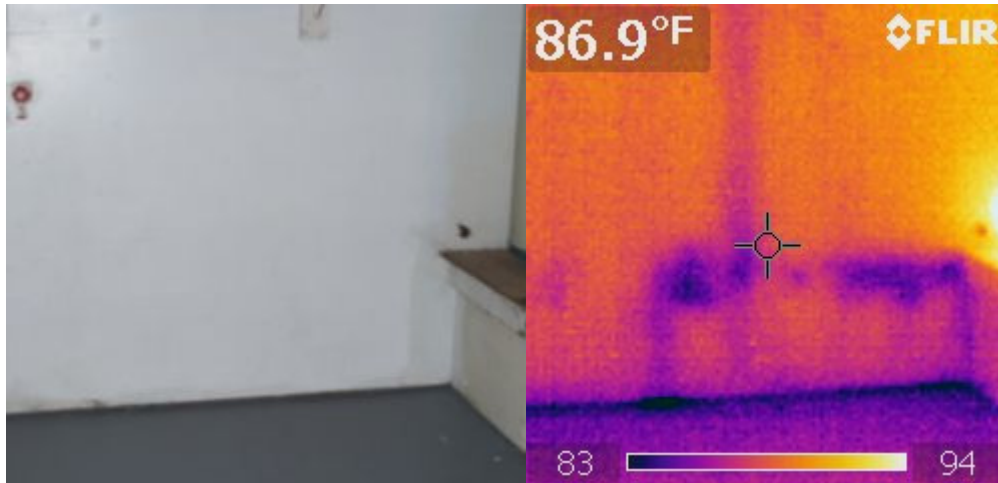
Air leaks in duct system (hot air meets cold air = what?)



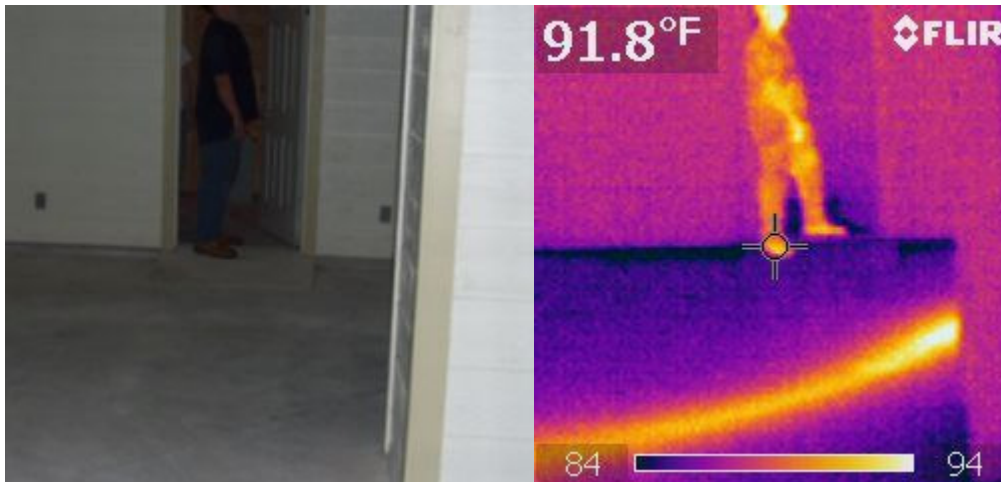
Lack of insulation and moisture problem.



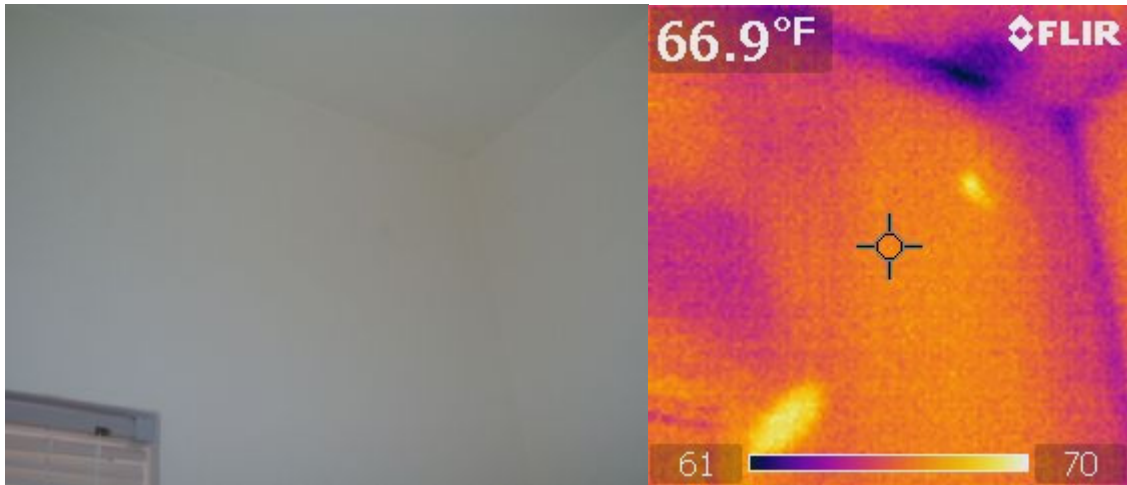
Hot spot coming through the back of an oven.



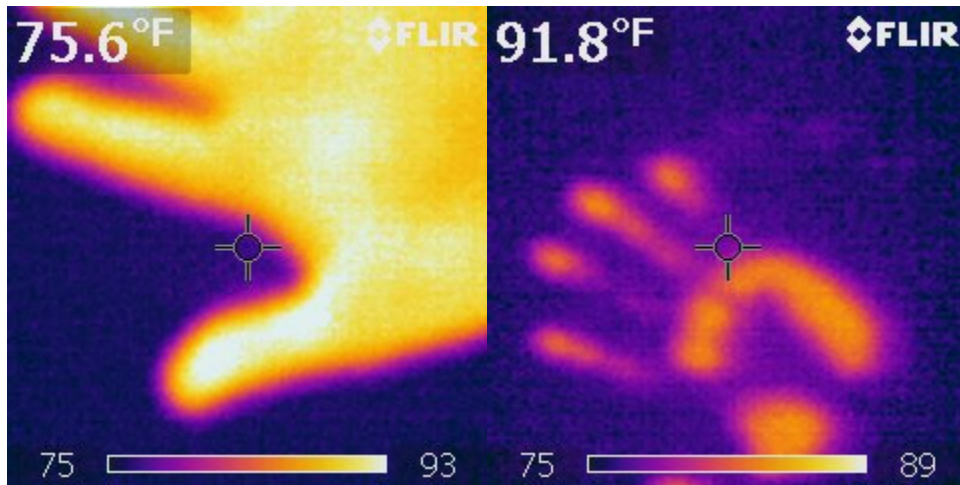
Plumbing repair still leaking in nice painted wall.



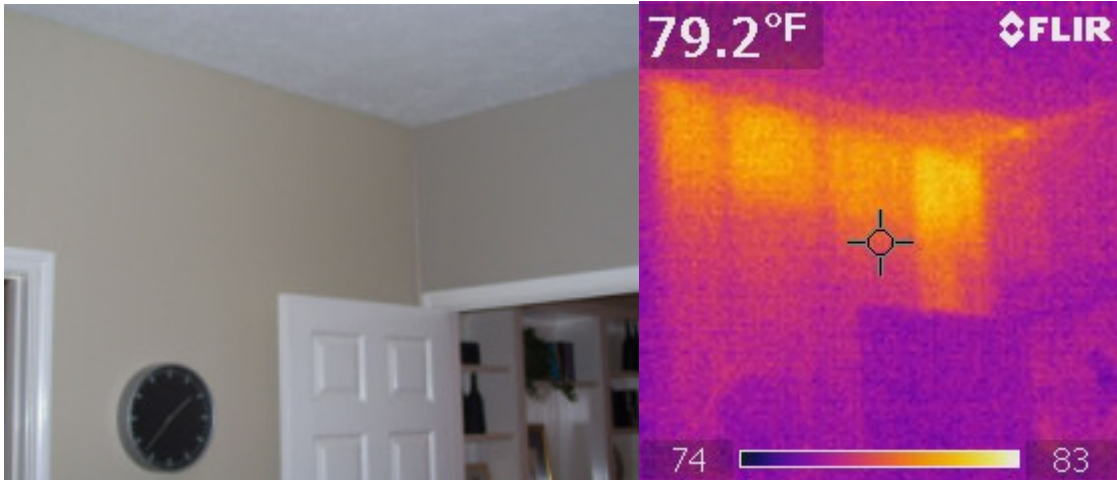
Hot water plumbing inside the slab? (correct?)



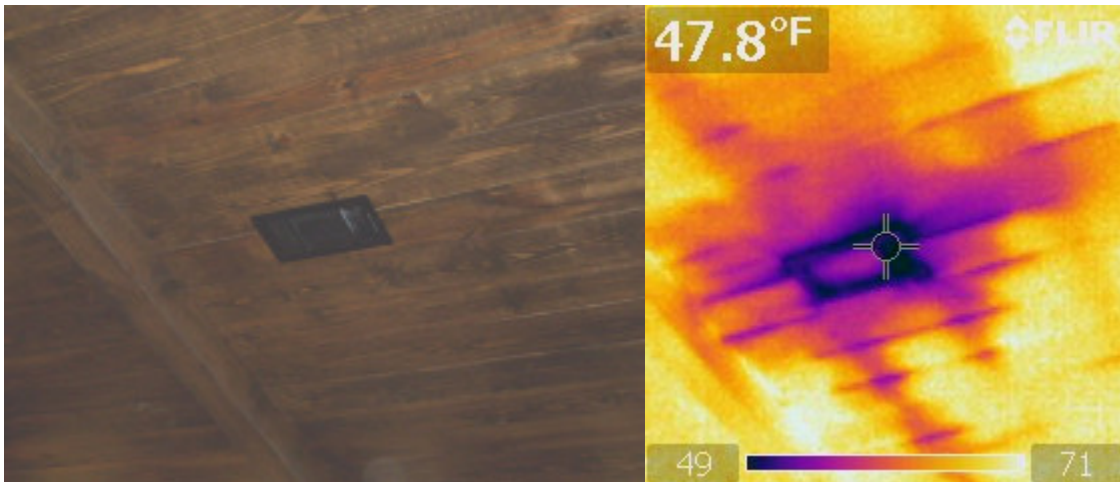
Moisture in upper corner of wall – ceiling intersection.



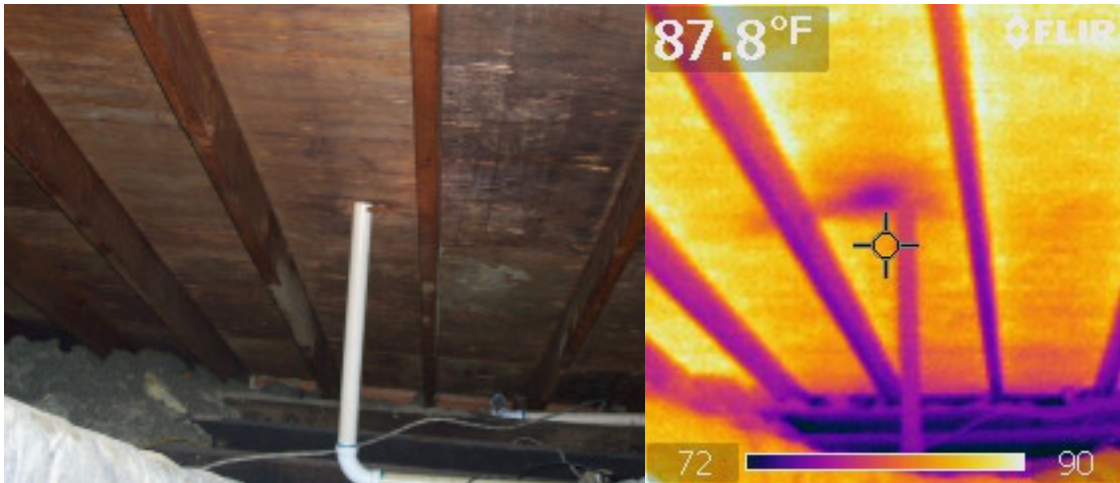
Hand print demonstrations (the wow affect)



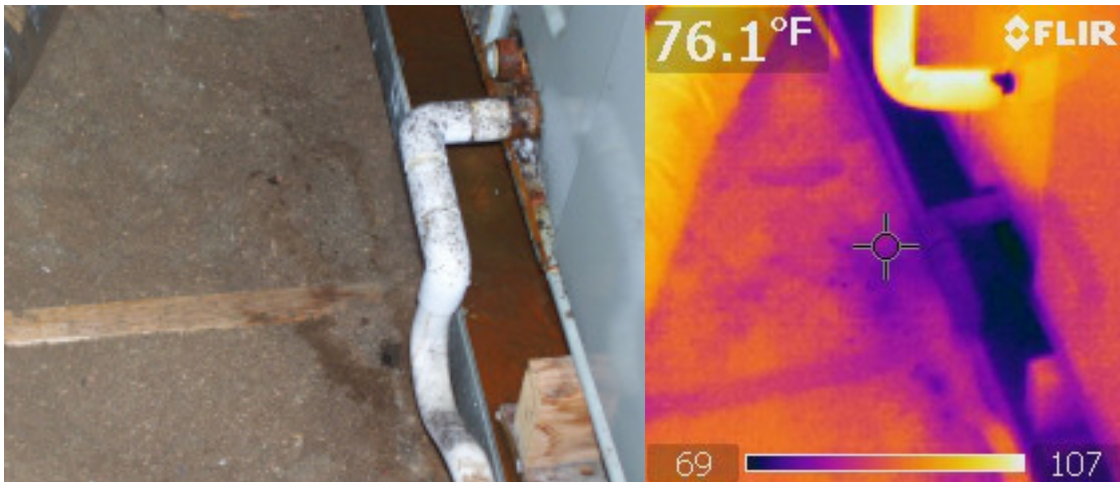
Lacking wall insulation or air gaps behind insulation.



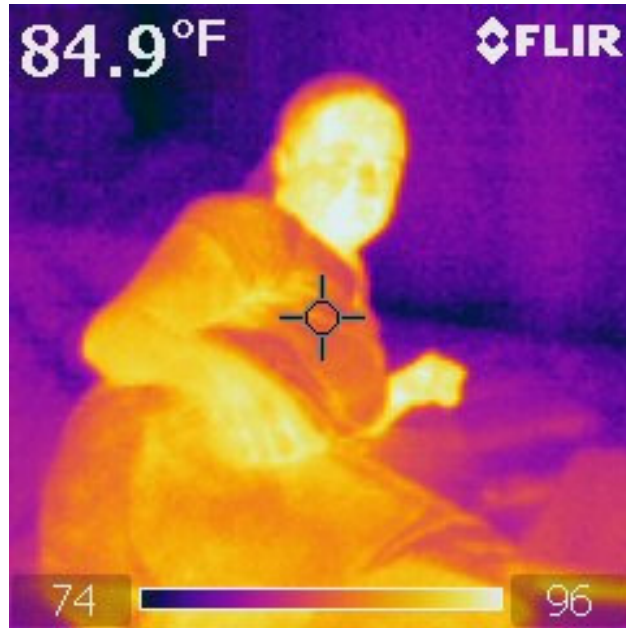
Air leaks around supply air vent in ceiling.



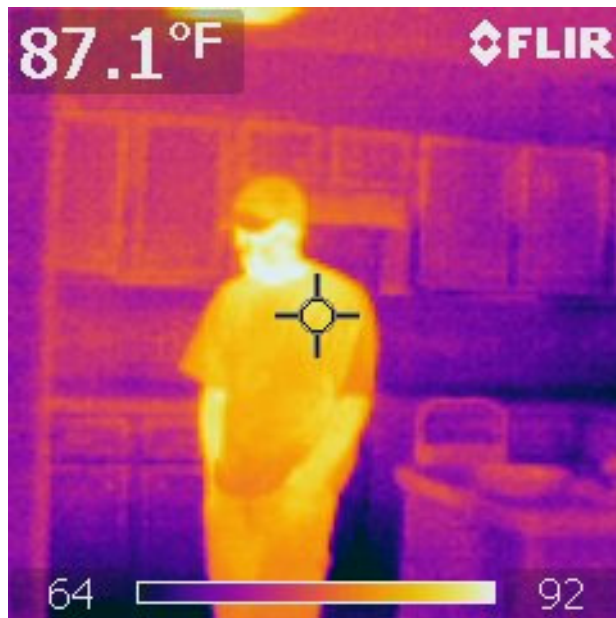
Moisture leak around roof jack or shadow?



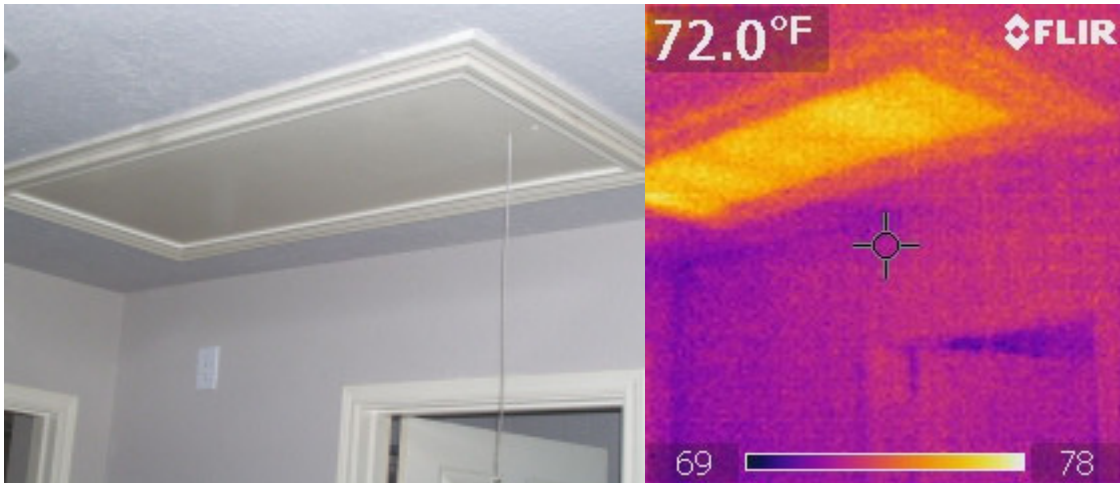
Leak in attic near the AC drip pan.
What 3 things can moisture cause?



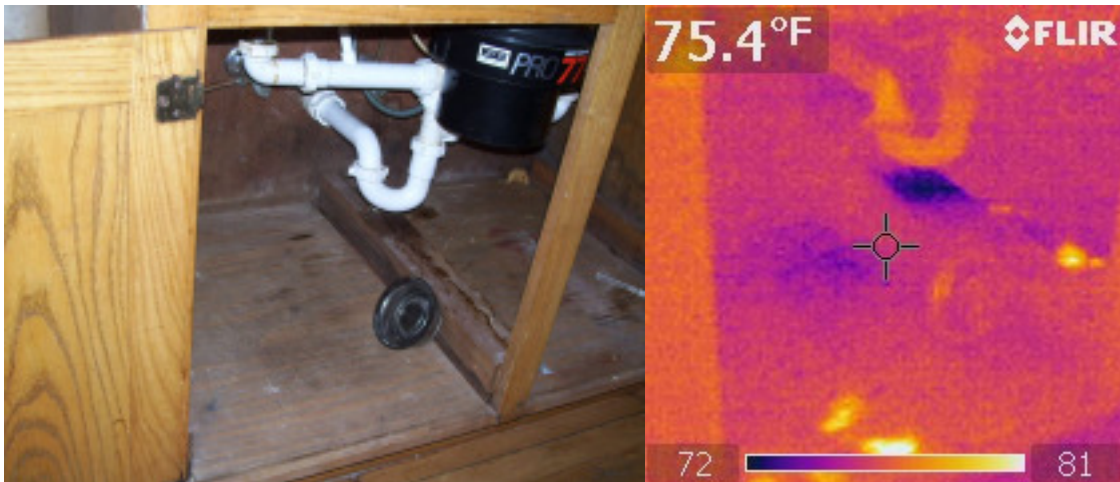
Thermal Imaging is not X-Ray vision.



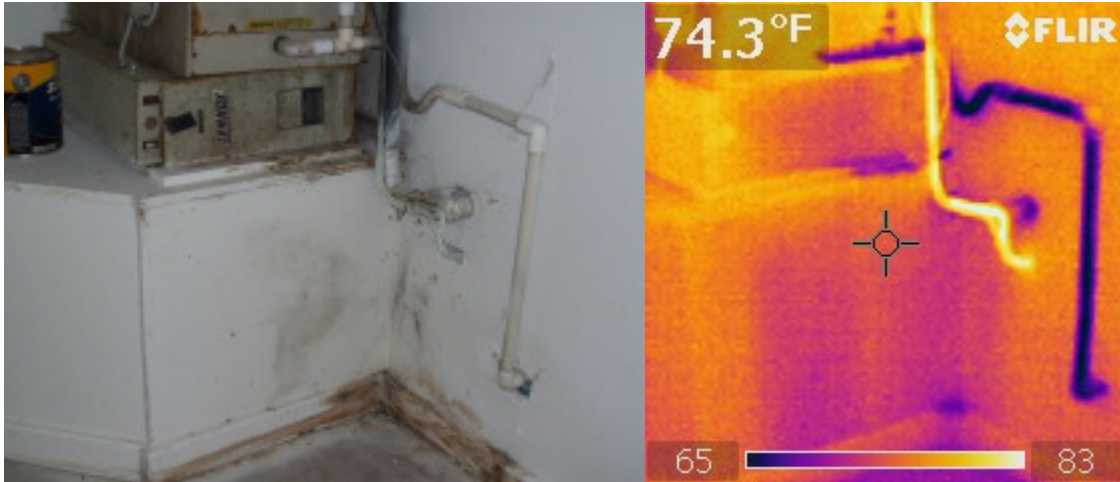
IR cameras do not release radiation.



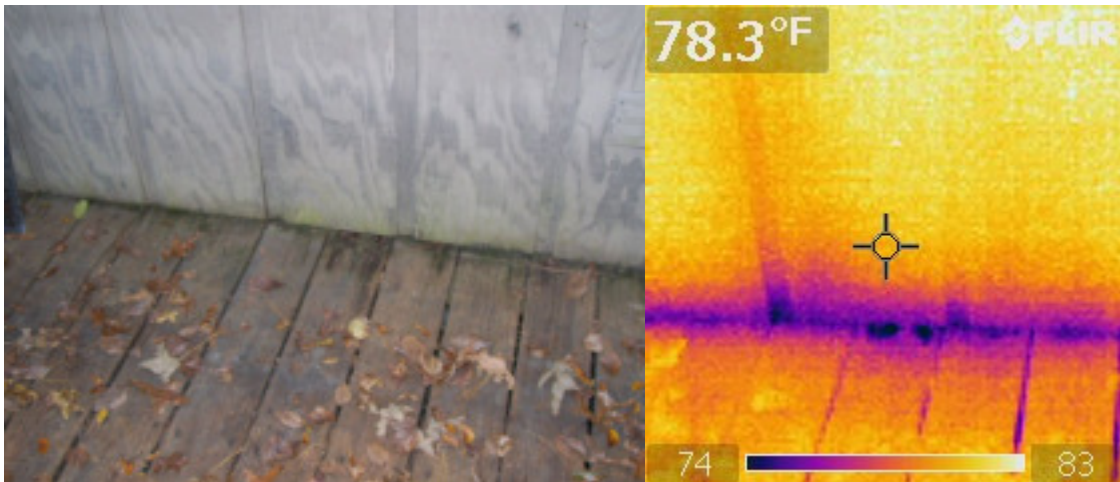
Attic door releasing heat into the dwelling.



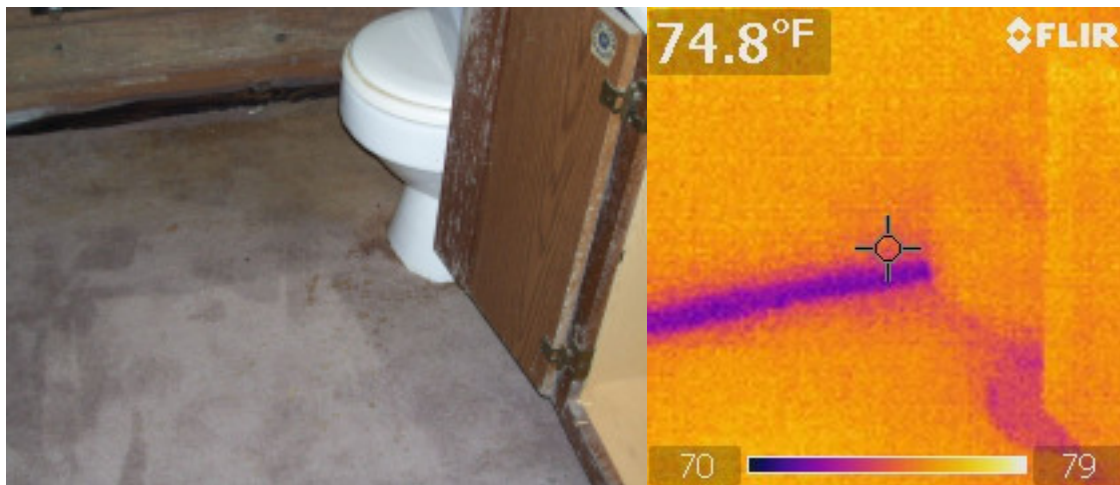
Moisture under the Kitchen sink.



Moisture leak by the AC



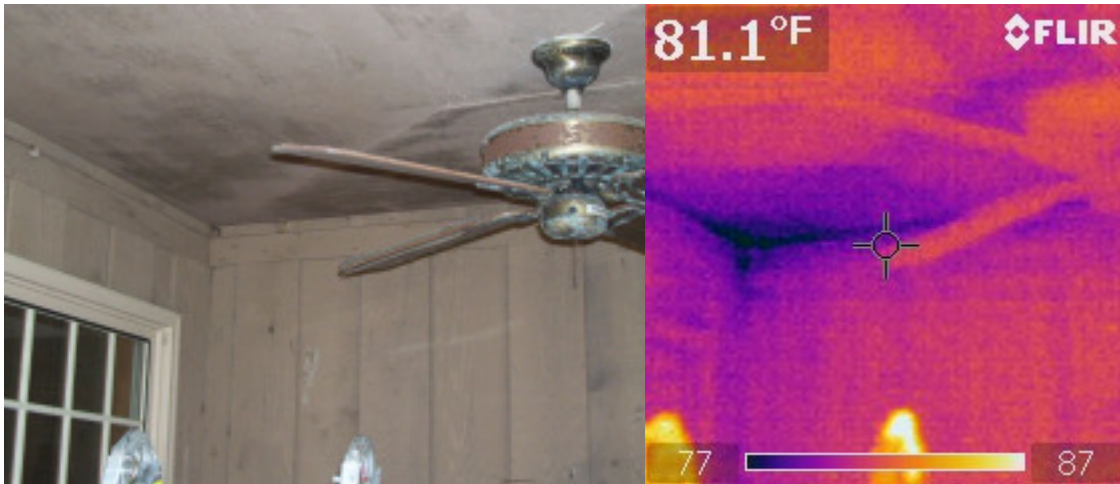
Moisture in exterior wall by porch.



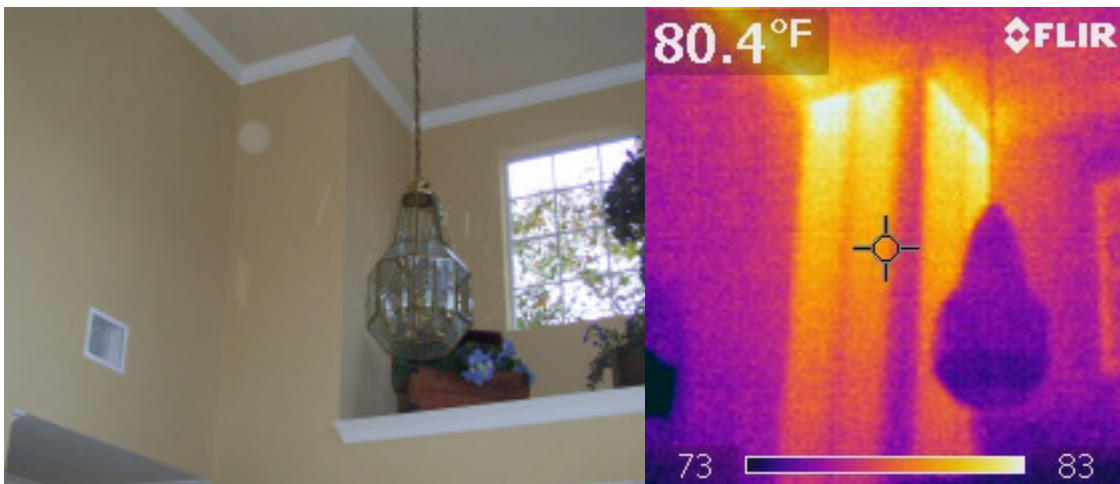
Moisture in wall by toilet.
Floor by toilet is also wet but did not show up.
WHY?



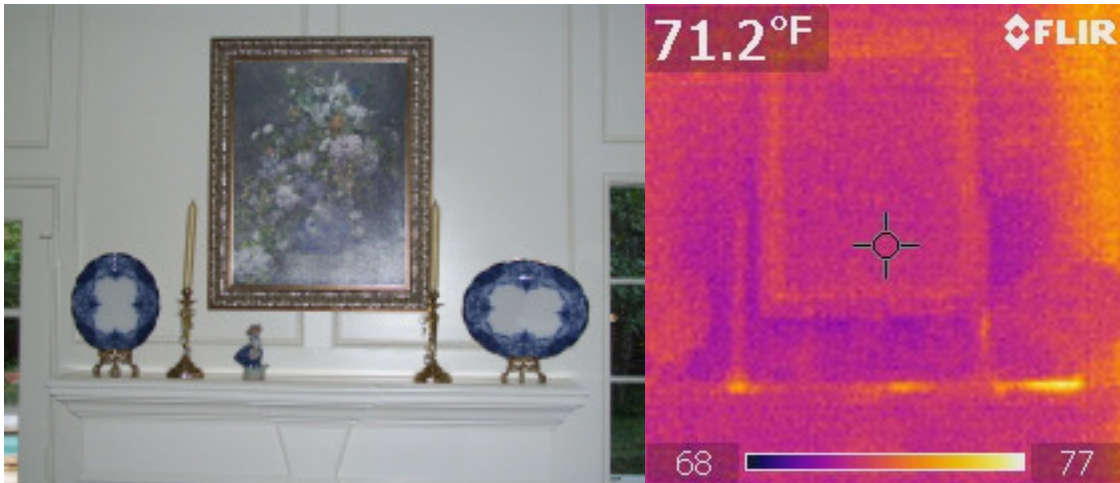
Moisture concealed deeper inside the carpet.
Use moisture meter to verify findings and probing.



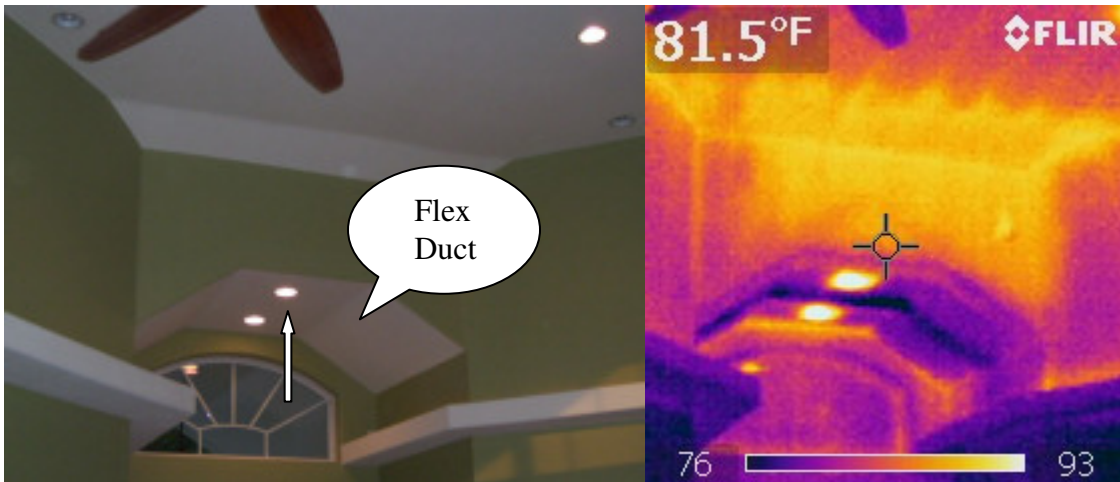
Moisture in ceiling of exterior porch.
Some dark spots are not always moisture...
What could they represent? Look at the pattern.



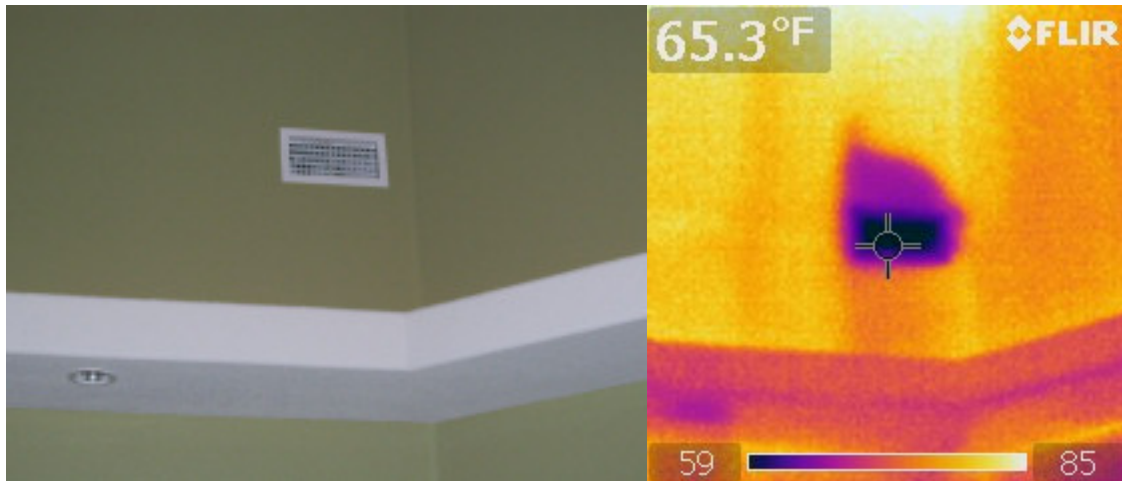
Lacking insulation in the wall chase.



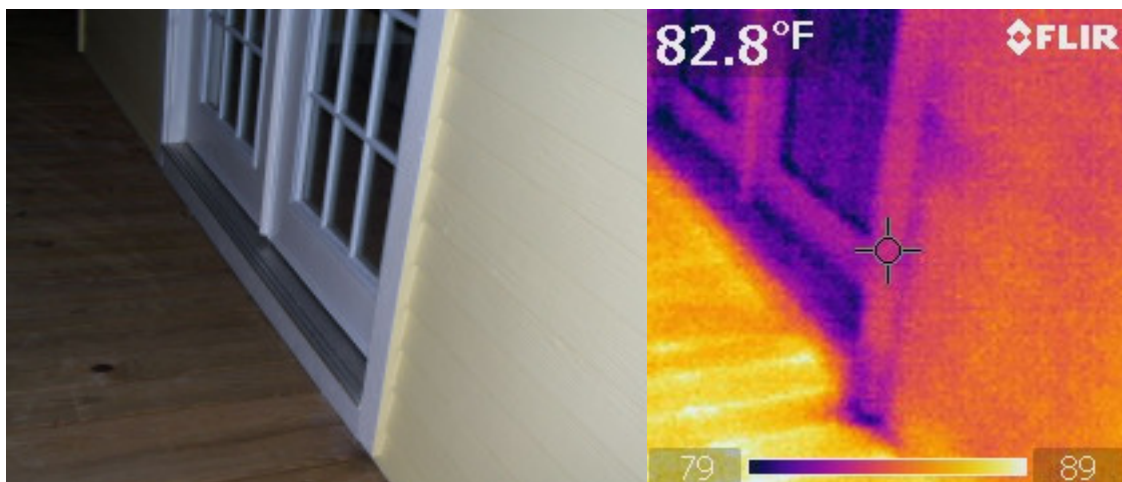
Moisture from chimney flashing leak.



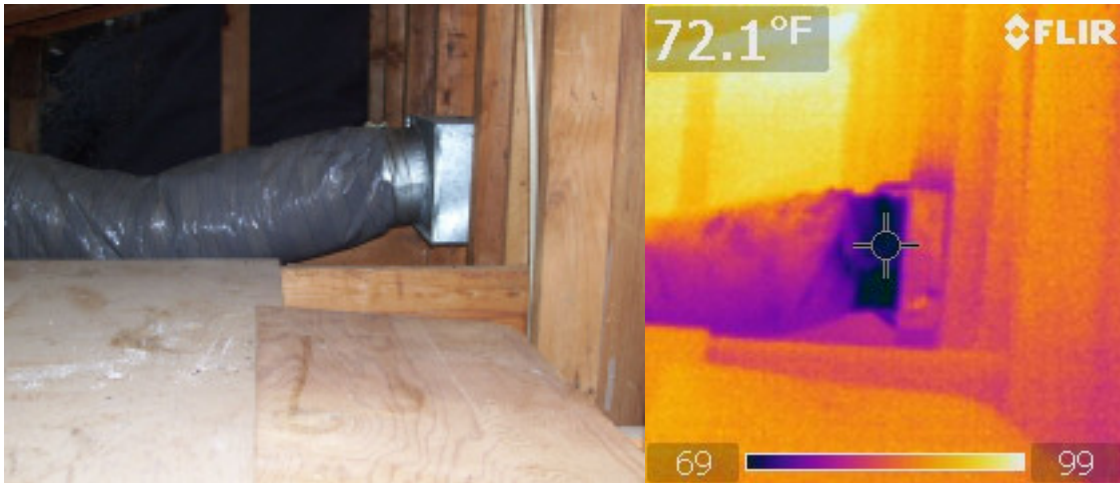
Lacking insulation in wall and ceiling.
What is the dark area running across the lower ceiling?



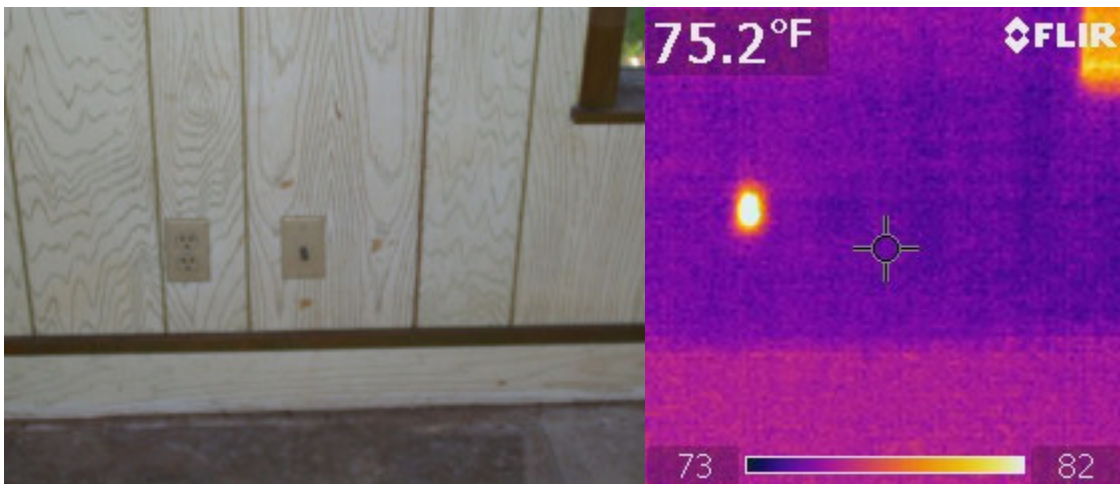
Air leak filling up space inside wall.
(Why is this a problem?)



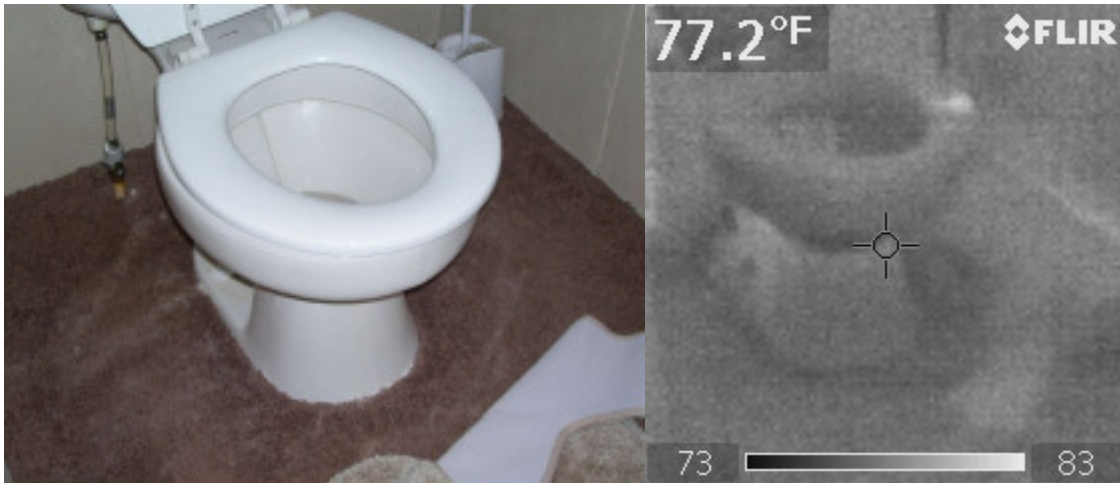
Air leaks around door jam (energy loss).



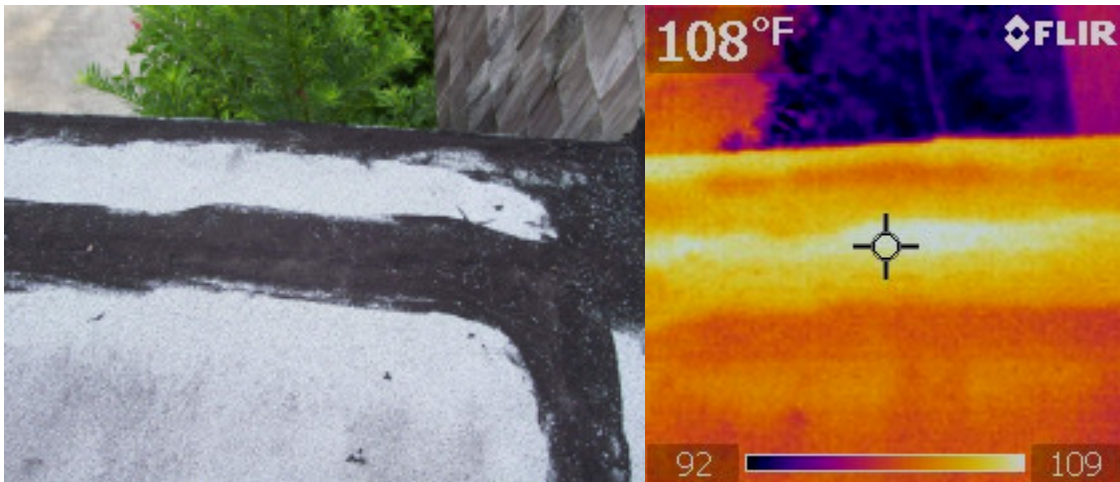
Poorly insulated duct connection (condensation?)



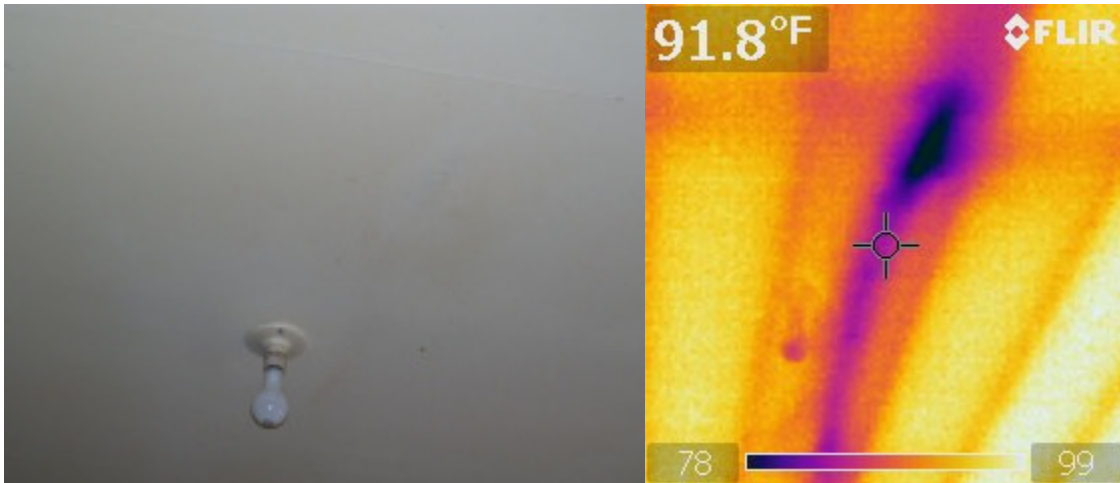
Plug outlet getting warm... Why???



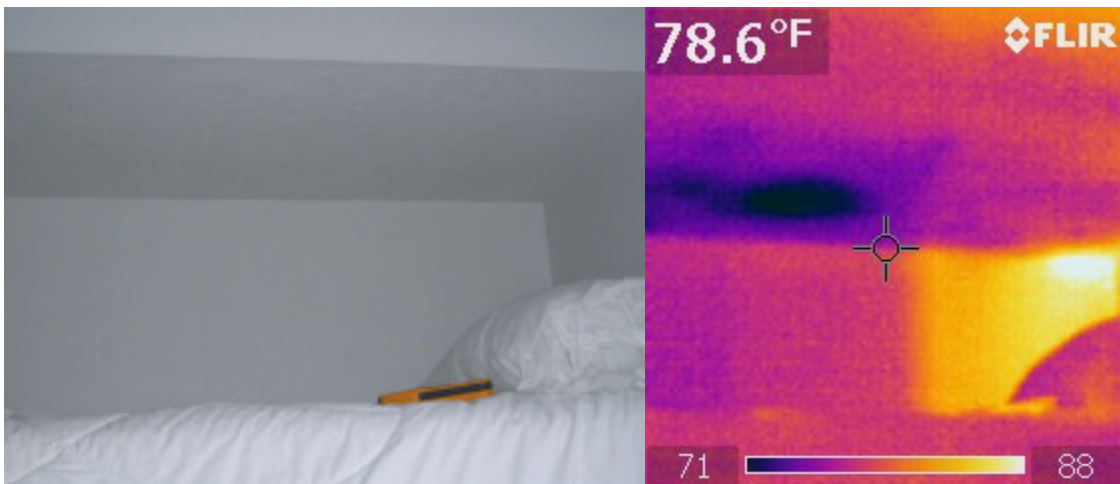
Different pallets help show anomalies (black & white)
Moisture in carpet next to the toilet.



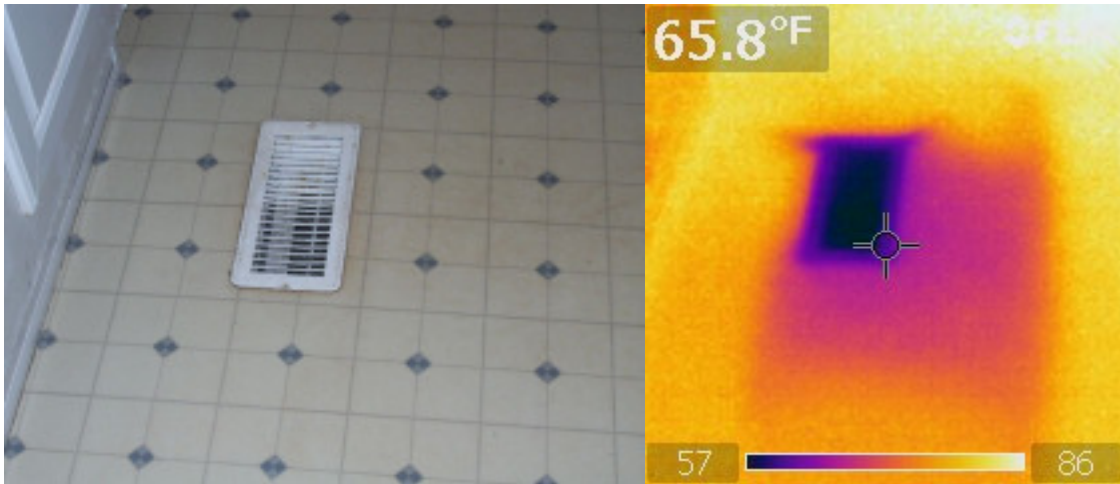
Moisture under flat roof (after sunset... watch
for clouds and wind factors that may affect image)



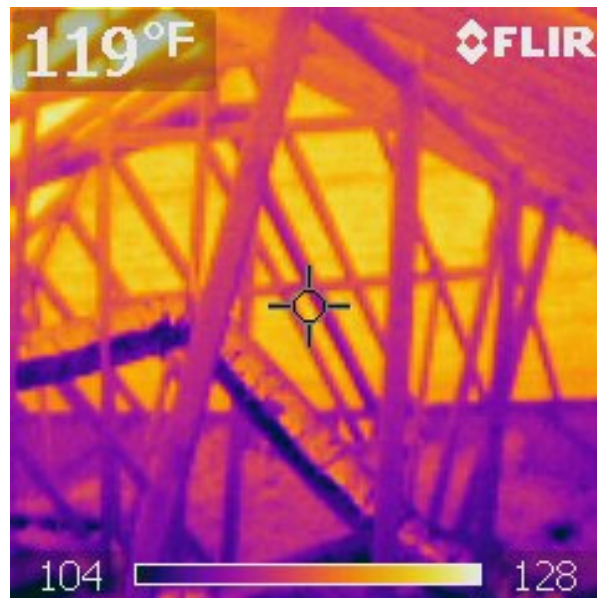
Freon line condensation (note difference between cool freon line and actual moisture spot).



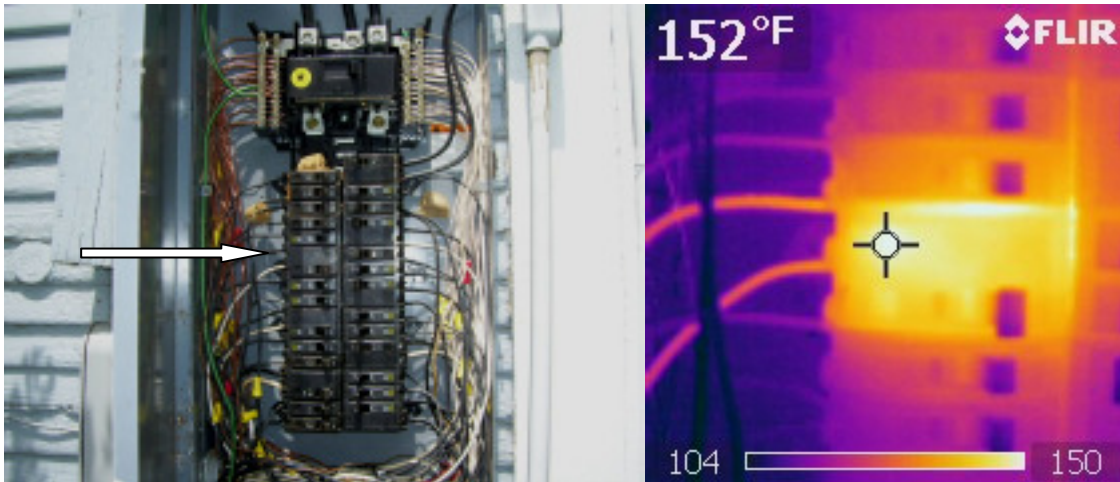
Moisture in ceiling over bed (no stains visible)



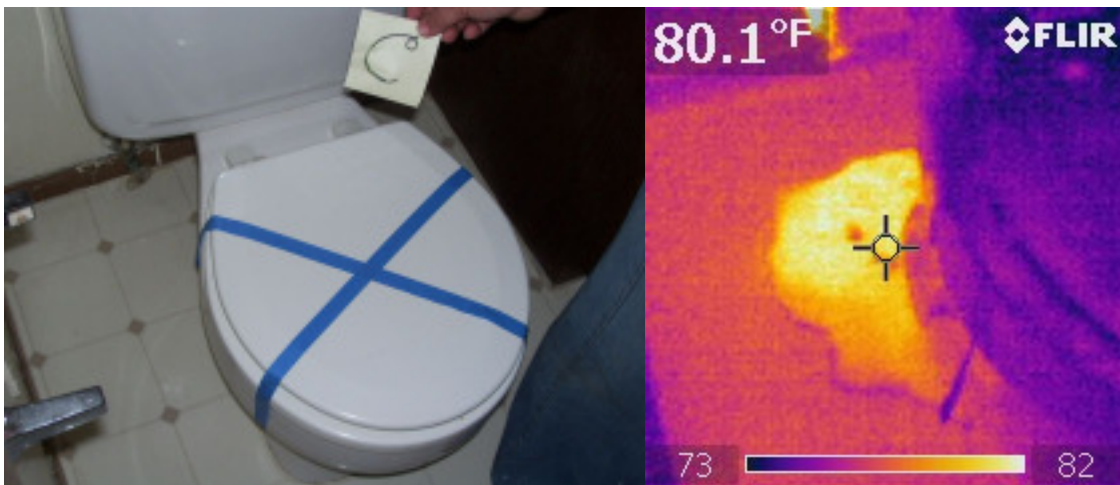
Space between floor joist filling up with cool air
(condensation potential?)...



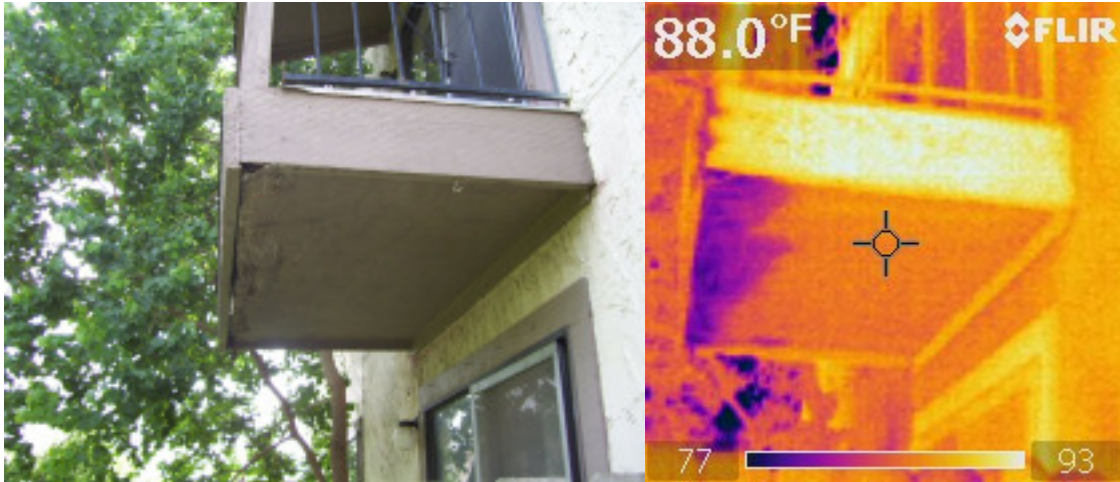
Is it hot in the attic?



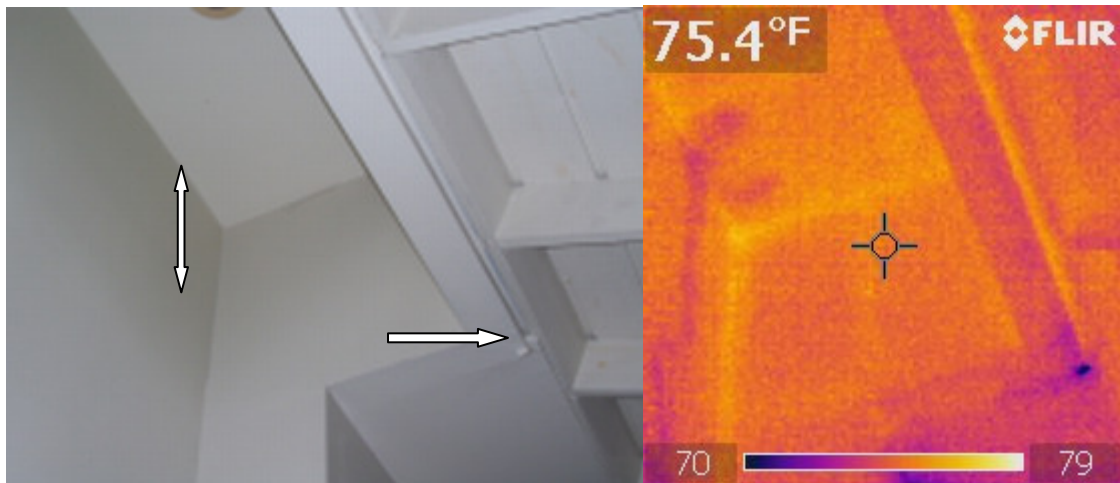
Electrical hot spot (remember...this is the APPARENT temperature)... check it out.
Note: If the circuit is not under a load then the resulting image may not show any hot spot.



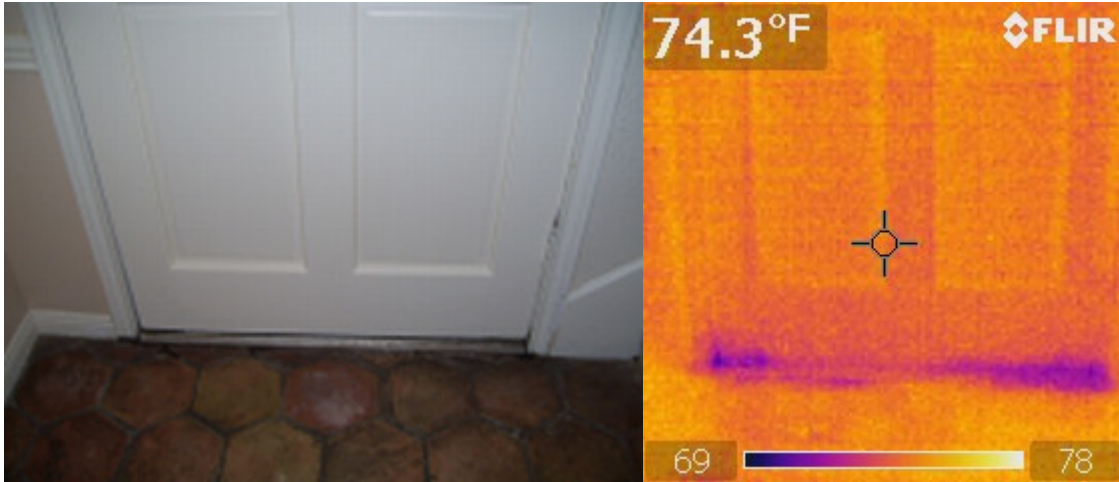
Moisture near toilet is warmer than floor in this image.



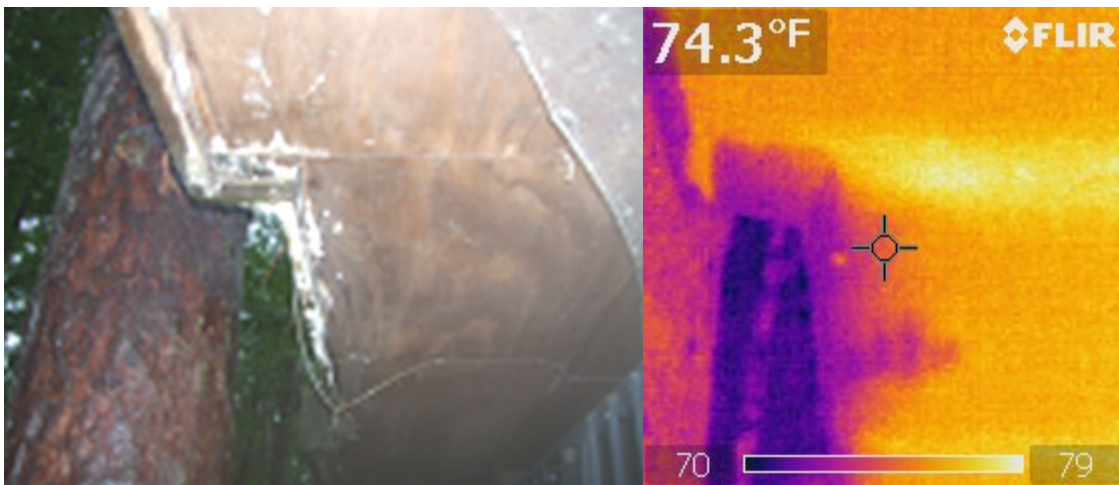
Stains are moist under exterior upper porch.
(what if it has not rained for a while...?)



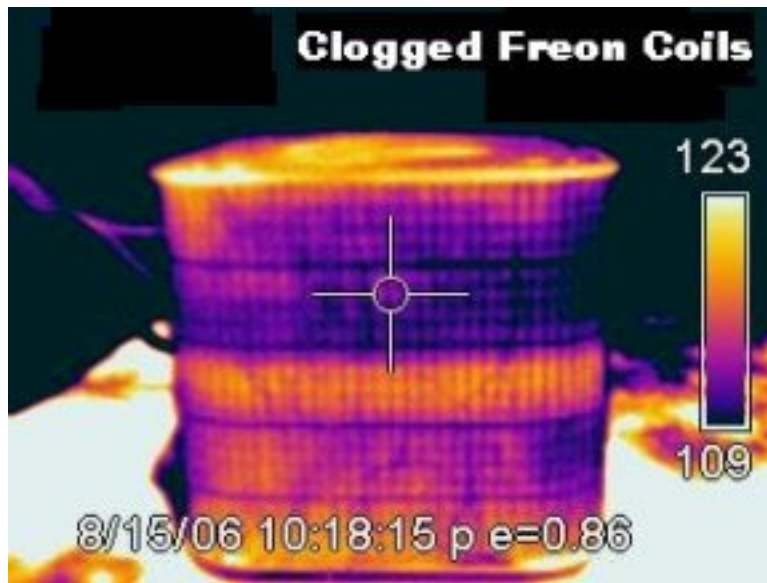
Seeing moisture in hard to reach places (high ceiling).

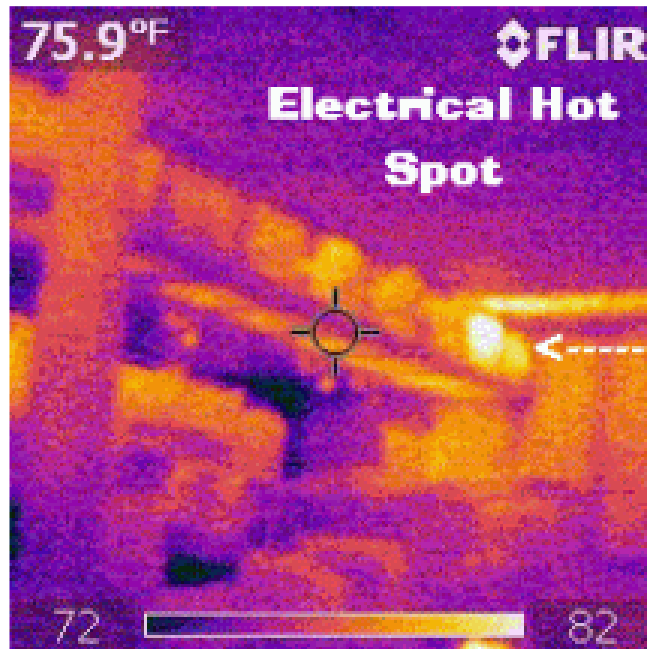
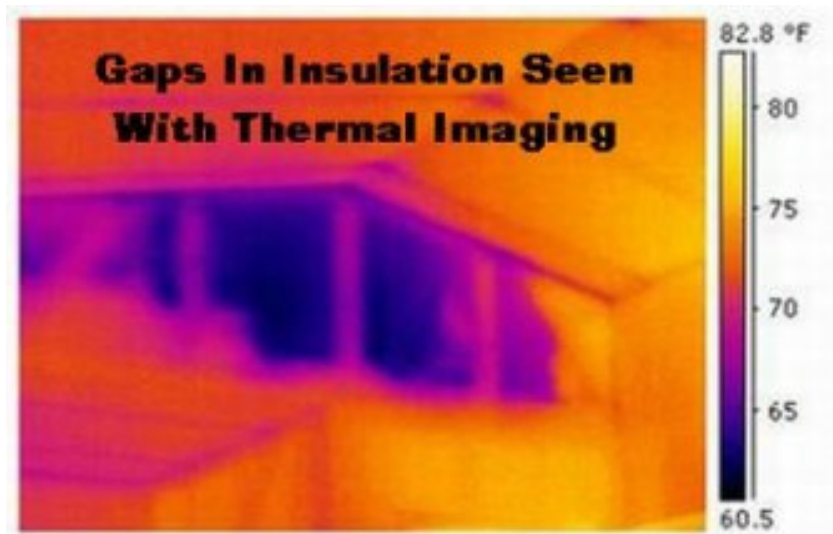


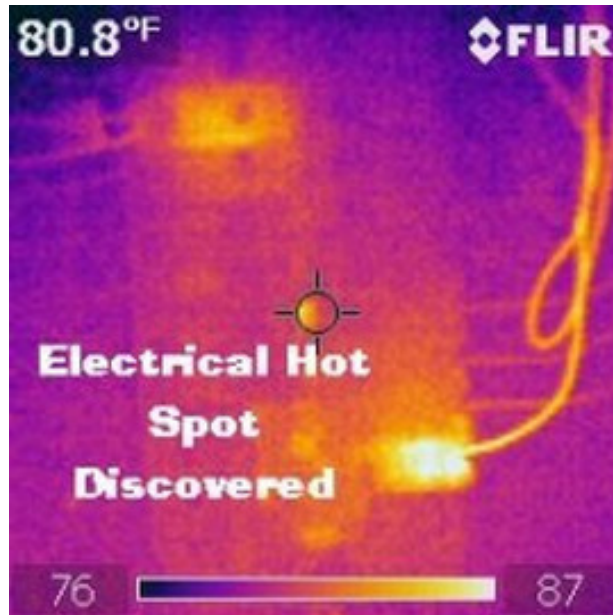
Moisture coming under door (does this happen often?)



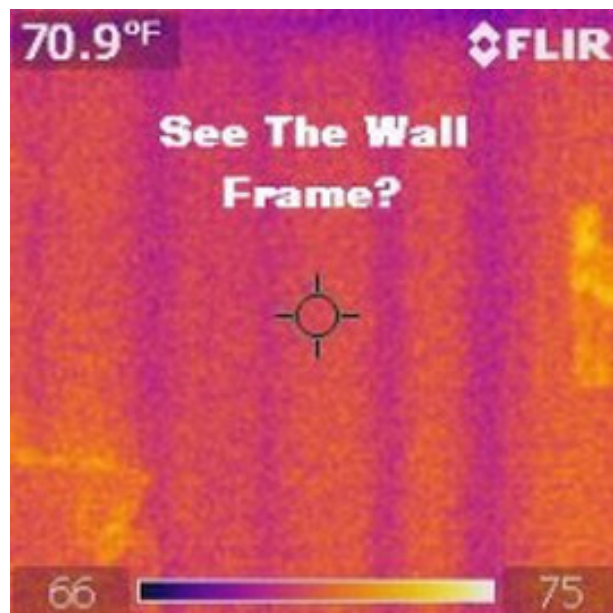
Unique roof designs sometimes have problems, ya think?







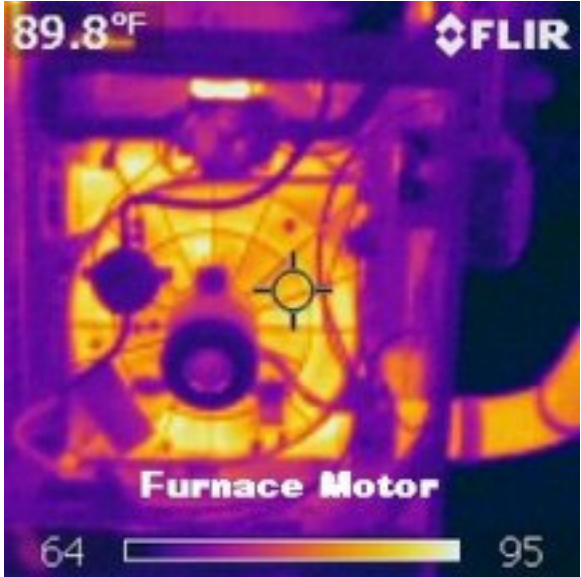
Is this really a problem?
(Electrical Knowledge Is Needed)



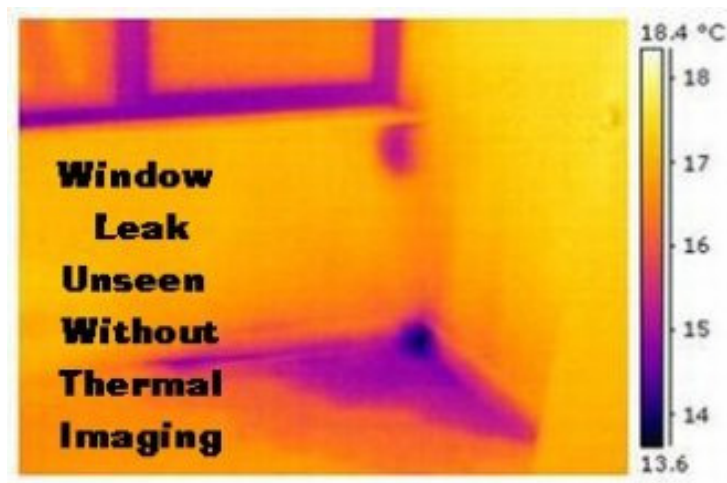
Verify structural components.



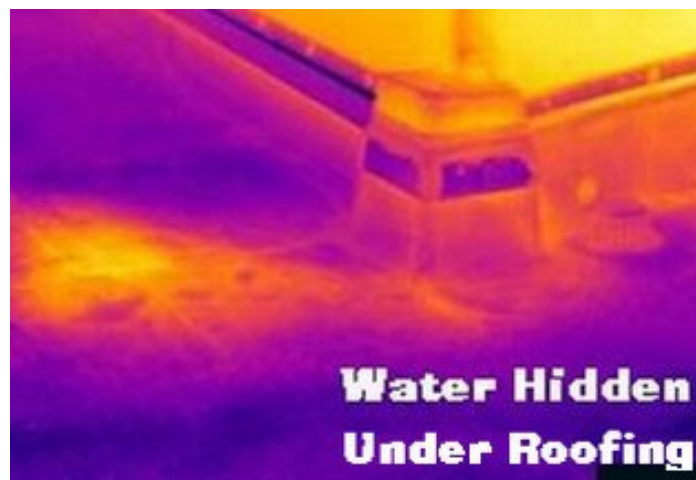
Hot spot on furnace.



HVAC Knowledge Required.



Confirm with moisture meter.



Why is water warmer under roofing..?

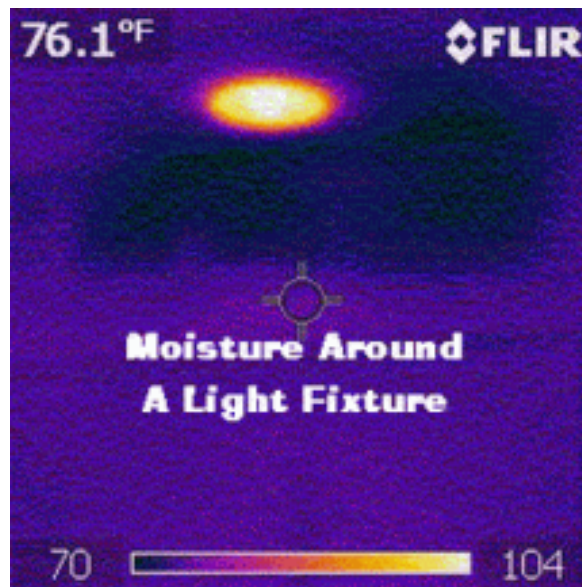
What time of day?

What may affect this image?

Sloped roof or flat?



Liability – Be Careful What You Claim.



Moisture in electrical fixtures can cause damage and may become a safety hazard.

Reporting, Marketing, Liability:



Side by side photos make good reports.

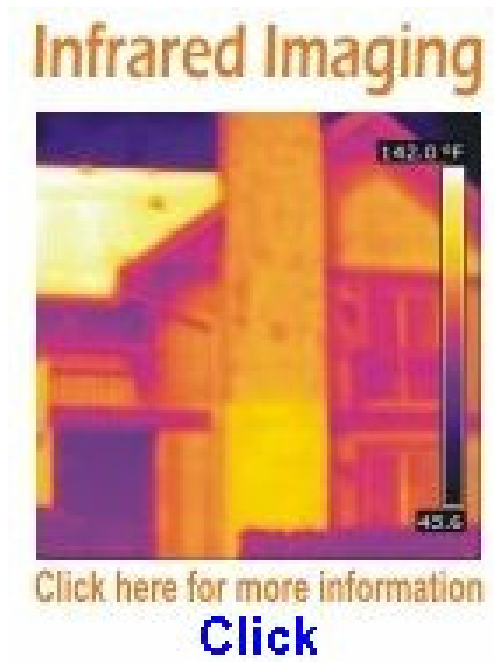
Make your reports clear and easy to understand. The photographs make it easy to understand your comments in the report. Also be sure to position your subject matter in such a way to help indicate the location of the reported item.



Super Inspector?.... No, but you
will stand out in the crowd...

One of the primary struggles that inspectors have is to distinguish themselves from their competition. Thermal Imaging clearly helps the CONSUMER see that you have superior technology and can help them discover things about the property that others may not be able to see. It requires that the inspector educate the public, in order for them to understand what thermal imaging can do for them.

Thermal imaging will also help your clients understand why you charge more than the average inspector.



Thermal Images make good ad content.



Thermal Imaging Is The Future.

Setting Proper Expectations:

NOTE: Thermal images of moisture problems (if any) have been confirmed with a quality moisture meter and proper repairs should only be done by a qualified Professional. Moisture can be conducive to fungi-mold, decay and wood destroying insects that cannot always be seen. Also remember that more repair items may be discovered during the process of further evaluations and repairs of any item listed.

NOTE: Although Infrared Thermal Imaging is a far better diagnostic tool than the naked eye, it does not guarantee 100% accuracy, unless removal or destruction of components can be achieved to validate findings. When possible, other tools are used to verify Thermal Images, but even with these considerations we do not claim to have x-ray vision. Conditions may change and cause the apparent temperature readings revealed in Thermal Images to be different at any given time.

EVERYONE SHOULD CONSULT A QUALIFIED ATTORNEY FOR THE EXACT TEXT THAT IS USED. THE ABOVE TEXT IS FOR INFORMATION ONLY AND NOT LEGAL ADVISE.

How Much Extra Does Thermal Imaging Cost?

Some inspectors charge an extra **50%...**



The POWER of Infrared Technology:

The thermogram of this vinyl-sided 3-floor apartment building clearly shows the path of a serious leak, completely hidden within the wall, from a washing machine on the third floor.

There are many applications and services that can be marketed through thermal imaging. The wave of interest has really taken off in the last few years.

News Articles:

CHICAGO SUN-TIMES

http://findarticles.com/p/articles/mi_qn4155/is_20071019/ai_n21064720

The Newest Technology For Home Inspections



U.S. Department of Energy

Energy Efficiency and Renewable Energy

http://www.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11200

Thermographic Inspections

“In addition to using thermography during an energy audit, you should have a scan done before purchasing a house; even new houses can have defects in their thermal envelopes. You may wish to include a clause in the contract requiring a thermographic scan of the house.”

Links: Helpful information about thermal imaging

<http://www.irinfo.org>

IRINFO.ORG is a content-based web resource and on-line community dedicated to professionally promoting infrared thermography and related PPM, PdM and NDT technologies.

<http://www.asnt.org>

The American Society for Nondestructive Testing helps create a safer world by serving the NDT professions and promoting NDT technologies, through publishing, certification, research and conferencing.

<http://www.mynact.org>

The **National Association of Certified Thermographers** was created so thermographers from diverse backgrounds can have an accessible place for unbiased information and services to enhance their business. A goal of NACT is to provide the public a place where they can find unbiased information on thermography and qualified thermographers.

<http://www.maintenanceworld.com>

Maintenance World is a site devoted to the maintenance management industry. Articles cover a wide range of topics, including thermography and thermal imaging.

<http://www.stocktoninfrared.com>

Stockton Infrared Thermographic Services provides comprehensive infrared services and is an industry recognized resource on infrared thermography.

<http://www.prothermographer.com>

AT **ProThermographer.com** you will find information on a variety of subjects from what infrared is and an infrared glossary of terms all the way to IR Camera Tips.

<http://www.inframation.org>

InfraMation is an annual conference ideal for anyone who wants to learn more about infrared and thermal imaging applications. Visit our booth!

<http://www.nachi.org>

The Inter-National Association Of Certified Home Inspectors has a forum dedicated to a vast array inspection related topics. There is a section for thermal imaging and IR cameras that is very helpful.

InterNACHI is the largest home inspection association in the world.