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Shaping the Future

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Building Performance Testing

Karim P. Allana, CEO & President, Senior Principal

Allana Buick & Bers, Inc.

Presentation Overview

- AAMA, WDMA and ASTM Standards
- Building Performance Testing for Quality Control
- Diagnostic Testing for Finding Leaks
- Curtain Wall and Glazing Testing
- Horizontal Waterproofing Testing
- Air Barrier Testing
- New Testing Technology - Electronic Leak Detection (ELD)

AAMA, WDMA and ASTM Standards

AAMA, WDMA, and ASTM Standards

- American Architectural Manufacturers Association (AAMA) - founded to support the common interests of glazing system manufacturers.
- Window and Door Manufacturer's Association (WDMA) - founded to support the door and window industry manufacturers.
- ASTM International (originally the American Society for Testing Materials) provides testing standards for everyday items
- AAMA, WDMA and the Canadian Standards Association (CSA) take some of the ASTM testing standards and add performance requirements.
- NAFS 2011 –AAMA/WDMA/CSA/101/i.S.1/A-440 – North American fenestration standard/specification for windows, doors and skylights

AAMA, WDMA, and ASTM Standards

- According to AAMA, “The AAMA 501-83 publication was the successor publication of the 1968 standard known as NAAMM Standards FC-1 and TM-1-68T originally published by the National Association of Architectural Metal Manufacturers.” In 1983, AAMA 501.3-84 states the following in regards to field test pressures:
    - 4.2 Laboratory tests are designed to give an indication of how a product will perform when actually installed in the building. However, the installed performance of a product may vary from that which was determined in the laboratory. This field test procedure provides a means for determining the performance of a product as installed.
- The stated intent of the field testing was that “…errors in fabrication or installation can be readily discovered and corrections made before the entire project …. is completed.”

AAMA 503 Standards

- In 1994, AAMA published a standalone AAMA 503 standard as a “voluntary specification” for field check of products using uniform air pressure - AAMA 503-94. For the first time, AAMA added the following language:
    - 4.7 The field water penetration tests shall be conducted at a static test pressure of two-thirds of the specified project water penetration test pressure, but not less than 6.24 psf.
- For instance, if a curtain wall is laboratory rated at 12 psf water resistance, AAMA would not allow testing of that same system in the field at more than 8 psf.

AAMA, 503 Standard

- In 2008, AAMA 503 further modified this voluntary specification. The title of the standard was changed to include the words “newly installed”. This standard was reduced to being applicable to new installations that are less than “6 months” old as follows:
    - 1.1 These specifications establish the requirements for test specimens, apparatus, sampling, test procedures and test reports to be used in evaluating the performance of newly installed storefronts, curtain walls and sloped glazing systems and their installation during construction, prior to issuance of building occupancy permit, but no later than six months after issuance of the occupancy permit. (“Test Area” hereafter referred to as “specimen”.)
- The final result is that a new installation tested in a laboratory at 12 psf can only be tested in the field at 8 psf.

Performance Testing for Quality Control

- Promote optimal system performance and reduces risk of premature failure with performance testing.
- Learn how to specify building envelope testing.
- Learn about the differences in AAMA and ASTM methods.
- Diagnosing air and water leakage through assemblies.
- Learn the pros and cons of the four types of Electronic Leak Detection (ELD) and test techniques.

Curtain Wall and Glazing Testing

Laboratory Water Penetration Test Standards

- NAFS 2011 – AAMA/ADMA/CSA/101/i.S.1/A-440 – North American fenestration standard/specification for windows, doors and skylights
- ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- ASTM E 547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference
- E 330 Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

Field Water Penetration Test Standards

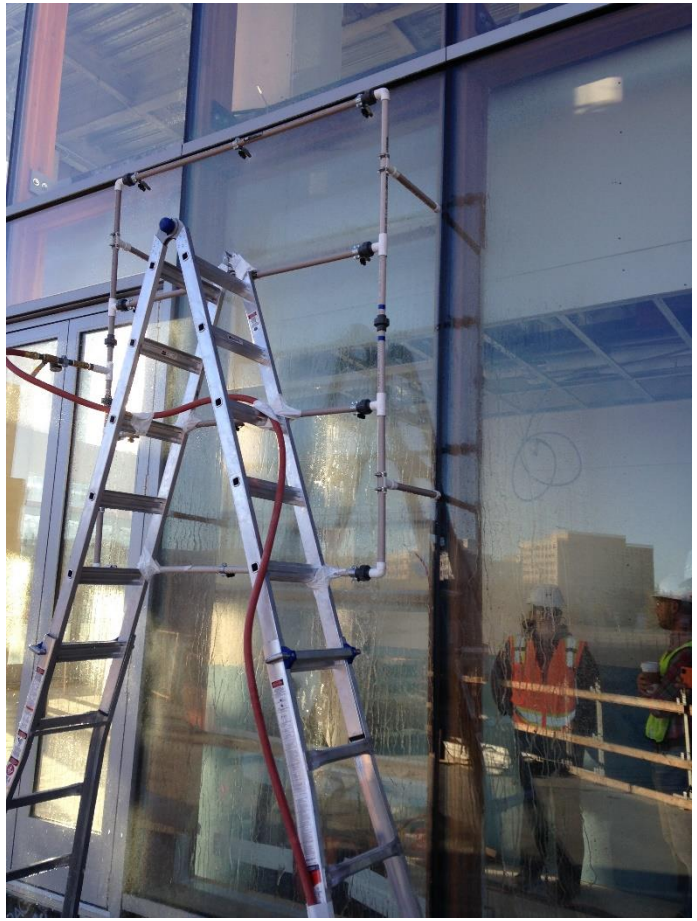
- ASTM E1105-15: Field determination of water penetration of installed exterior windows, curtain walls, and doors by uniform or cyclic static air pressure difference
- AAMA 501.2-15: Quality assurance and diagnostic water leakage field check of installed storefronts, curtain walls, and sloped glazing systems
- AAMA 501.1-17: Test method for water penetration of windows, curtain walls, and doors using dynamic pressure

Water Test Standards Leak Diagnostics

- AAMA 501-05: Test methods for exterior walls
- ASTM E783: Standard test method for field measurements of air leakage to installed exterior windows and doors
- ASTM E2128-12: Standard guide for forensic evaluation of water leakage by building walls
- ASTM E283: Air leakage of windows, curtain walls, and doors
- ASTM E1827: Standard practices for air leakage site detection in building envelopes and air barrier systems

ASTM E1105

- Procedure A – Uniform
- 15 min. uniform spray and pressure
- Procedure B – Cyclic
- Minimum 15 min. duration
- 3-6 min. cycles of 5 min. with pressure and 1 min without
- Water spray remains constant throughout



ASTM E1105

- Architect Specifies:
  - 10.1.1 – Specimen sampling, selection, adjustment and identification
  - 10.1.2 – Pressure difference(s)
  - 10.1.3 – Uniform, cyclic or both with number of cycles
  - 10.2 – Failure criteria if desired to be different

ASTM E1105 Failure Criteria

3.2.3 *water penetration, n*—penetration of water beyond a plane parallel to the glazing (the vertical plane) intersecting the innermost projection of the test specimen, not including interior trim and hardware, under the specified conditions of air pressure difference across the specimen. For products with non-planer surfaces (domes, vaults, pyramids, etc.) the plane defining water penetration is the plane defined by the innermost edges of the unit frame.

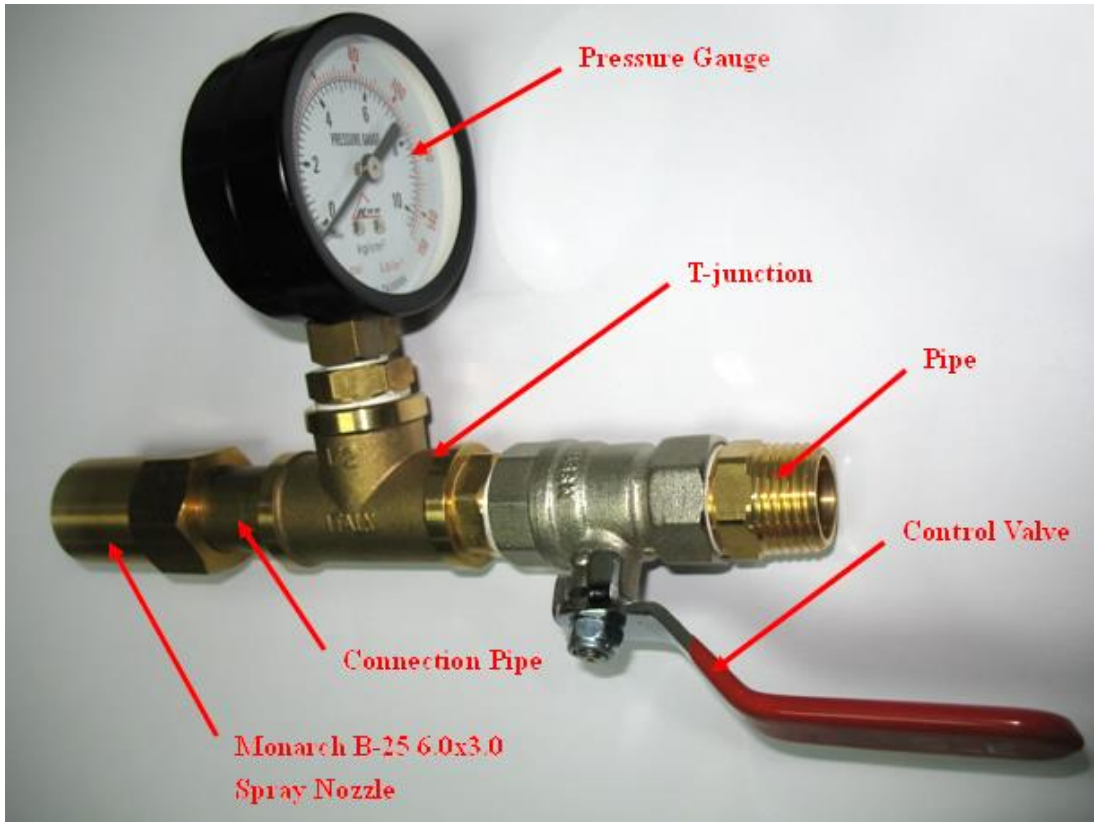
AAMA 501 Failure Criteria

Water leakage is defined as any uncontrolled water that appears on any normally exposed interior surfaces, that is not contained or drained back to the exterior, or that can cause damage to adjacent materials or finishes. Water contained within drained flashings, gutters, and sills is not considered water leakage. The collection of up to 15 ml (1/2 oz) of water in a 15-minute test period on top of an interior stop or stool integral with the system shall not be considered water leakage.

AAMA Performance Rating of Window

AAMA 501.2-15 Nozzle Test

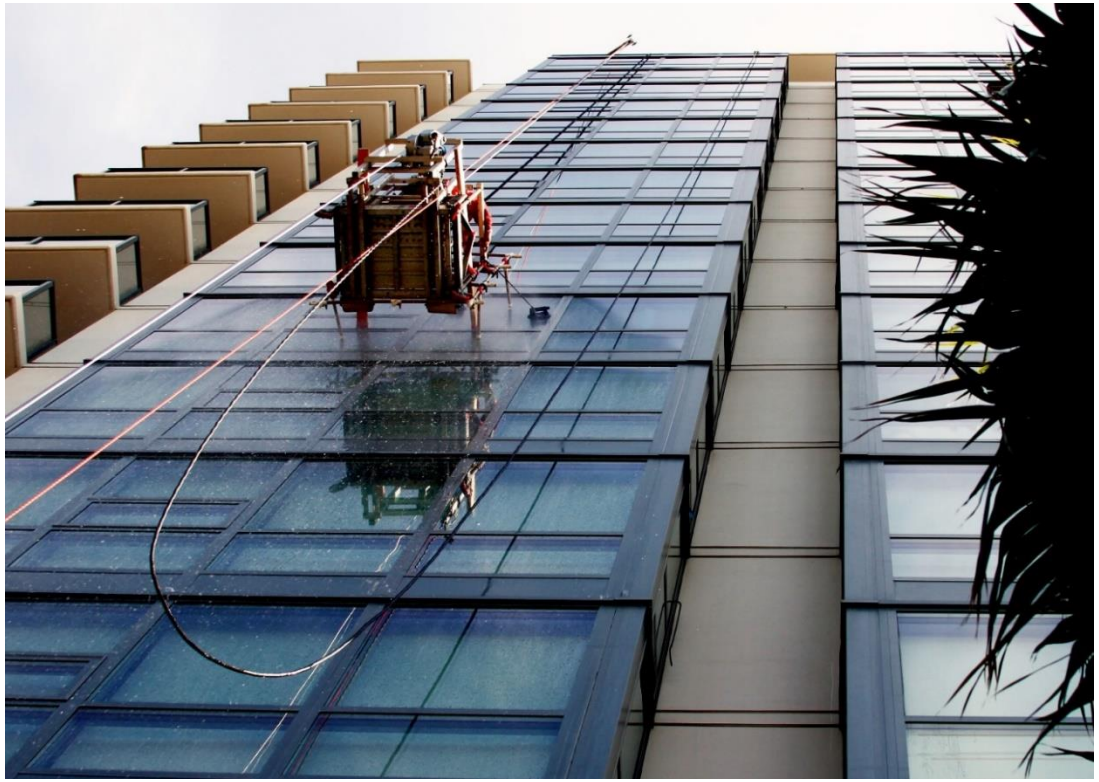
- Wand Test aka Monarch Test
- Generally used to identify and isolate leaks
- Can test longer members, joints, gaskets, and seals of permanently closed parts of curtain walls, sliding doors and storefronts.
- Use of standard AAMA nozzle
- Test 5 ft length over 5 min. at 30-35 PSI
- Non-fenestration diagnostic capabilities



AAMA 501.2-15

Isolation Testing – Window Only

AAMA 501-05, Leak Isolation Testing



Negative Pressure Chamber

Negative Pressure Blower Door

Pressure Difference Chart (Wind Speed)

Pressure Differential Conversion Chart

AAMA 503: Differential Pressure Chart for Water Penetration Testing

Laboratory			Field 2/3 of Lab		
Lab Pressure in psf	Equivalent Wind Speed (MPH)	Conversion to Inches of Water (PSF x 0.01923)	Field Pressure = 2/3 Lab Pressure in psf	Equivalent Wind Speed (MPH)	Conversion to Inches of Water (PSF x 0.1923)
6.24	49.37	1.20	4.16	40.31	0.80
7.00	52.29	1.35	4.67	42.70	0.90
7.25	53.22	1.39	4.83	43.45	0.93
7.50	54.13	1.44	5.00	44.19	0.96
7.75	55.02	1.49	5.17	44.92	0.99
8.00	55.90	1.54	5.33	45.64	1.03
8.25	56.77	1.59	5.50	46.35	1.06
8.50	57.62	1.63	5.67	47.05	1.09
8.75	58.46	1.68	5.83	47.74	1.12
9.00	59.29	1.73	6.00	48.41	1.15
9.25	60.11	1.78	6.17	49.08	1.19
9.50	60.92	1.83	6.33	49.74	1.22
9.75	61.71	1.87	6.50	50.39	1.25
10.00	62.50	1.92	6.67	51.03	1.28
10.25	63.28	1.97	6.83	51.66	1.31
10.50	64.04	2.02	7.00	52.29	1.35
10.75	65.55	2.07	7.17	52.91	1.38
11.00	66.29	2.12	7.33	53.52	1.41
11.25	67.02	2.16	7.50	54.13	1.44
11.50	67.75	2.21	7.67	54.72	1.47
11.75	68.47	2.26	7.83	55.32	1.51
12.00	69.17	2.31	8.00	55.90	1.54
12.25	69.88	2.36	8.17	56.48	1.57
12.50	70.57	2.40	8.33	57.05	1.60
12.75	71.26	2.45	8.50	57.62	1.63
13.00	71.94	2.50	8.67	58.18	1.67
13.25	72.62	2.55	8.83	58.74	1.70
13.50	73.29	2.60	9.00	59.29	1.73
13.75	73.95	2.64	9.17	59.84	1.76
14.00	74.61	2.69	9.33	60.38	1.79
14.25	75.26	2.74	9.50	60.92	1.83
14.50	75.26	2.79	9.67	61.45	1.86
14.75	75.91	2.84	9.83	61.98	1.89
15.00	76.55	2.88	10.00	62.50	1.92

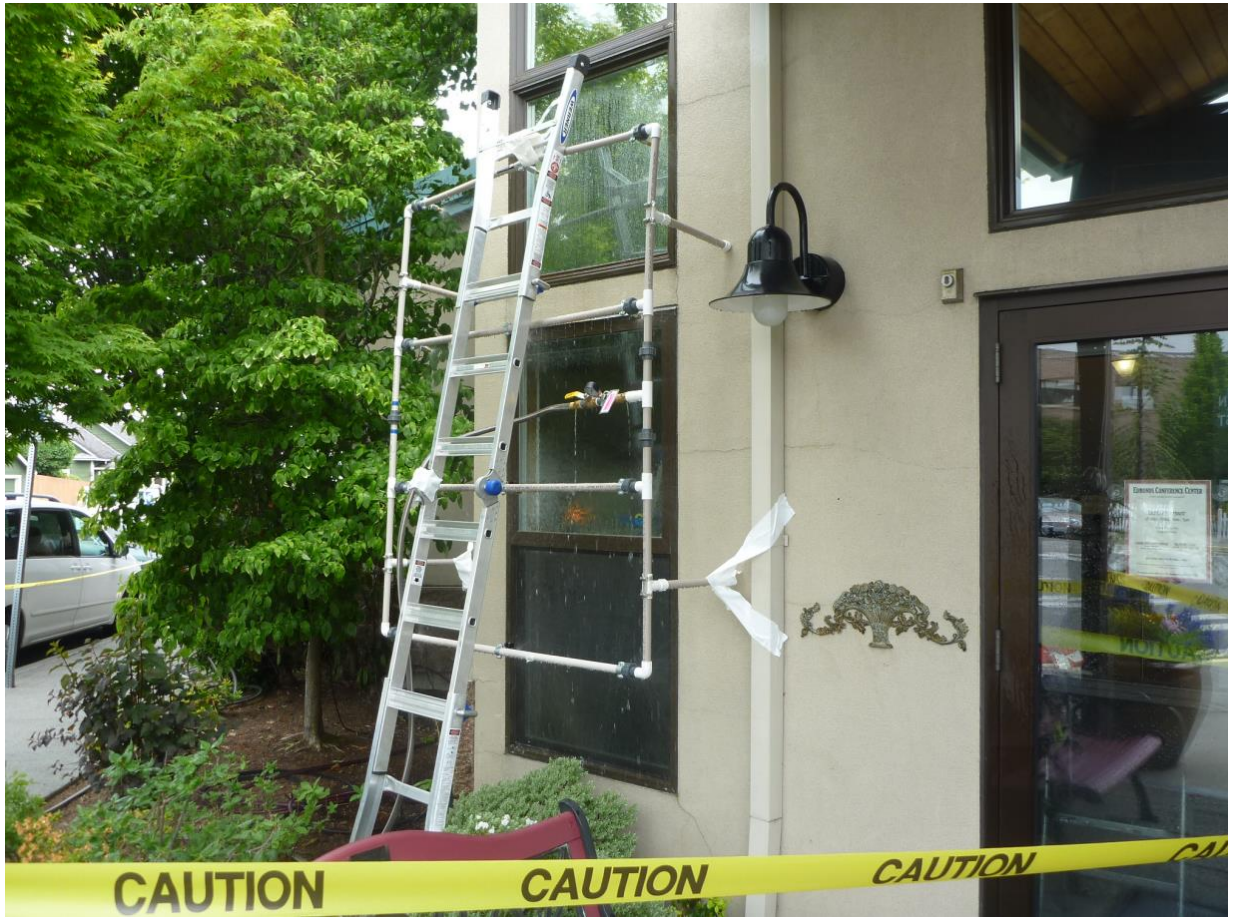
Product Defect Leaks at Mulled Joints

Product Leak, Glazing Seal Failure

Product Leak, Trickle Vent Gasket Failure

Interior Visual
(May Require Finishes Removed)

Integration Testing – Window And Wall



Flashing/Integration Leaks

Moisture Meters (Without Removing Finishes)

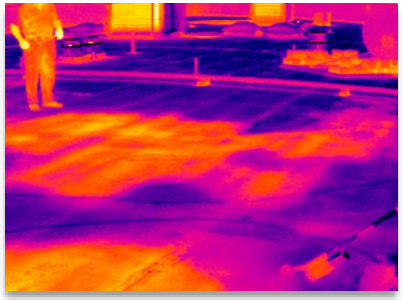
Destructive Testing (Flashing & Leak Damage)

Horizontal Waterproofing Testing

Horizontal Leak & Integrity Test Standards

- Leak detection standard testing methods include:
  - Horizontal Flood Testing (ASTM D5957)
  - Infrared Imaging (ASTM C1153-10) (2015)
  - Nuclear Gauge Testing (ASTM D6938-17)
  - Capacitance/Impedance Scanners (ASTM D954/D7954M-15A)

Flood Testing



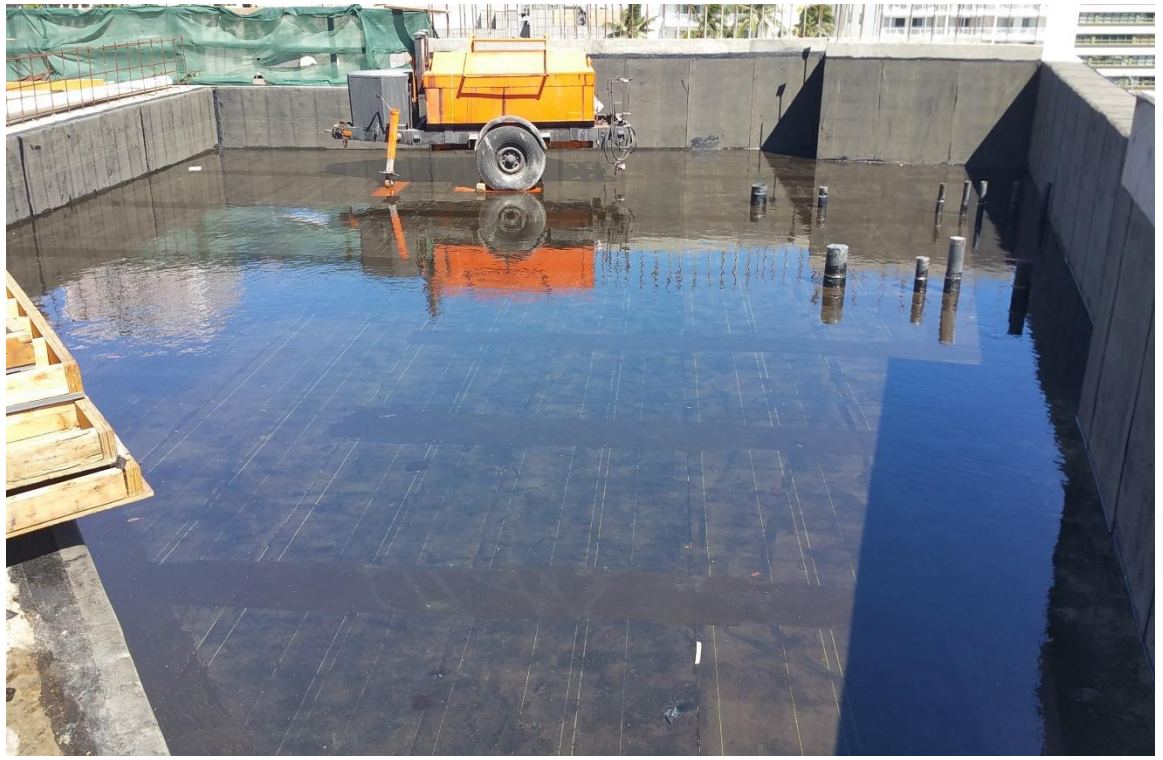
Infrared Imaging

Nuclear Gauge

Capacitance

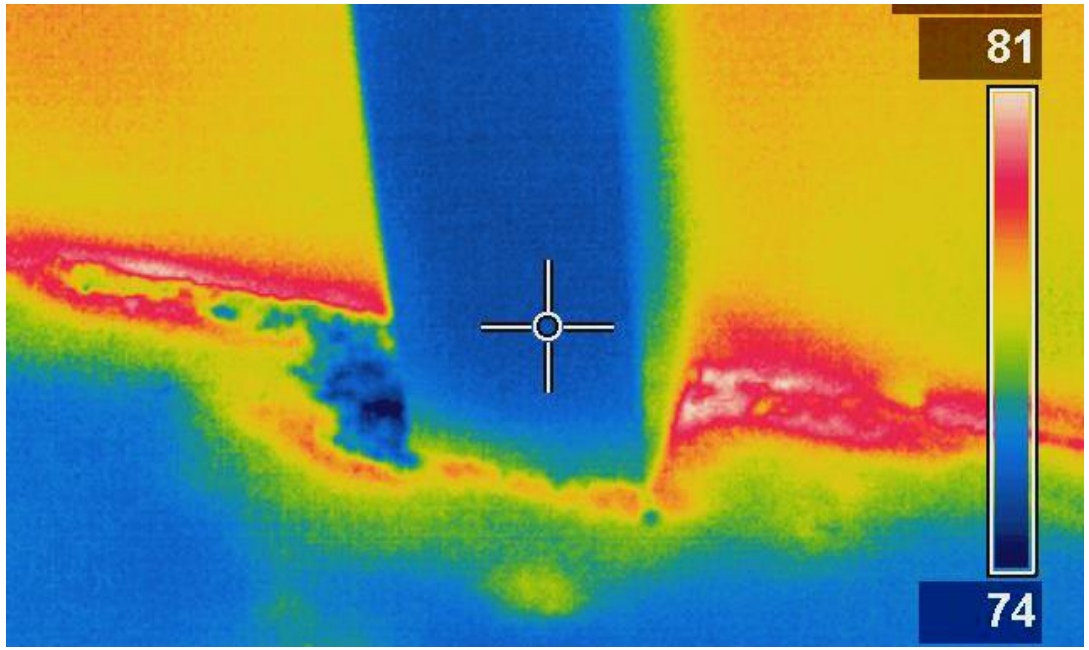
Horizontal Flood Testing – ASTM D5957

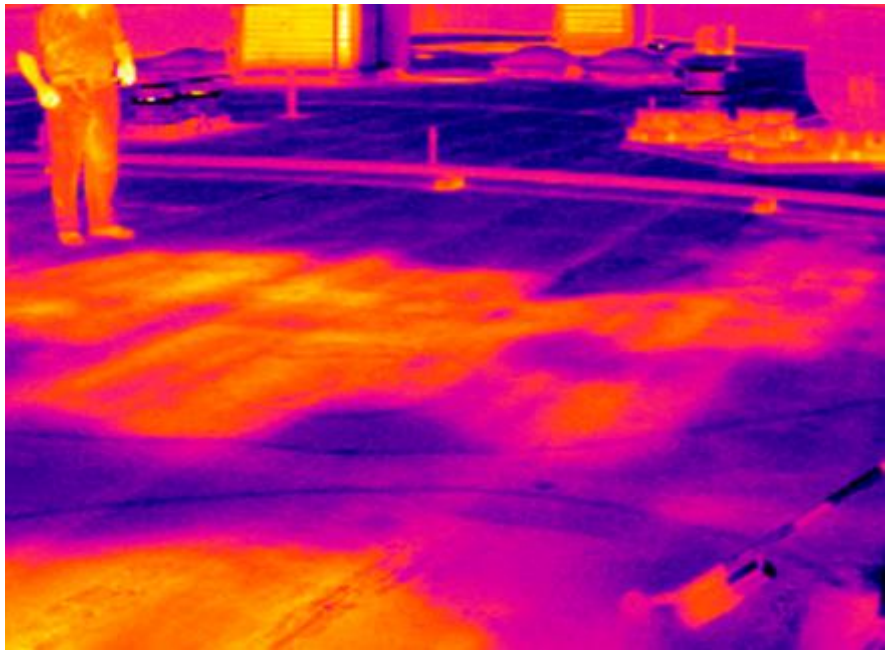
- 24-48 hour flood test with 2” standing water
- Compartmentalize water to reduce weight



Infrared Imaging - ASTM C1153-10 (2015)

- Generally used for air barrier testing, leak diagnostics and non-destructive testing.





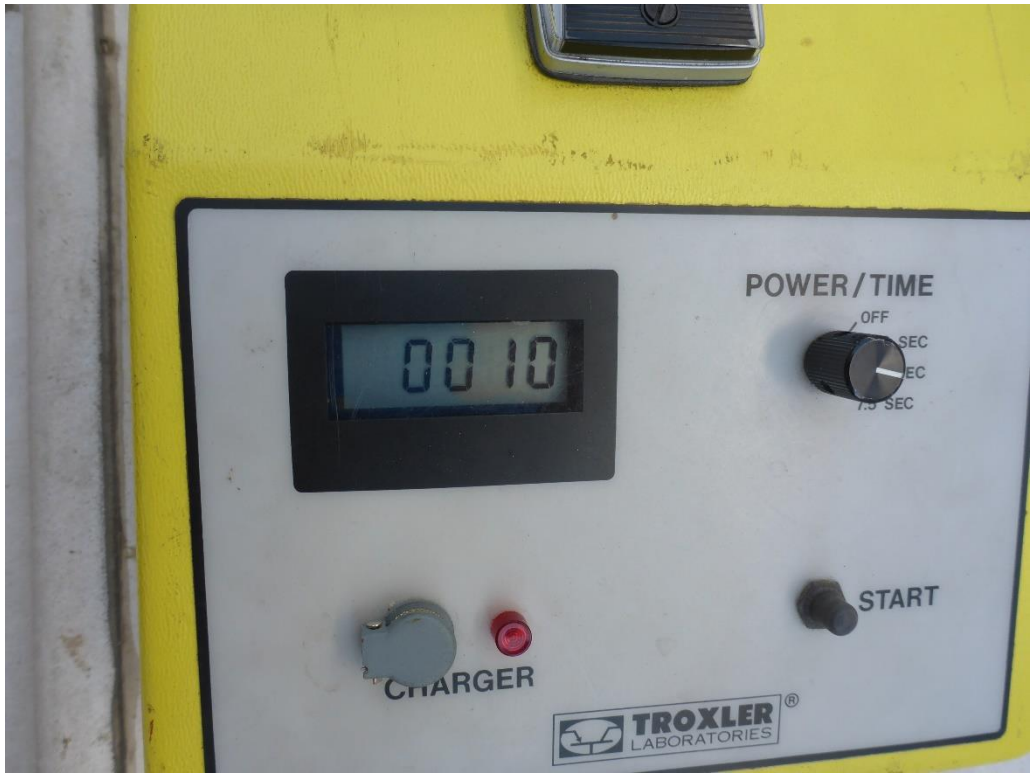
Pros & Cons Infrared Testing

- Advantages:
  - Non-destructive testing to verify assembly integrity & underlining materials
- Disadvantages:
  - Environmental conditions (sun, rain & wind) and climate must be correct for testing
  - Requires rain or flooding to induce a leak
  - Requires a dry surface prior to and during the testing. All debris and soiled areas within test area must be cleaned and removed from roof surface prior to testing
  - There must be an inside/outside temperature difference of the roof assembly in order to provide positive results
  - Walls, roof units, mechanical screens and windows are some of the items that can influence the surface temperature of the membrane thus effecting positive results
  - In most cases the roof will require destructive testing for coring to establish results

Nuclear Gauge Testing ASTM D6938 - 17

- Reads substrates by bouncing radiation off hydrogen atoms.
- Can read up to a depth of 12”.
- Used for diagnostics and non-destructive

Nuclear Gauge Testing ASTM D6938 - 17



Pros & Cons Nuclear Gauge Testing

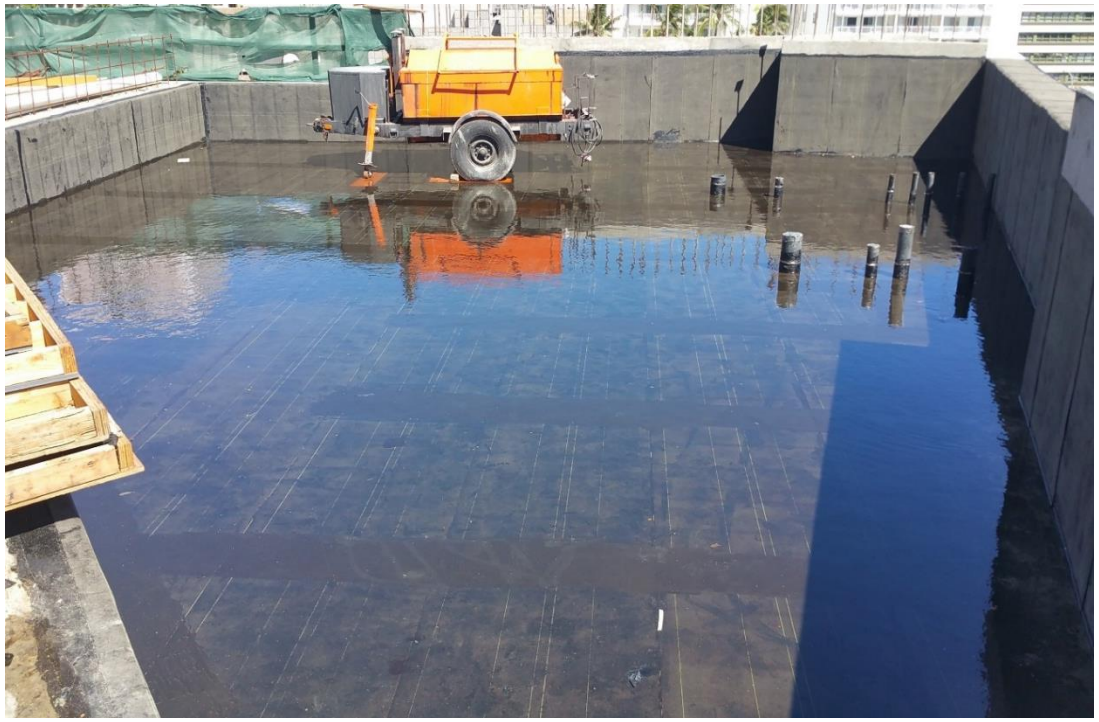
- Advantages:
  - Portable
  - Quick results
  - Non-destructive
  - Can test up to 12” depth
- Disadvantages:
  - Low level radiation is emitted from the gauge
  - Transportation of radioactive materials has become much more difficult and cost prohibited
  - May not pinpoint a leak pathway, merely indicates trapped moisture during testing.

Capacitance Scanners ASTM D954/D7954M-15A

Pros & Cons Impedance

- Advantages:
  - When insulation becomes damp or wet, its impedance changes, and so do the electrical properties. This change can be sensed from above the membrane, without puncturing it by the Capacitance Meter.
- Disadvantages:
  - Any conductive surface such as a high-carbon black EPDM, a foil-surfaced bitumen membrane or a foil-faced insulation board, will create false high readings and hence prevent valid or reliable results.
  - Roof surface must be completely dry for testing.
  - Roof must have insulation and leak area must have wet insulation
  - Destructive testing including coring should be expected for calibration.
  - May not pinpoint a leak pathway, merely indicates trapped moisture during testing.
  - Equipment has a limited depth of testing.

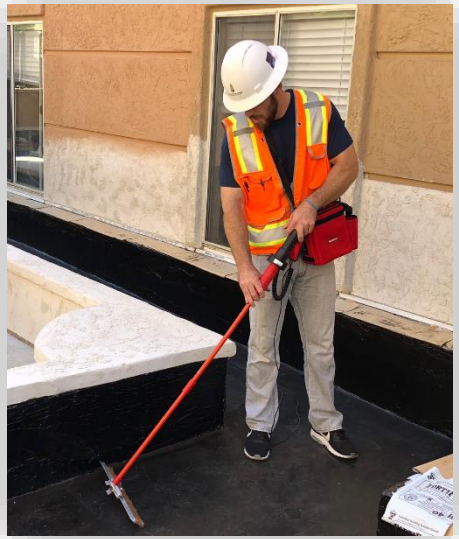
Horizontal Flood Testing – ASTM D5957



Pros & Cons Flood Testing

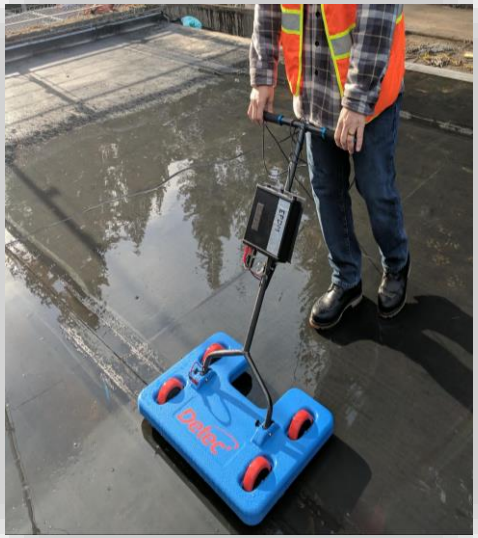
- Advantages: Creates hydrostatic pressure (could also be a disadvantage)
- Disadvantages:
  - Creates hydrostatic pressure
  - Weight (don’t exceed 2”)
  - Time consuming - up to 48 hours
  - May be false negative if ceiling is enclosed
  - Concrete slabs, especially PT slabs, may not readily show leaks
  - Leak location will be difficult to identify
  - After roof is drained, the leak below may persist for several hours - up to 48 hours
  - After repair conduct re-testing to confirm repair (another 48 hours)

4 Types of Electronic Leak Detection



ELD - HV Spark

ELD - EFVM
LV Horizontal



ELD – Platform
LV Horizontal

ELD – Platform
LV Vertical

Electronic Leak Detection ASTM D7877

Designation: D7877

Standard Guide for
Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes[1]

1. Scope

- 1.1 This guide describes standard procedures for using electrical conductance measurement methods to locate leaks in exposed or covered waterproofing membranes.

4. Significance and Use

- 4.4 The electric conductance methods described in this guide require a conductive substrate under the membrane to serve as a ground return path for the test currents. In roof assemblies where the membrane is installed over electric insulating material such as insulating foam or a protection board, or both, the electric path to any conductive deck is interrupted. The situation can be remedied by placing a conductive material directly under the membrane. The conductive material provides the return path for the test currents.

What is Electronic Leak Detection (ELD)?

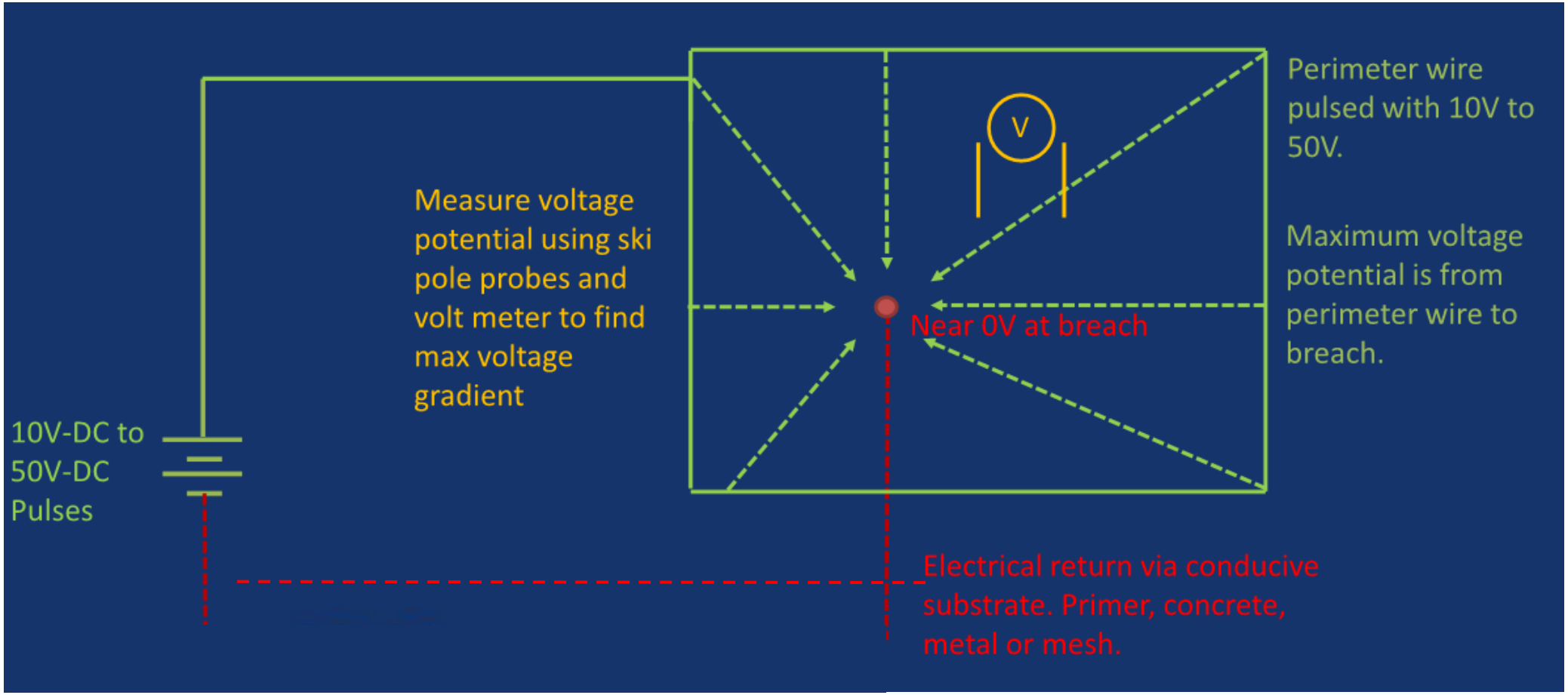
- Most commonly performed for new membranes for commissioning and existing leaks that other testing equipment cannot locate as accurately.
- Disadvantages
  - Membrane must be wet in low voltage
  - Requires a grounding substrate.
- Advantages
  - ELD requires a wetted surface for the test area in low voltage testing and a dry surface for high voltage testing.
  - Leak needs to penetrate the membrane and contact the substrate (thickness is not an issue).
  - Un-finished materials below are effected and the repair(s) can be conducted immediately and retested.

Manufacturer's Warranty Requirements

- **Membranes with overburden required ELD Testing**
  - Manufacturer requires and specifies the use of Electronic Leak Detection (ELD) as the main Quality Assurance (QA) method over completed, exposed membranes on all waterproofing projects. This test is also required to help confirm the water tightness of the system prior to overburden placement so that a warranty can be issued.

Electric Field Vector Mapping (EFVM™)

Low Voltage Circuitry - EFVM™



Electric Field Vector Mapping (EFVM™)

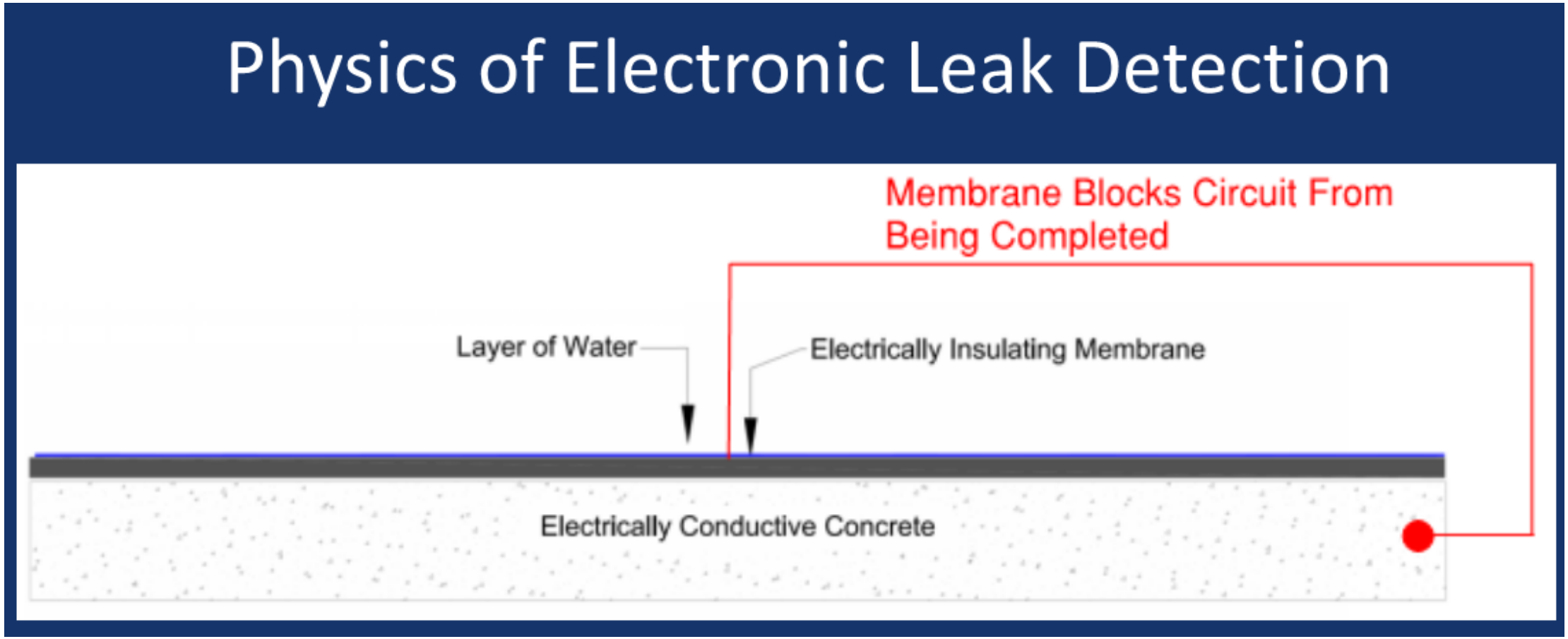
- Requires wire mesh to be installed under the membrane if not directly applied to conductive substrate. Wire mesh installed below cover board does not follow ASTM D7877
- Requires location triangulation as base of testing technique
- Trace wire blocks any signals from outside of the loop
- Test results based upon the technician's experience (technician sensitive)
- Limited to testing of field waterproofing membrane ONLY. Does not test vertical membrane, drains, sumps, vertical transition details, penetrations and all locations outside the trace wire
- Does not provide accurate test results through overburden as implied

Electric Field Vector Mapping (EFVM™)

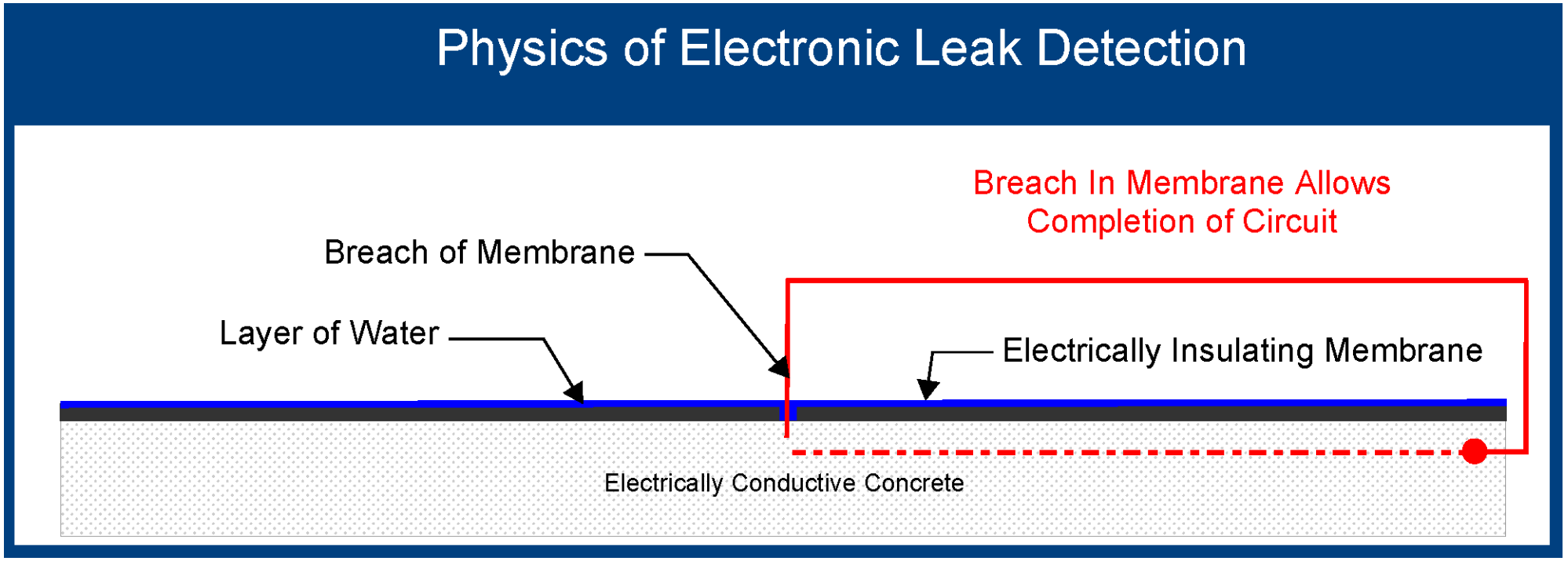
- Requires wire mesh to be installed under the membrane
- Uses low voltage, measures voltage potential using probes
- Requires location triangulation
- EFVM cannot be used with EPDM and many others.
- Requires the isolation of all grounding penetrations, at drains and critical penetration details.
- Cannot test vertical membranes

Limitations of EFVM™ (Trace Wire)

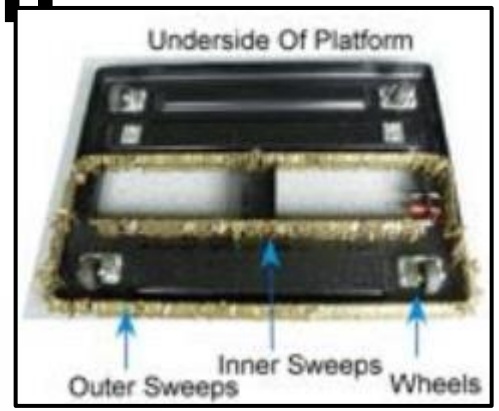
How Non-EFVM™ ELD Circuitry Works



Leak Identification Circuit Breach



Non-EFVM™ ELD Platform



D7877

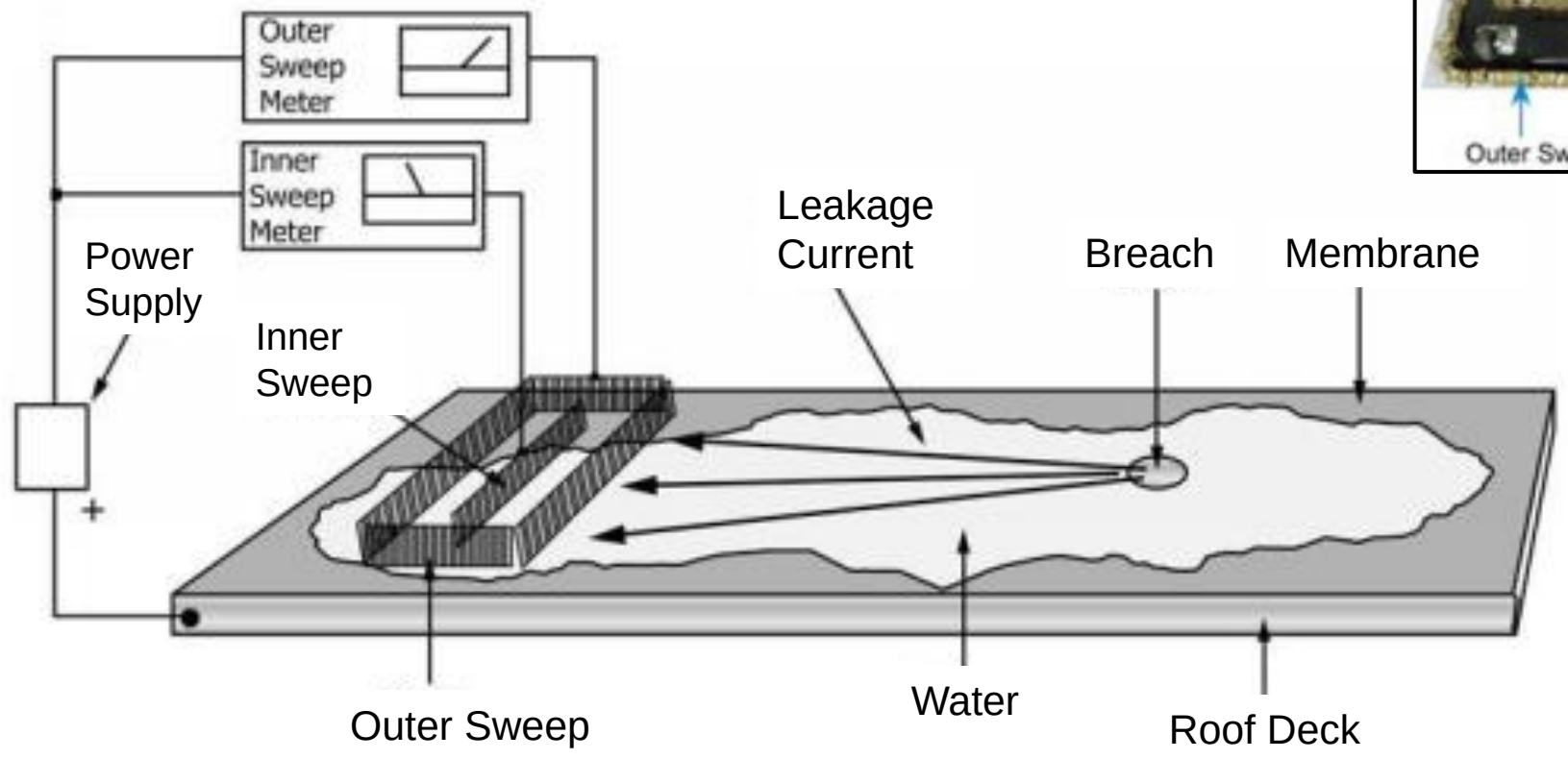
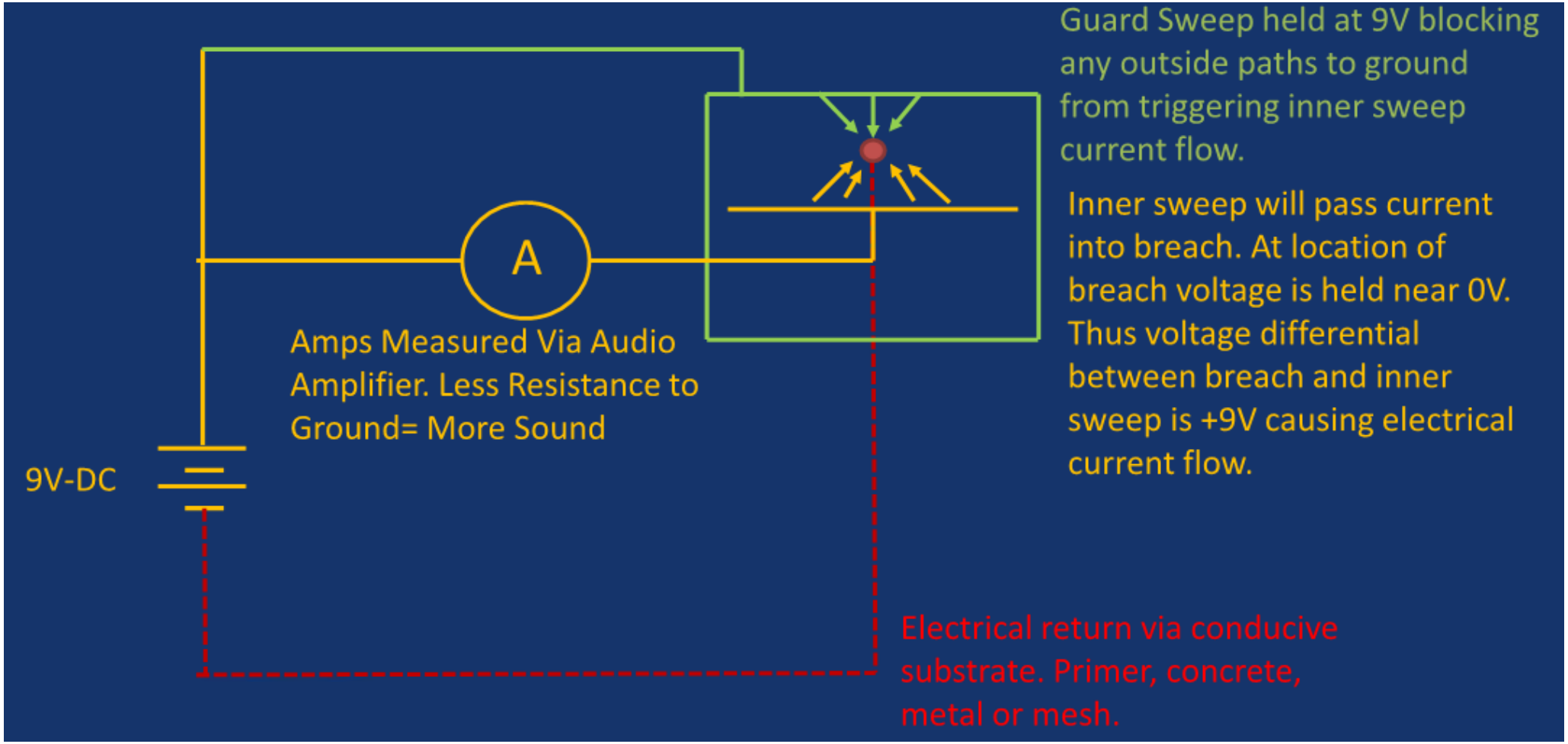


FIG. 1 Basic Circuit and Application of Membrane Scanning Platform

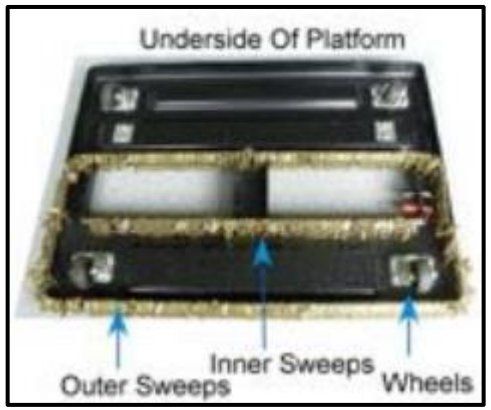
Low Voltage Circuitry Platform - ELD



ELD Testing Scanner

VIDEO

ELD Platform



D7877

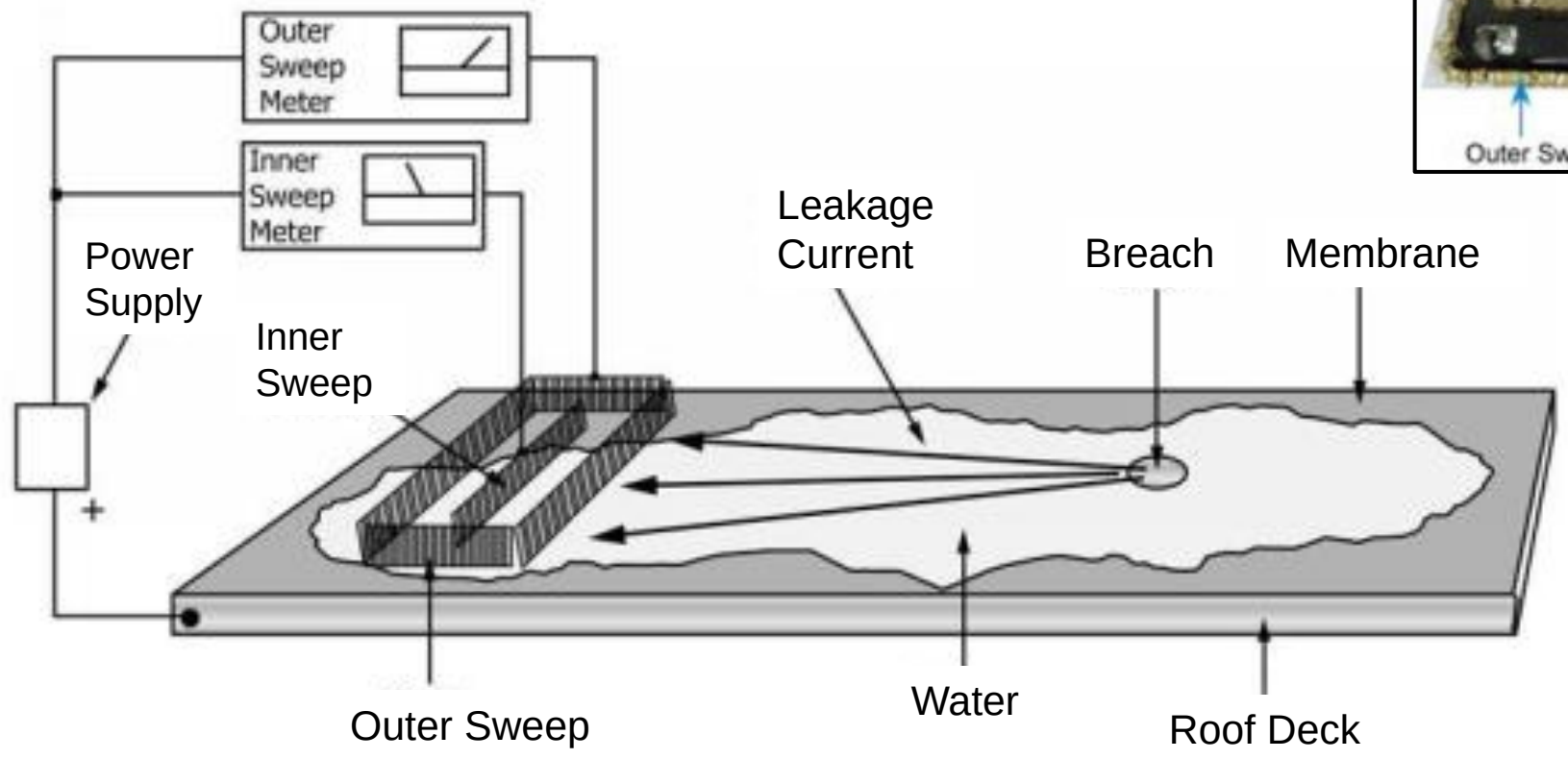


FIG. 1 Basic Circuit and Application of Membrane Scanning Platform

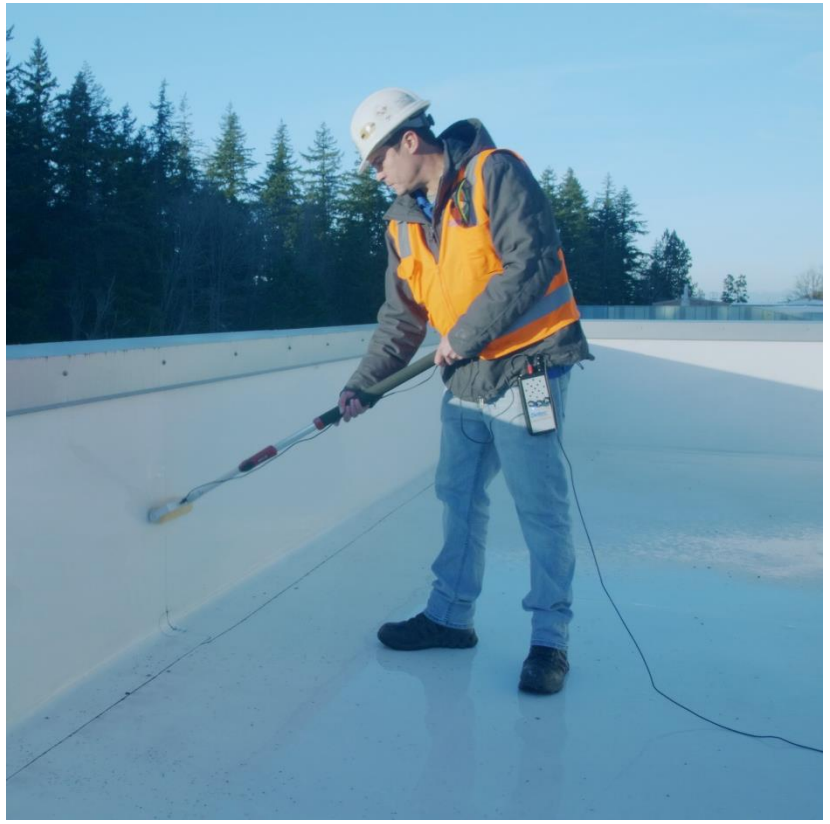
ELD Platform Circuitry - Testing Tools

Wet Roller

Glove

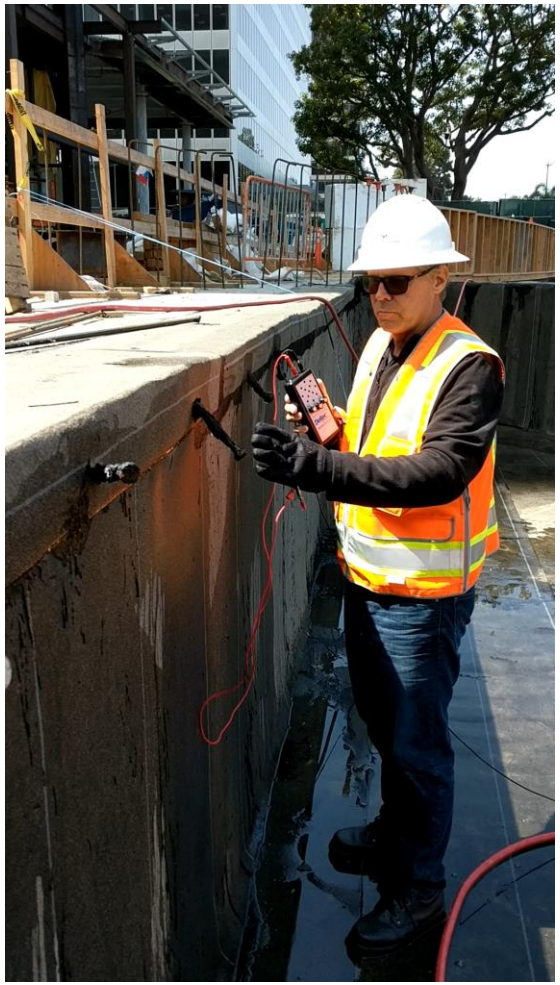
Low Voltage Vertical Scanning – Wet Roller

- Traditional methods and EFVM testing can be problematic for vertical application
- Measure small changes in current flows
- High current, high tone; low current, low tone.
- Greatly reduces anomalies, less false negatives
- Pinpoints exact locations vs. triangulation
- Vertical and horizontal surfaces
- Able to isolate and test penetrations



Vertical Breach in Membrane

ELD Hand Sweep Video

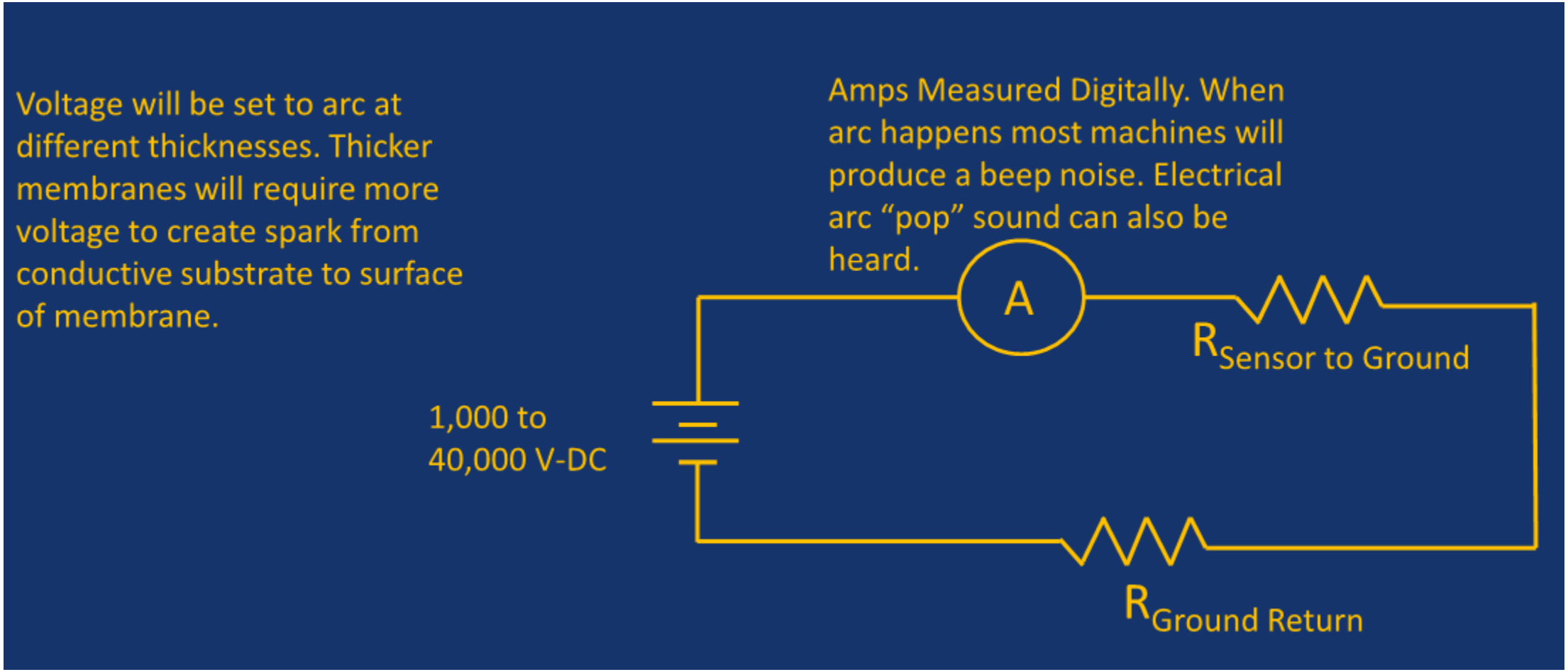


ELD High Voltage Spark Testing (ST)

High Voltage Circuitry - ELD

Voltage will be set to arc at different thicknesses. Thicker membranes will require more voltage to create spark from conductive substrate to surface of membrane.

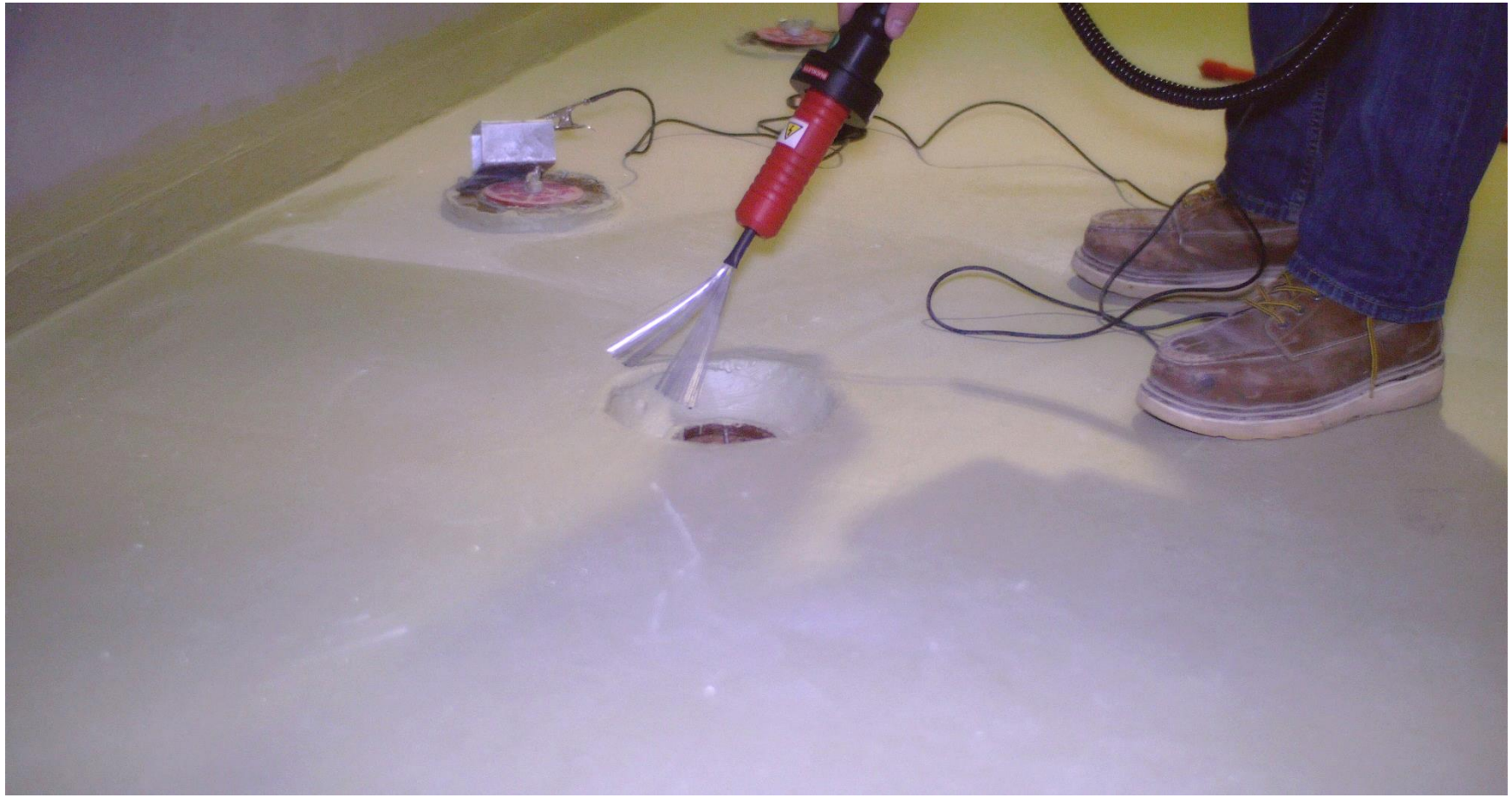
Amps Measured Digitally. When arc happens most machines will produce a beep noise. Electrical arc “pop” sound can also be heard.



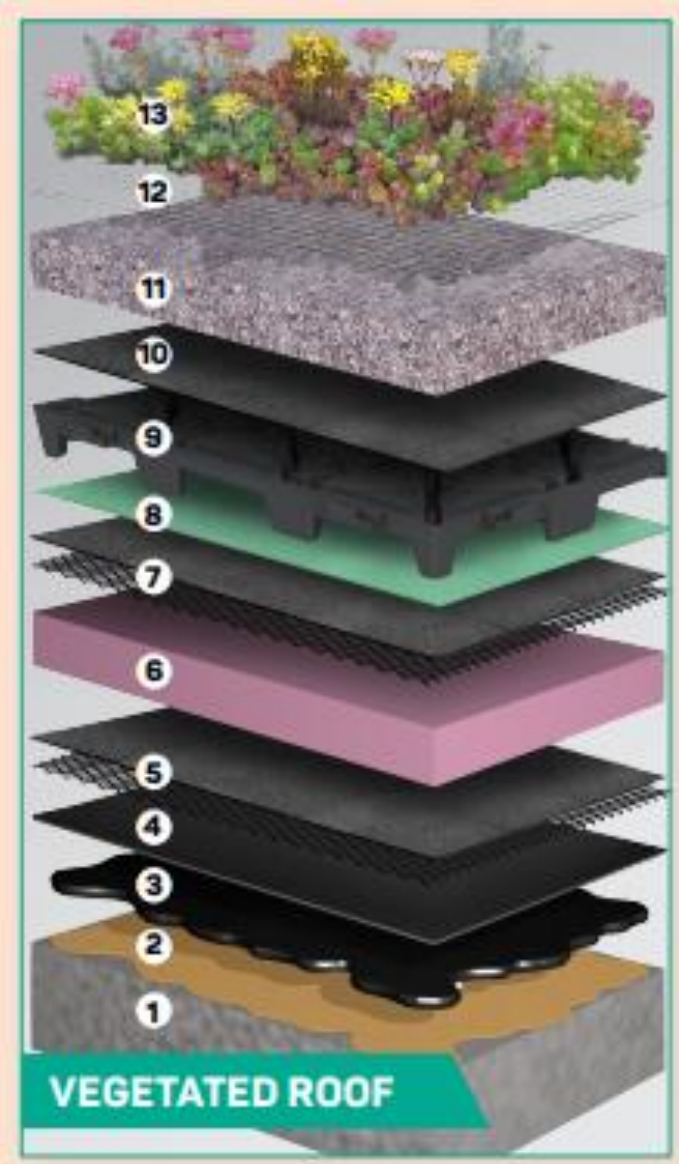
High Voltage Spark Testing “ST”

- Uses high voltage
- Does not require water - “Dry Testing”
- May be difficult to test new membranes as they are “sticky” when brooming
- Can test vertical areas
- Visible or spark sounds indicate voids in membrane
- Improper setting of equipment can damage the membrane

High Voltage Testing with Brooming Wand



Limitations of ELD With Overburden



1 Concrete substrate
2 Primer
3 TREMproof 6100 with embedded Tremco Reemay
4 Tremco-approved protection course & HDPE-40 Root Barrier
5 TREMDrain drainage board
6 Insulation
7 Drainage board (optional)
8 Air layer
9 Drainage / Retention tray
10 Filter fabric
11 Engineered growing media
12 Stabilization net
13 Vegetation

Hydrostatic Pressure Improves ELD

Wire Mesh Below Cover Board for EFVM™

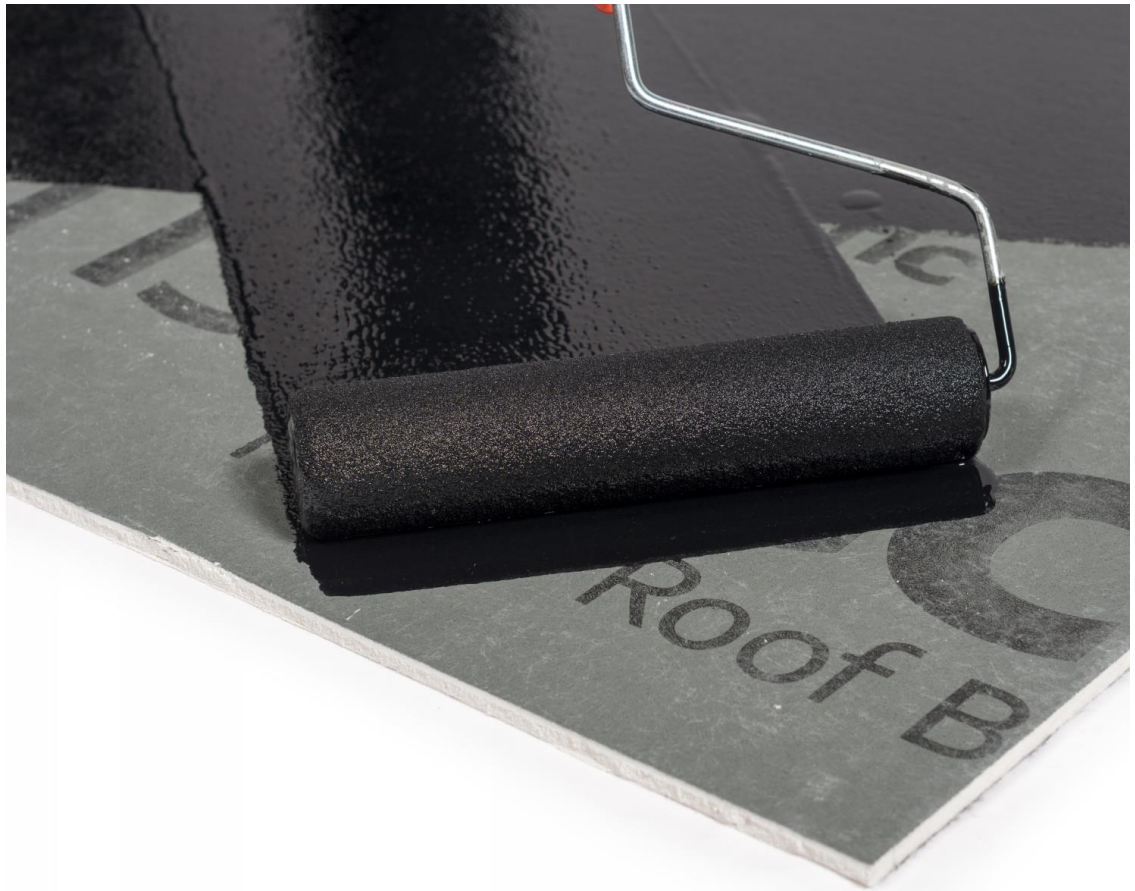
Low Voltage Horizontal Scanning

- Wire mesh below cover board not below membrane. Does not follow ASTM D7877.
- Moisture from waterproofing membrane void must migrate through cover board and come in contact wire mesh.
- Moisture could pass through the wire mesh opening(s) without contacting wire mesh.
- Does not test vertical flashings
- Cannot be applied to horizontal penetrations.

Conductive Substrate Primer for ELD

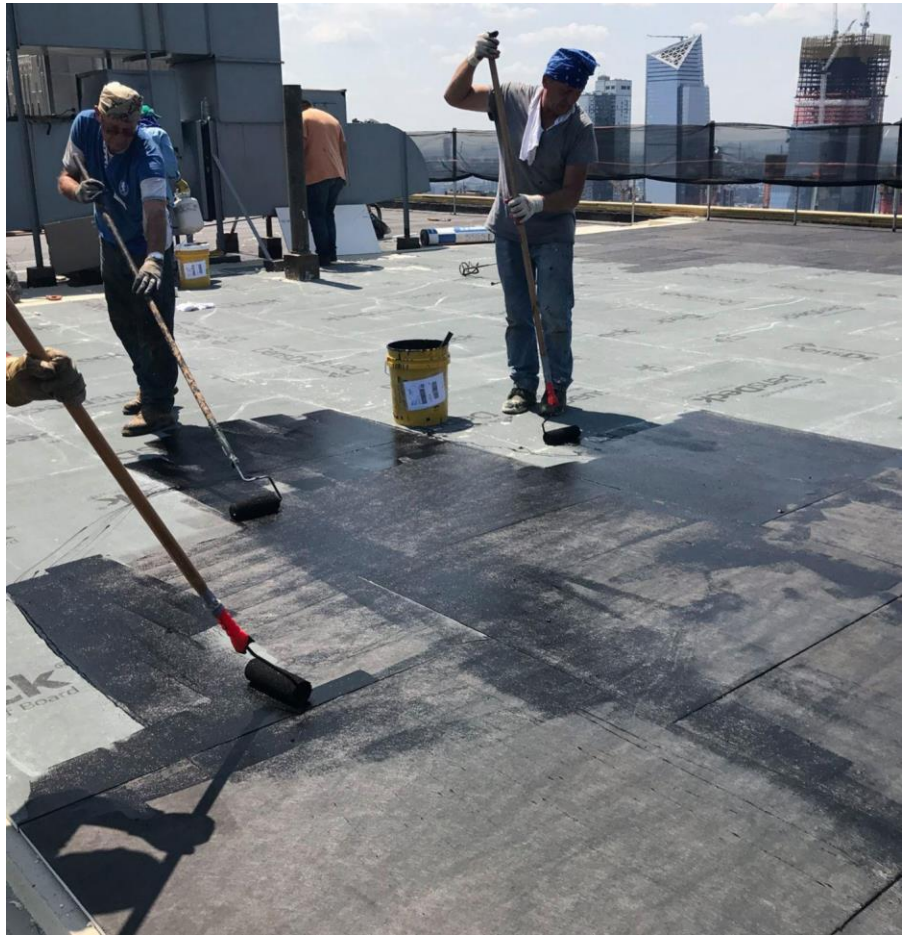
Low Voltage Horizontal Scanning

- Conductive primer applied to cover board directly below waterproofing membrane.
- Moisture cannot pass through assembly without contact with conductive primer.
- Conductive primer covers 100% of horizontal area.
- Can be applied to vertical area and penetrations.



Conductive Primer

- Meets ASTM Standard D7877
- Compatible with these membrane systems:
  - **PVC – TPO - EPDM**
    - Fully Adhered
    - Mechanically Attached
  - **Fluid Applied**
    - Elastomeric
    - Polyurea
  - **BUR - Modified Bitumen**
    - SBS & APP
    - Cap Sheet
    - Smooth Surface



Difference Between EFVM and ELD

EFVM

- Requires wire mesh
- Can be used under standing water
- Cannot use on vertical surfaces like parapet walls and base flashings
- Doesn’t test drain bowls and other penetrations

Electric Leak Detection (ELD)

- Does not require or incorporate wire mesh
- Except for concrete substrates, requires a conductive primer
- Can test vertical membranes and penetrations including the drain connection

Air Barrier Testing

Air Barrier Testing Uses

- New Construction
  - Evaluate Mock-ups
  - Determine whole building air leakage rates
  - Air leakage of individual units

- Existing Construction
  - Find sources of air leakage
  - Quantify air leakage
  - Monetize energy loss
  - Monetize potential energy savings
  - Justify capital improvements

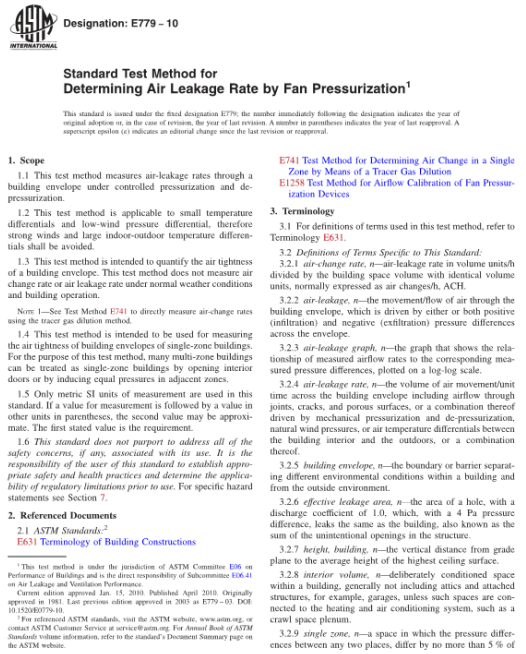
Air Barrier System Test Standards

- ASTM E779-10: Standard test method for determining air leakage rate by fan pressurization
- ASTM E1827-11: Standard test methods for determining airtightness of buildings using an orifice blower door
- ASTM E283-04: Standard test method for determining rate of air leakage through exterior windows, curtain walls, and doors under specified pressure differences across the specimen
- ASTM E1186: Standard practices for air leakage site detection in building envelopes and air barrier systems

Whole Building Test

- Based on the area of the air barrier surface = Effective Leakage Area
- Effective Leakage Area calculated by Architect
- Must use pressurization, but a combination of pressurization and depressurization recommended
- Requires planning, prep and building shut down

- ASTM E779 – Standard Test Method for Determining Air Leakage Rate by Fan Pressurization



Designation: E779 – 10

Standard Test Method for
Determining Air Leakage Rate by Fan Pressurization[1]

This standard is issued under the fixed designation E779; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method measures air-leakage rates through a building envelope under controlled pressurization and de-pressurization.

1.2 This test method is applicable to small temperature differentials and low-wind pressure differential, therefore strong winds and large indoor-outdoor temperature differentials shall be avoided.

1.3 This test method is intended to quantify the air tightness of a building envelope. This test method does not measure air change rate or air leakage rate under normal weather conditions and building operation.

NOTE 1—See Test Method E741 to directly measure air-change rates using the tracer gas dilution method.

1.4 This test method is intended to be used for measuring the air tightness of building envelopes of single-zone buildings. For the purpose of this test method, many multi-zone buildings can be treated as single-zone buildings by opening interior doors or by inducing equal pressures in adjacent zones.

1.5 Only metric SI units of measurement are used in this standard. If a value for measurement is followed by a value in other units in parentheses, the second value may be approximate. The first stated value is the requirement.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]
E631 Terminology of Building Constructions
E741 Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution
E1258 Test Method for Airflow Calibration of Fan Pressurization Devices

3. Terminology

3.1 For definitions of terms used in this test method, refer to Terminology E631.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *air-change rate, n*—air-leakage rate in volume units/h divided by the building space volume with identical volume units, normally expressed as air changes/h, ACH.

3.2.2 *air-leakage, n*—the movement/flow of air through the building envelope, which is driven by either or both positive (infiltration) and negative (exfiltration) pressure differences across the envelope.

3.2.3 *air-leakage graph, n*—the graph that shows the relationship of measured airflow rates to the corresponding measured pressure differences, plotted on a log-log scale.

3.2.4 *air-leakage rate, n*—the volume of air movement/unit time across the building envelope including airflow through joints, cracks, and porous surfaces, or a combination thereof driven by mechanical pressurization and de-pressurization, natural wind pressures, or air temperature differentials between the building interior and the outdoors, or a combination thereof.

3.2.5 *building envelope, n*—the boundary or barrier separating different environmental conditions within a building and from the outside environment.

3.2.6 *effective leakage area, n*—the area of a hole, with a discharge coefficient of 1.0, which, with a 4 Pa pressure difference, leaks the same as the building, also known as the sum of the unintentional openings in the structure.

3.2.7 *height, building, n*—the vertical distance from grade plane to the average height of the highest ceiling surface.

3.2.8 *interior volume, n*—deliberately conditioned space within a building, generally not including attics and attached structures, for example, garages, unless such spaces are connected to the heating and air conditioning system, such as a crawl space plenum.

3.2.9 *single zone, n*—a space in which the pressure differences between any two places, differ by no more than 5 % of

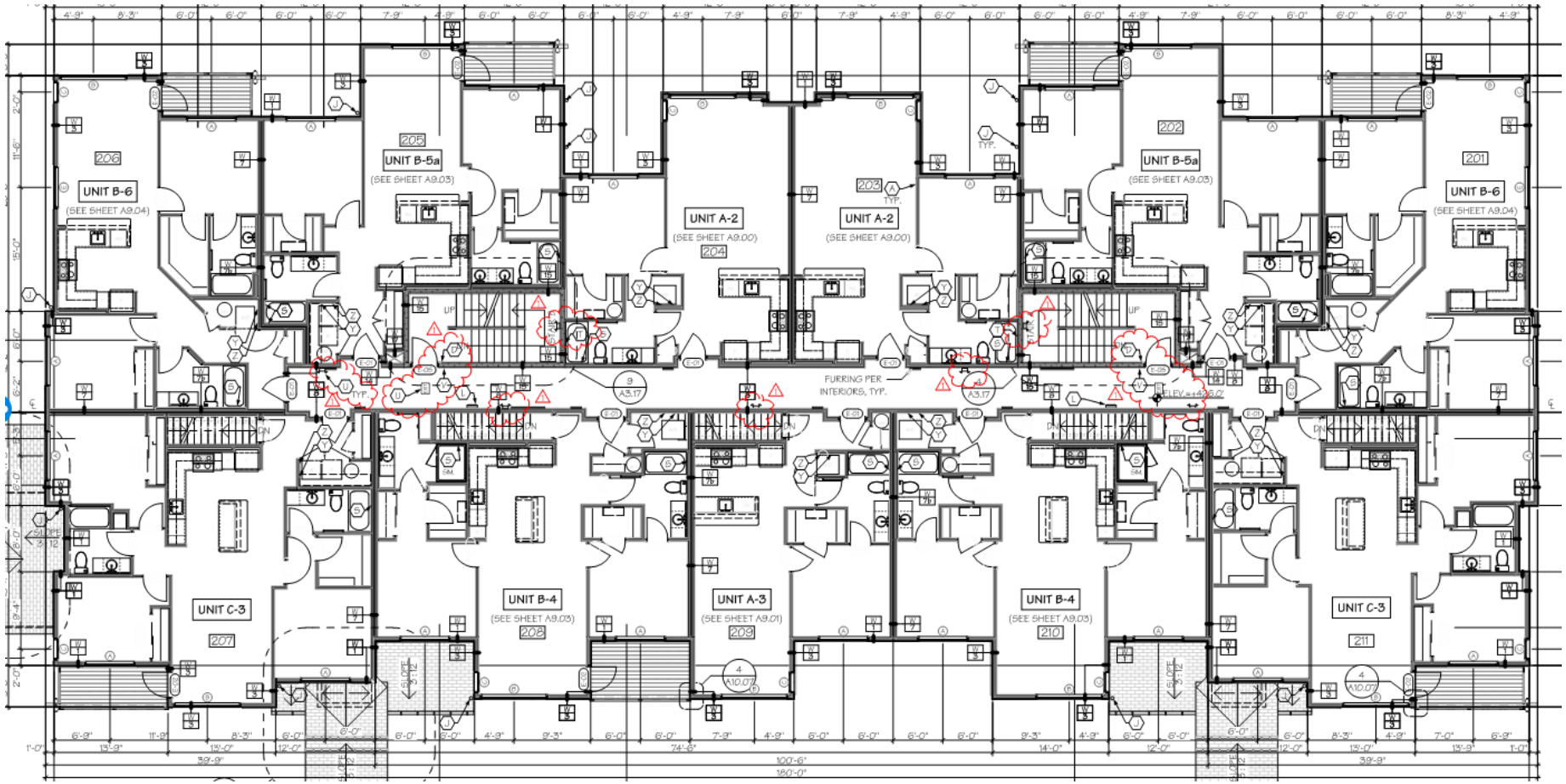
[1] This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.41 on Air Leakage and Ventilation Performance.
Current edition approved Jan. 15, 2010. Published April 2010. Originally approved in 1981. Last previous edition approved in 2003 as E779 – 03. DOI: 10.1520/E0779-10.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

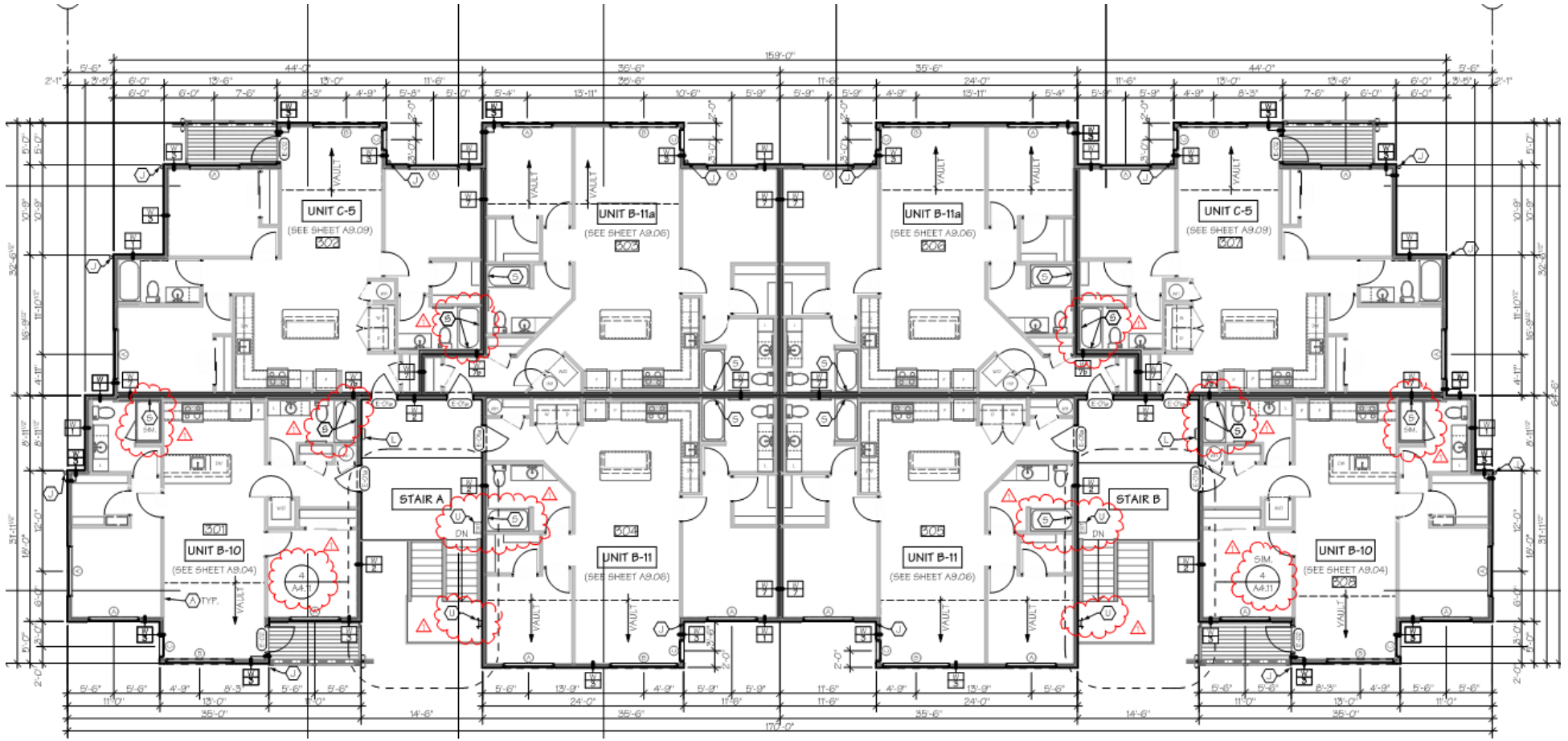
2015 IECC Whole Building Testing (Commercial)

- C402.4.1.2.3 – Building Test
- ASTM E 779
- Tested air leakage that does not exceed 0.40 cfm/ft2 at 75 Pa
- Report submitted to Building Official
- If exceeds limit – Visual Inspection of air barrier
- Seal leaks to extent practicable
- Additional report outlining corrective action completed

Conditioned Spaces Connected via (Interior Hallway)



Conditioned Spaces Not Connected (Walk-ups)



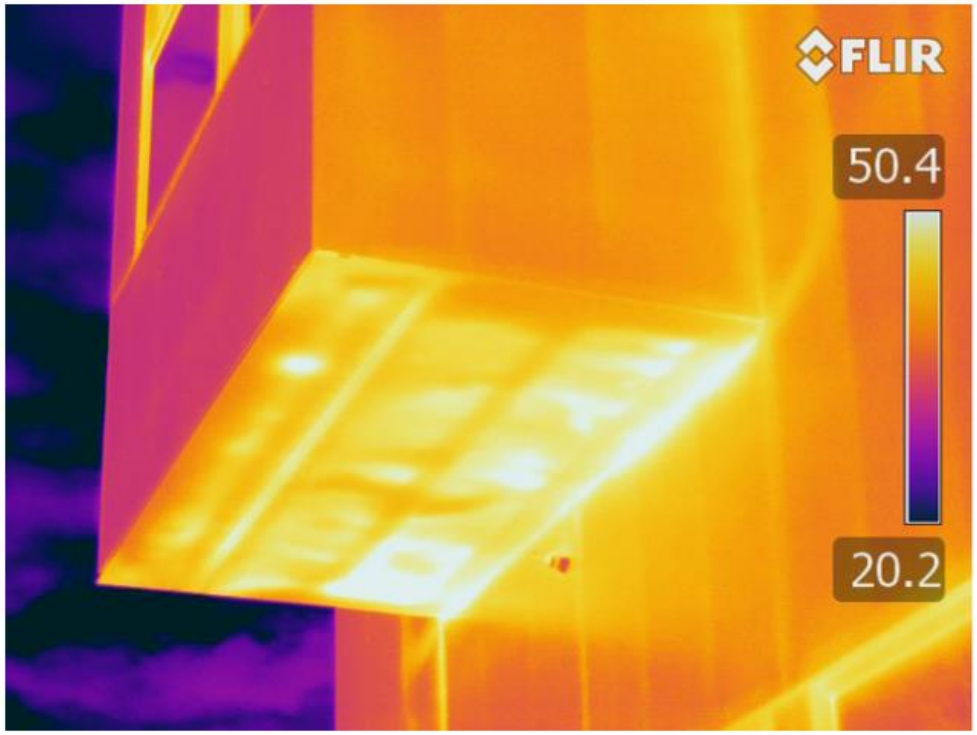
Preparation

Set Up

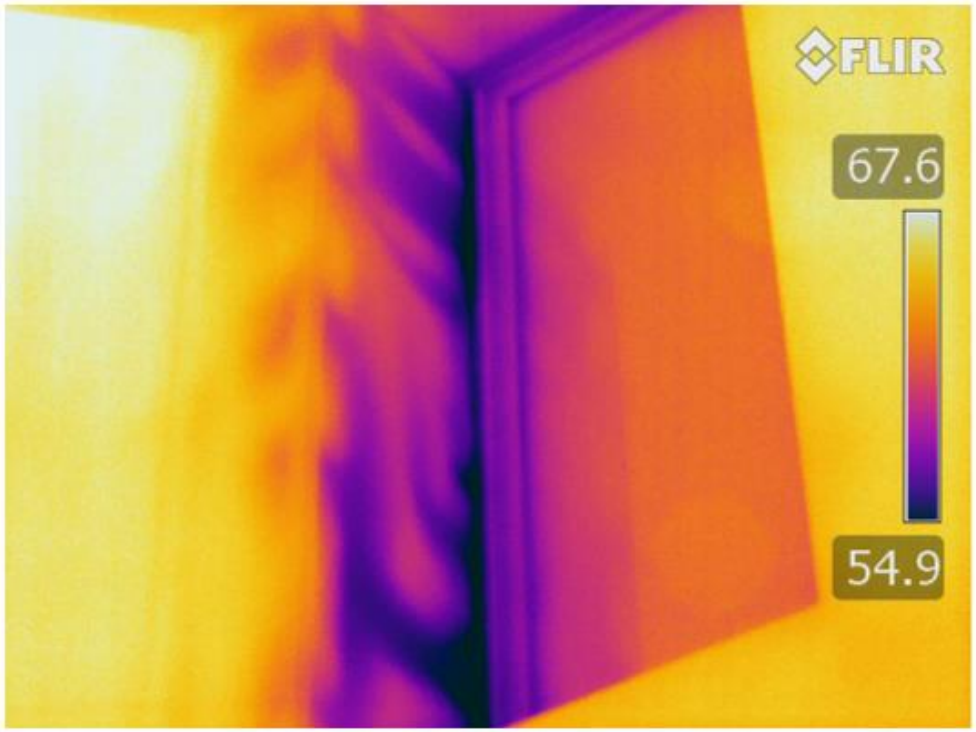
Identifying Air Leakage

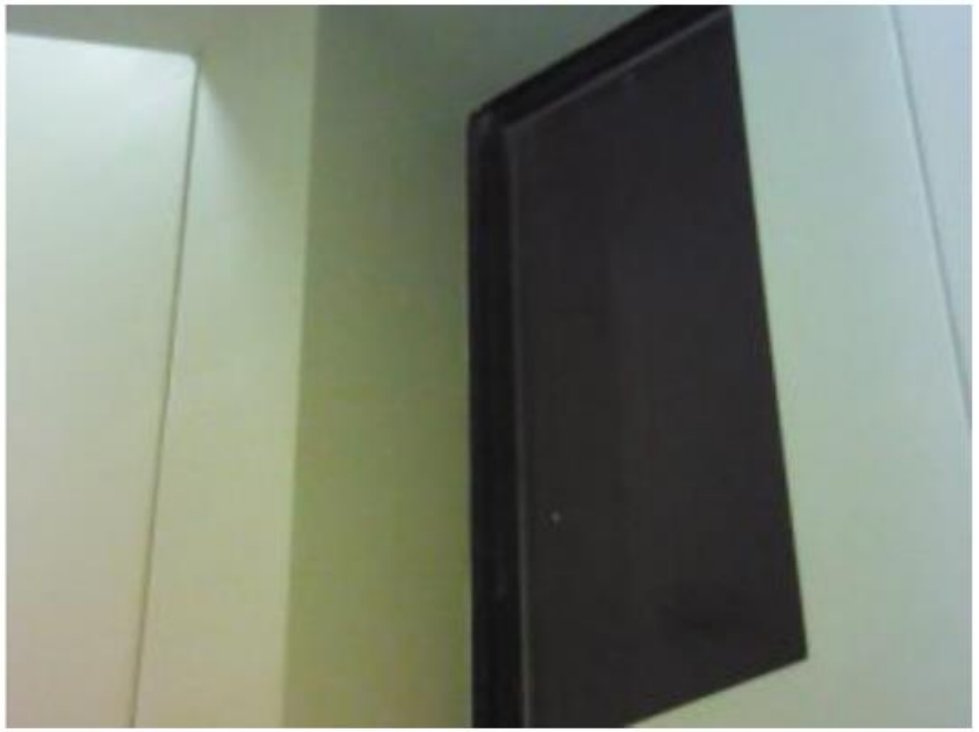
- ASTM E1186 – Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
- 4.2.1 Air Infiltration Site Detection Using Infrared Scanning
- 4.2.2 Smoke Tracers Used in Whole Building Pressurization or Depressurization
- 4.2.6 Smoke Tracers Used in Chamber Pressurization or Depressurization
- 4.2.7 Detection Liquid Air Testing

ASTM E1186 – 4.2.1 Positive Pressurization



ASTM E1186 – 4.2.1 Depressurization

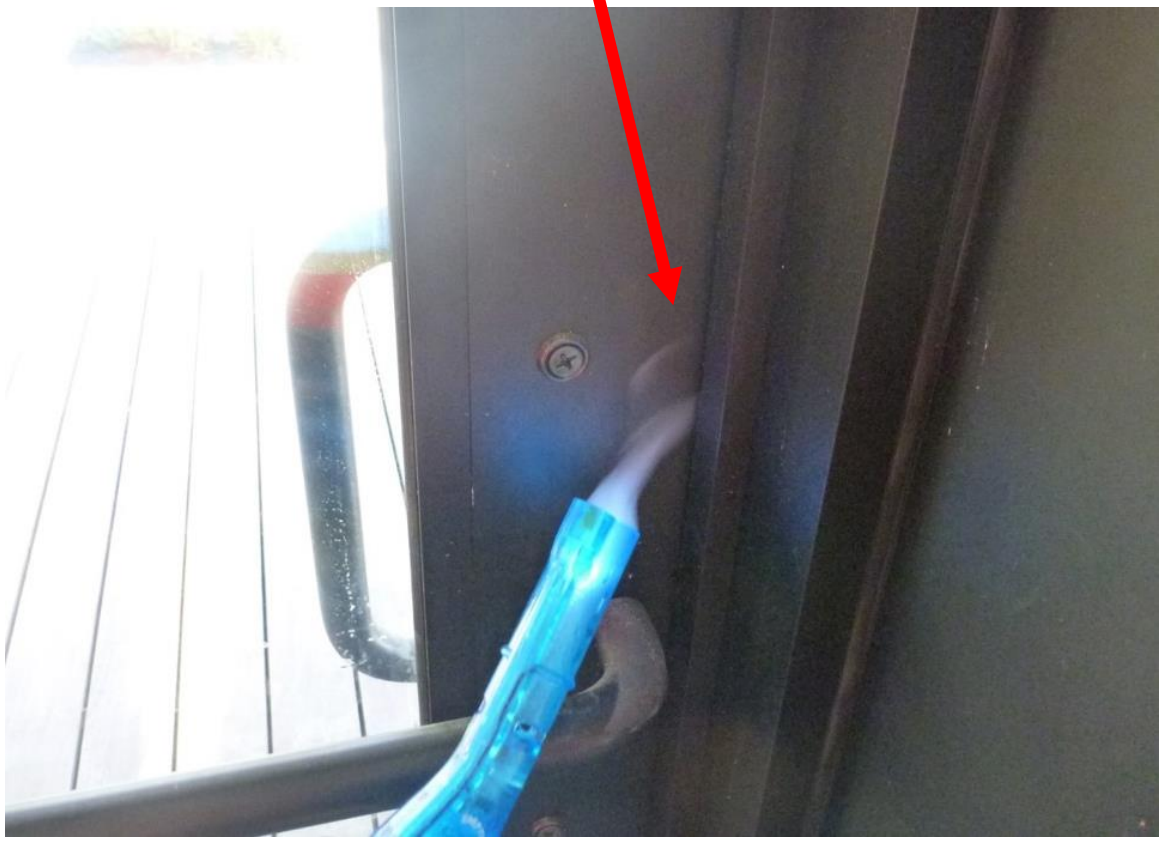




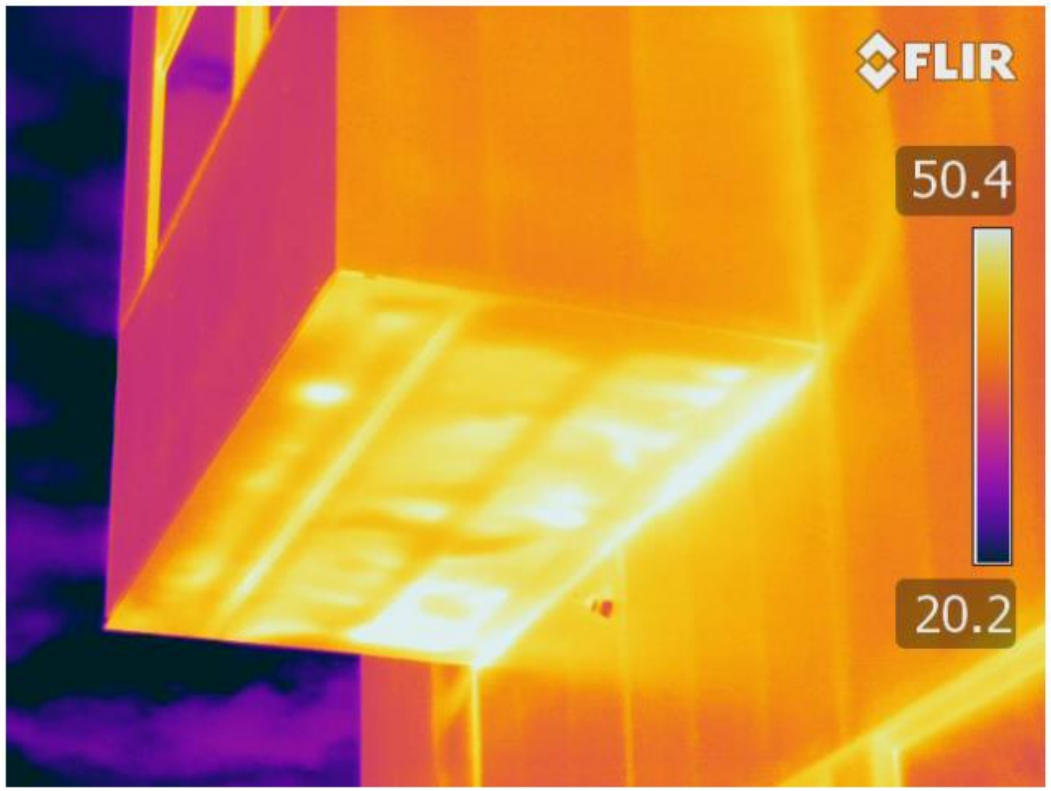
ASTM E1186 – 4.2.6 Smoke Tracers

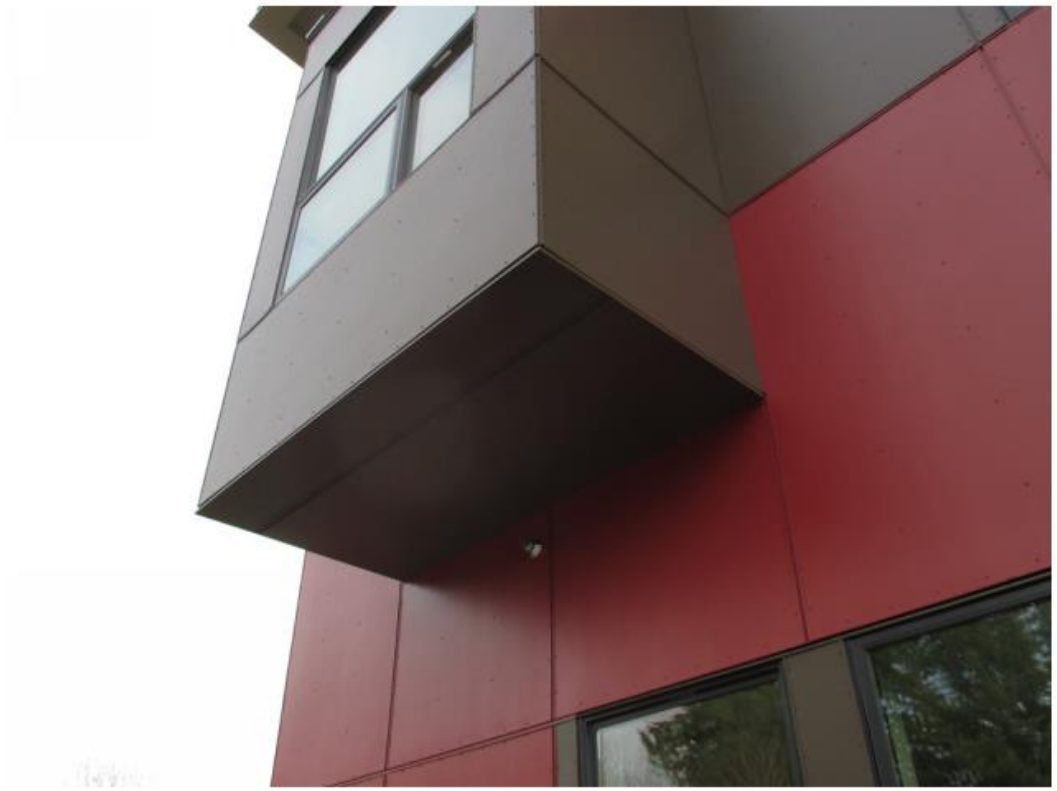
No Air Leakage

Air Leakage



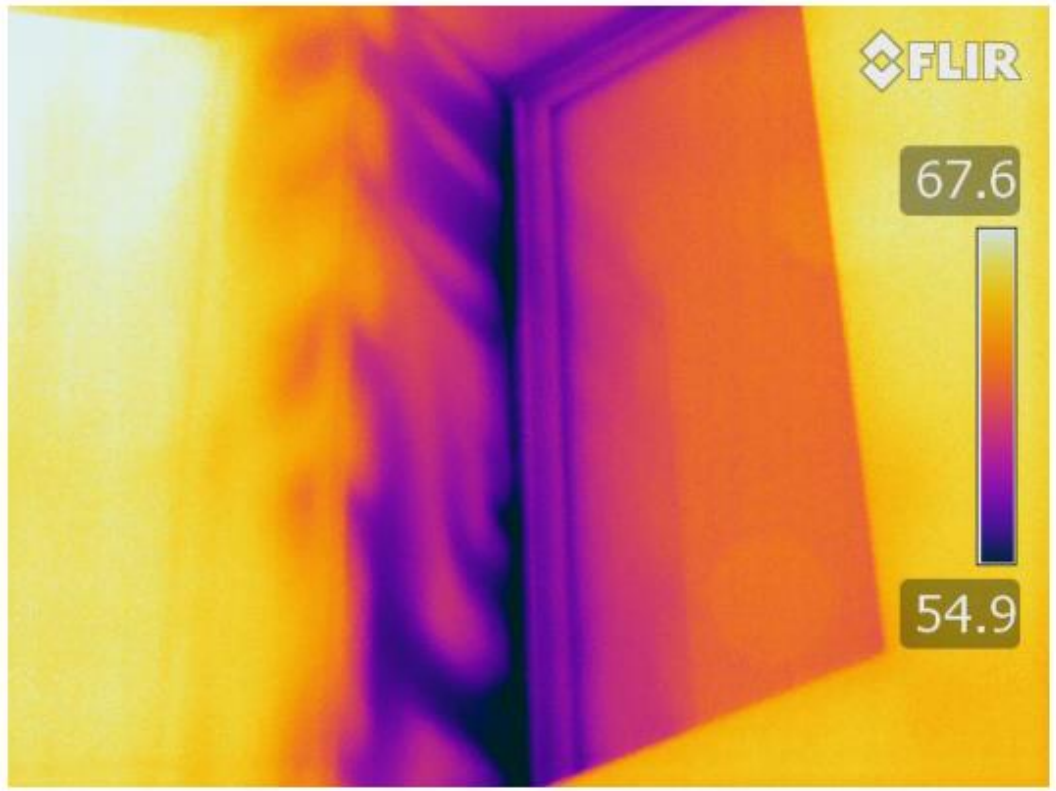
Thermal Camera – Positive Pressurization

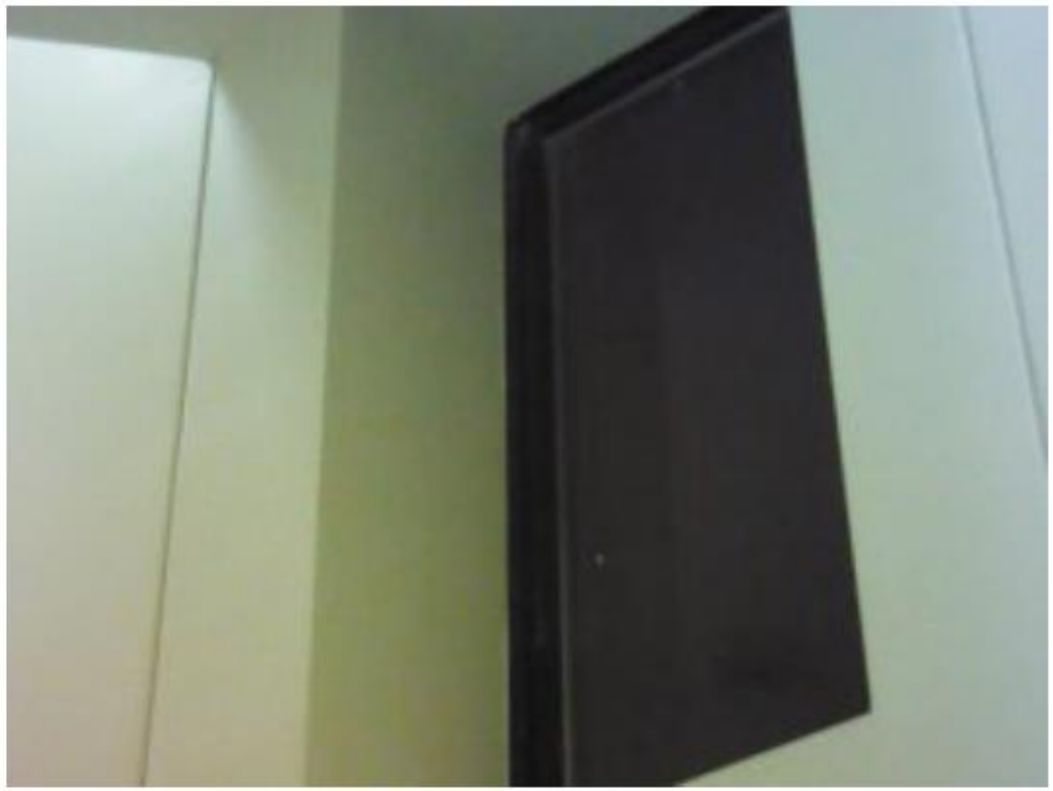




Looking at infra-red image from exterior side

Thermal Camera - Depressurization



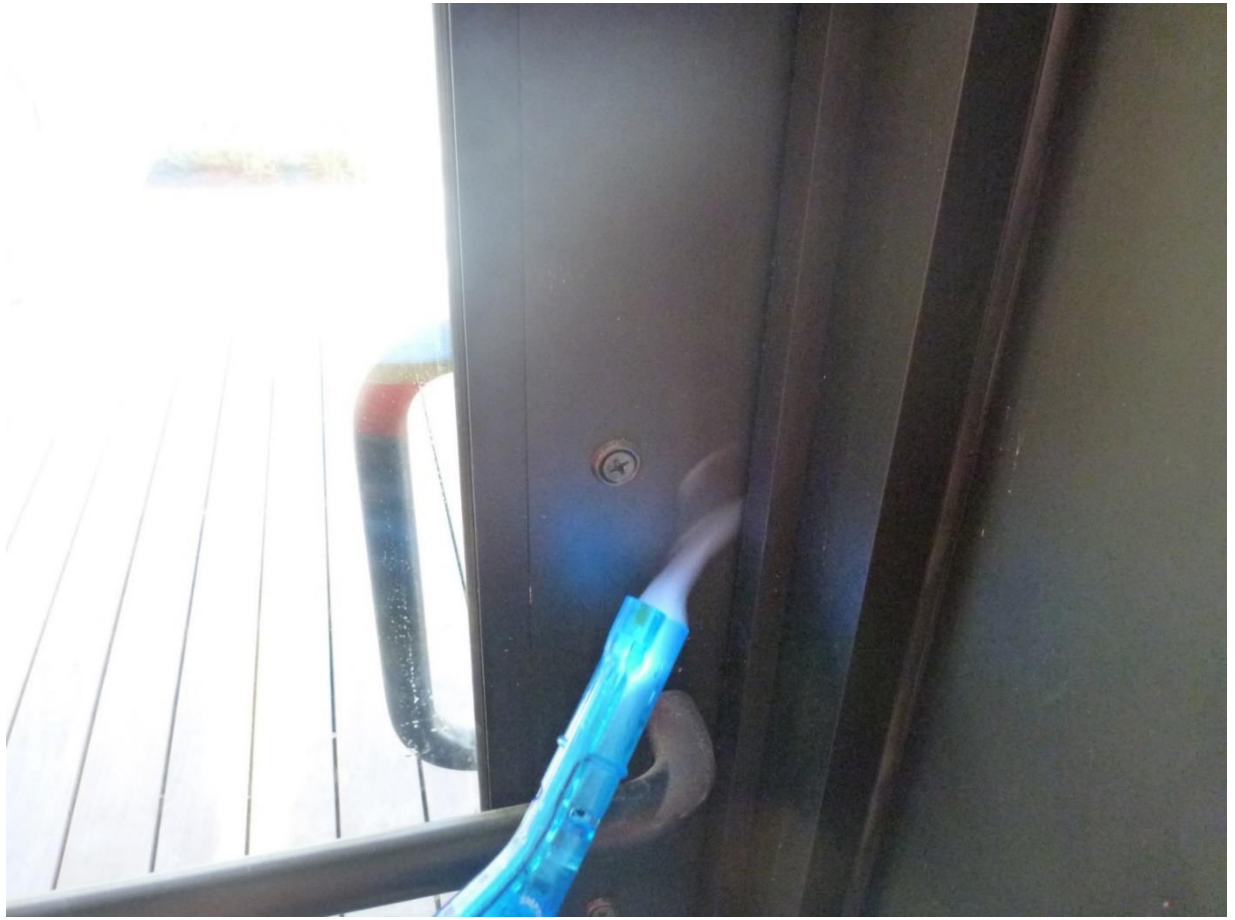


Looking at infra-red image from interior side

ASTM E779 Whole Building Fan Pressurization

ASTM E779 Whole Building Fan Pressurization

What Air Leakage Looks Like



Air leakage identified by tracer testing

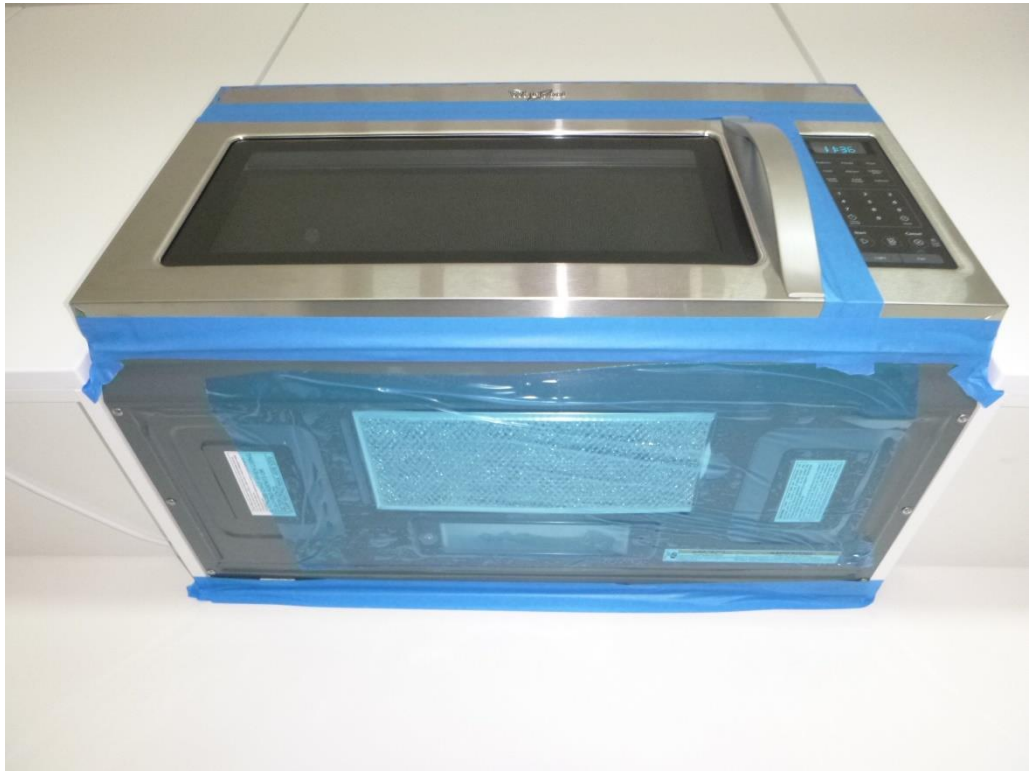
What No Air Leakage Looks Like

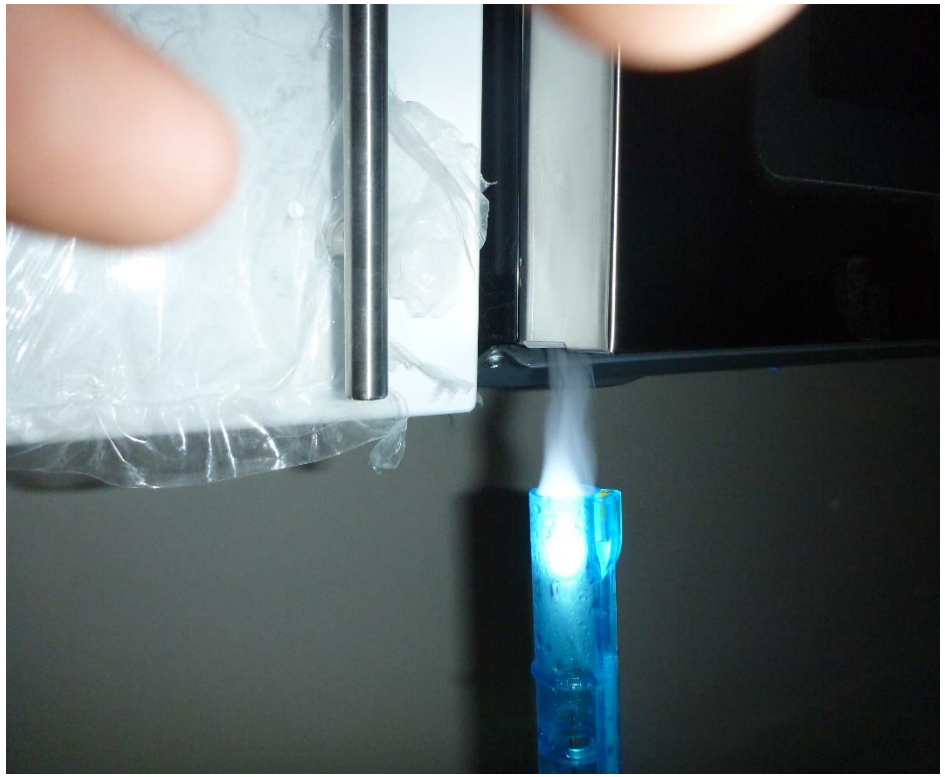
Tracer smoke test, no leakage

Exterior Air Barrier Breach

Fire Rated Assembly Breaches

Things that Make the Day Longer





Things that Make the Day Longer

Things that Make the Day Longer

When All Else Fails….

Questions and Answers

Thank You!

Karim Allana, PE, RRC, RWC
karim@abbae.com