

This 4-page handout note provide a summary of the key points as well as web links to reference articles.

Why this topic is important

Home inspectors are responsible for disclosing reasonably discoverable deficiencies that would affect a client's property decisions. Our clients (and the courts) expect us to report signs of past and present leaks, and warn when there is a foreseeable risk for these occurrences. In fact, most of our clients consider finding leaks among the top reasons for hiring a home inspector. Moisture meters used properly are indispensable inspection aids, when combined with visual observations and assessment. This session discusses proper selection, use, limitations and reporting with moisture detection devices commonly used by home inspectors. We will limit the discussion to hand held resistance and capacitance moisture meters, psychrometers measuring relative humidity in air, and thermal cameras. We will not discuss testing for mould, but we will discuss some information sources that can help assess the basement flood risk, as well as drain camera inspections that might be performed by plumbers.

I have used a variety of moisture detection tools for the past 35 years while performing fee paid home inspections and performing moisture investigations. I am qualified as a building science specialist and have an engineering license to perform building envelope condition assessments. I am also an ASNT Level 3 trained thermographer with 14-years of experience interpreting thermal images. Years ago, it was not unusual for home inspectors to deliberately not use a moisture meter for fear of being sued, but today a home inspector could not convince a court that it is not necessary.

Should I trust my moisture meter really means do I understand the capabilities and limitations of my moisture meter, when I should use it, and what it is telling me. But the same could be said for understanding the limitations of my visual observations and knowledge, and my obligation to know of and refer specialty services, when appropriate. One other important consideration is whether we should trust the claims made by equipment manufacturers or whether we should do our own due diligence.

Session Objective To help you answer the following:

1. How can moisture detection tools improve my observations and reduce my liability?
2. What procedures should I follow so I can trust my moisture meter readings?
3. What do I need to know about the limitations of my moisture meter and the conditions I am testing?

What I have learned about moisture meters after performing home inspections since 1984

1. Our Objective is to Disclose Reasonably Discoverable Material Defects – Leaks/Moisture Matter
2. Finding moisture is easy, if inspection conditions are right and I have the right tools. Finding the moisture cause is not easy since I can't be certain what is below the surface.
3. All building moisture conditions are variable. Sometimes its wet and sometimes its dry.
4. Absence of Evidence is not evidence of absence. A dry reading does not mean it is or will remain dry
5. Moisture meters should be *mostly* used to validate visual observations. (Is it wet now?)
6. I must Know the limitations of my tools, observations and knowledge of conditions I'm testing.
7. Everyone is susceptible to **Confirmation Bias**. Our inspection reporting systems determines what is observed.
8. The Standard of Care (court cases) is that I should test for moisture when appropriate
9. Trust but verify- Try to confirm moisture by more than one method.
10. I must be able to justify my procedures, because published standards are not specific to building inspection.
11. Never test for moisture (or anything else) unless you are prepared to explain your results. (Joe Lstiburek)
12. Moisture meters can be effective observation aids that can reduce a home inspector's liability, provided the user understands their proper use, limitations and the conditions they are testing. Too many users lack a basic understanding, to the detriment of their clients and their own liability.
13. There is no such thing as 100 % reliability or ability for people or things. Everything and everyone have limitations. We want to know but don't know all facts and can't predict the future, so we have to rely on trust, including trust in our moisture measuring tools and their readings. Clients place a lot of trust in our ability to provide the right interpretation.

14. I should recommend "immediate investigation/ repair" for significant elevated moisture levels or any other deficiency condition where there is a potential for a costly repair. I will be blamed or found liable if recommending monitoring and a foreseeable failure event occurs.

Five things must come together for my effective use and trust in my moisture meter results

1. I can only observe signs of current or past leaks/moisture, their contributing causes or related conditions when inspection conditions are right. (i.e. sometimes its wet and sometimes its dry)
2. I can only obtain a history of past leak and repairs if I ask and the information provided is accurate and complete.
3. My moisture meter(s) must be capable of detecting elevated moisture levels in the building assembly tested. I must know the composition of the building assemblies I am testing.
4. My client must follow my inspection recommendations for further evaluation/ repair, or conditions may deteriorate, and they will blame me.
5. I document my observations with photos showing moisture meter readings, speculate the potential contributing causes, and report so I can later recall and defend my actions and methodology.

Moisture meter types

1. Contact type moisture meter (pins) operate by electrical resistance. They makes holes in materials tested and can be accurate at the depths tested.
2. Non-contact type moisture meters operate by electrical capacitance. This type is mostly used by home inspectors as it is non-destructive, but can not determine the depth at which moisture is sensed.
3. Thermo-hygrometers measure air temperature and relative humidity. Some models have probes that can be inserted into wall cavities or floor slabs to directly measure moisture levels
4. Thermal cameras only measure surface temperature, but are often used to identify cold spot patterns associated with leaks.
5. Some manufacturers offer all-in-one single units that perform multiple functions.

Standard of Care for Home Inspectors related to moisture meter use

1. Moisture meters are commonly used to determine if stains have elevated moisture levels and to check areas where the risk of future leaks is high. The 2015 OAHI/ Conestoga Survey shows an overwhelming use of moisture meters used by home inspectors in Ontario.
2. Moisture meter use is specifically mentioned in the National Occupational Standard from 2013 and the 2016 CSA A770. The absence of specific mention of moisture meters in some standards of practice does not protect the home inspector who does not use it.
3. Court cases such as Deters and Halliwell illustrate how the proper use of a moisture meters can assist a home inspector's defense.
4. It would be difficult to counter court decisions that found home inspectors responsible for disclosing reasonably discoverable material deficiencies, regardless of the standards of practice used. A home inspector encountering evidence of past leaks or related moisture damage, however minor is obligated to investigate further and make appropriate recommendations. (i.e.-further investigate-not monitor)

Published standards for moisture testing

1. While there are ASTM and other standards for moisture testing individual materials such as wood, concrete and gypsum board, there are few standards defining unacceptable moisture levels in building assemblies encountered by home inspectors. For this reason, home inspectors should only use moisture meters to comparatively check areas with suspected elevated moisture to determine if moisture levels are elevated, or are similar to the other dry-appearing areas.
2. Home inspectors who use thermal cameras should always confirm suspected areas with elevated moisture levels by using a moisture meter. Thermal cameras should be used in accordance with published standards. I do not recommend home inspectors use a thermal camera without ASNT Level 1 training.
3. IICRC Standards 500 and 520 offer guidance information on moisture meter use for water damage restoration, that would be helpful for home inspectors.

Specific questions I ask myself when using a moisture meter

1. Are there stains or elevated moisture levels that warn of hidden deterioration or the need for repairs?
2. Are there underlying dampness problems that I can or may not detect?
3. Are there signs of related dampness, damage or water entry points nearby?
4. Is the current moisture level the same as other areas, elevated, or extremely elevated?
5. What warning is appropriate based on the condition of other potential leaks contributing causes together with the moisture meter reading?
6. If conditions become worse, have I given sufficient warning to the client, based on what was reasonably discoverable?
7. Will the real estate agent try to reassure the client based on a low moisture meter reading?

Using a thermal camera for moisture detection – Reality Check

1. Thermography only detects Surface Heat– Not Mould, Not Wet, Not Leaks, Not Cold Air Drafts
2. Abnormal heat or lack of heat patterns typically happen under specific temperature, pressure, humidity inside and outside conditions or electrical or mechanical loads.
3. I cannot count on abnormal temperature conditions happening at time of inspection.
4. You need advanced knowledge to: know your test conditions, the building assembly or components, and to be able to explain the observation and validate with other tests. Thermography is not as easy as using a moisture meter.
5. Thermography is not as reliable as a primary moisture detection tool.

Some situations where a moisture meter is helpful on a home inspection

1. Checking basement trim for hidden moisture below the surface
2. Checking drywall stains for active moisture
3. Checking for elevated moisture behind bath enclosure tile
4. Checking for elevated moisture behind EIFS
5. Checking for moisture under flat roof membranes

Defensive reporting strategies

1. Provide photos showing moisture meter readings of “comparatively dry areas” and areas tested, as well as showing where the readings were taken.
2. Recommend “immediate further investigation/repair” when there are highly elevated moisture readings. Never recommend monitoring.
3. If reporting situations where moisture meter levels were not elevated, state, “stains suggesting past moisture were noted, but moisture meter readings were not elevated at time of inspection. These readings may not reflect future conditions”
4. Identify other risk factors or signs of potential moisture or leaks, but leave the cause and recommendations open ended, so the client cannot claim that they relied on your recommendation for a specific repair that was incorrect.

Practical situations for home inspectors to use a moisture meter

1. Confirm if stains and finishes with signs of moisture are damp
2. Check finished basement walls and trim
3. Check exterior wood trim for hidden moisture
4. Check EIFS vulnerable areas for hidden moisture
5. Checking bath enclosure tile for hidden moisture
6. Checking attic framing and sheathing and ceilings for evidence of roof leaks

Common Moisture sources

- a. Building envelope leaks
- b. Plumbing leaks
- c. Interior humidity resulting in condensation
- d. Unusual occupant activities aquariums, water beds

Recommended Inspection/ Reporting Protocol

1. Advise the client that you will use a moisture meter at your discretion to check visible stains and high-risk areas. Also advise the testing limitations of depth, intermittent nature of water, etc..
2. Take baseline readings and check suspicious areas.
3. Take photos of your readings showing location and actual readings
4. Report readings as low, elevated or saturated.
5. Recommend follow up investigation if elevated.

References

Moisture content determination in wood -Detailed discussion of Moisture testing

<https://dnr.wi.gov/topic/ForestBusinesses/documents/BiomassMoistureContent.pdf>

<https://www.greenbuildingadvisor.com/article/the-physics-of-water-in-porous-materials>

<https://www.greenbuildingadvisor.com/article/four-ways-that-water-gets-into-buildings>

Understanding Evaporation -Why moisture does not show on my thermal images

https://obec.on.ca/sites/default/uploads/files/newsletter/Pushing_the_Envelope_Fall2009.pdf

Deters V Elliot Windsor case where moisture meter use successfully defended the home inspector

<https://www.canlii.org/en/on/onsc/doc/2017/2017onsc4224/2017onsc4224.html?searchUrlHash=AAAAAQAPRGV0ZXJzIFYgRWxsaW90AAAAAE&resultIndex=1>

ASTM F2170 Relative Humidity in Concrete Testing Protocol

<http://www.actechperforms.com/media/1072/technical-bulletin-18-astm-f2170-moisture-testing.pdf>

Moisture Control Guidance for Building Design, Construction and Maintenance EPA 402-F13053

www.epa.gov/iaq/moisture

NMS 022713 Building Envelope 2017 Thermographic Assessment Building Envelope

https://www.brikbases.org/sites/default/files/best2_colantonio_theauvette.pdf

Practical issues associated with the use of Infrared

<http://obec.on.ca/sites/default/uploads/files/members/CCBST-Oct-2014/A6-3-a.pdf>

Flir Technical Note Temperature Guns versus Thermo Imagers -Explanation of Thermal Sensitivity

<https://www.flir.ca/discover/rd-science/temperature-guns-versus-thermal-imaging-technology/>

Comparison of Flir C2 with Fluke TI520 <https://nacbi.org/community/index.php?threads/flir-c2-review-and-comparison.1726/>

Infrared Camera Resolution for the Building Thermographer – Snell Group

<https://www.scribd.com/document/386002811/infrared-camera-resolution-for-building-thermographer-pdf>

ASTM D7438-08 Standard Practice for Field Calibration of Hand-Held Moisture Meters (for wood only)

ASTM F259 Standard Guide for preliminary Evaluation of Comparative Moisture Conditions of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter

ASTM Moisture Control in Buildings 2nd Edition

ASTM E241-1-09 Standard Guide for Limiting Water-Induced Damage to Buildings

IICRC Standard 500 and 520 Water Restoration Standards

Moisture Control Handbook – Lstiburek , Carmody 1991

<https://www.osti.gov/biblio/586594-moisture-control-handbook-new-low-rise-residential-construction>