Summary of Electronic Leak Detection (ELD)

ELD is primarily used as a quality control test in new roofing and waterproofing applications

What is Electronic Leak Detection (ELD)?

ELD is a Quality Control Test and Active Leak Locating Tool

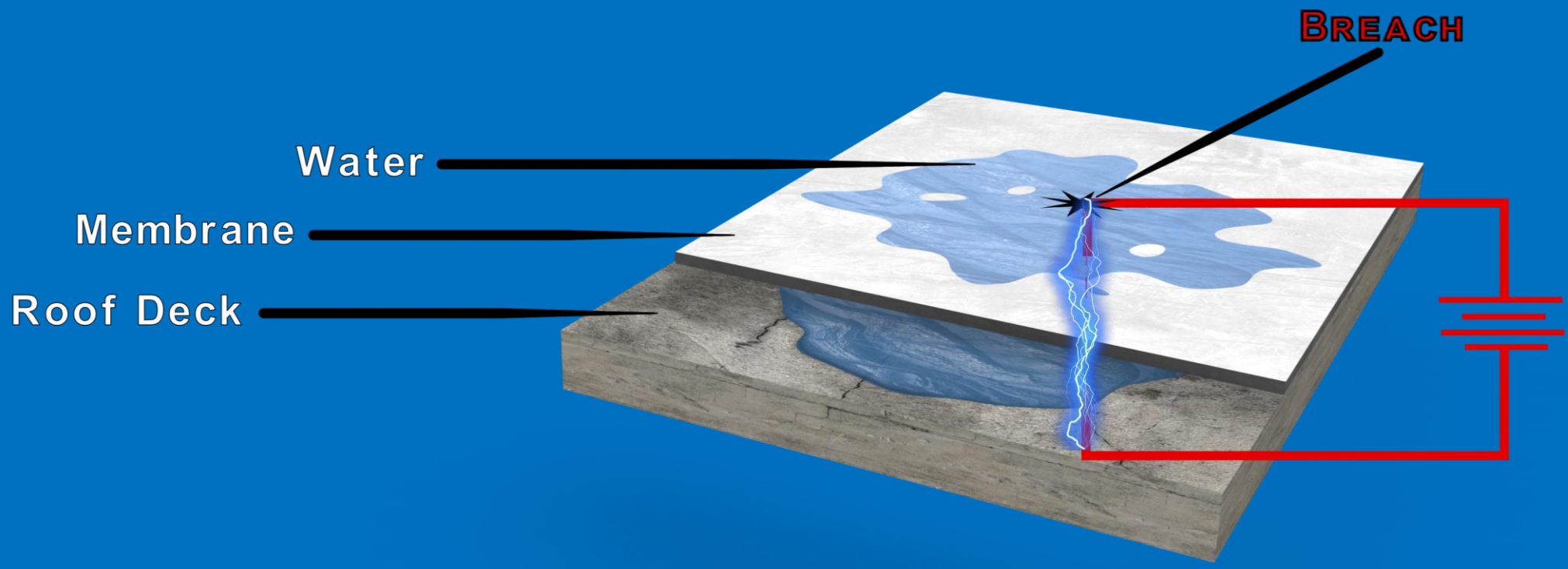
- ELD pinpoints breaches, holes and seam voids in roofing and waterproofing membranes
  - Breach: A defect in the membrane that allows surface water to reach the substrate below
  - Leak: Any unintended opening through an installed membrane which may allow the passage of liquid.
- ELD is typically performed in new construction
- ELD is often also referred to as:
  - Low/High Voltage Integrity Testing (LVIT or HVIT)
  - Membrane Integrity Survey
  - Electronic Breach Detection
  - Electronic Testing
  - Electrical Conductance Testing

Why is ELD beneficial?

ELD Provides Risk Mitigation and Loss Control

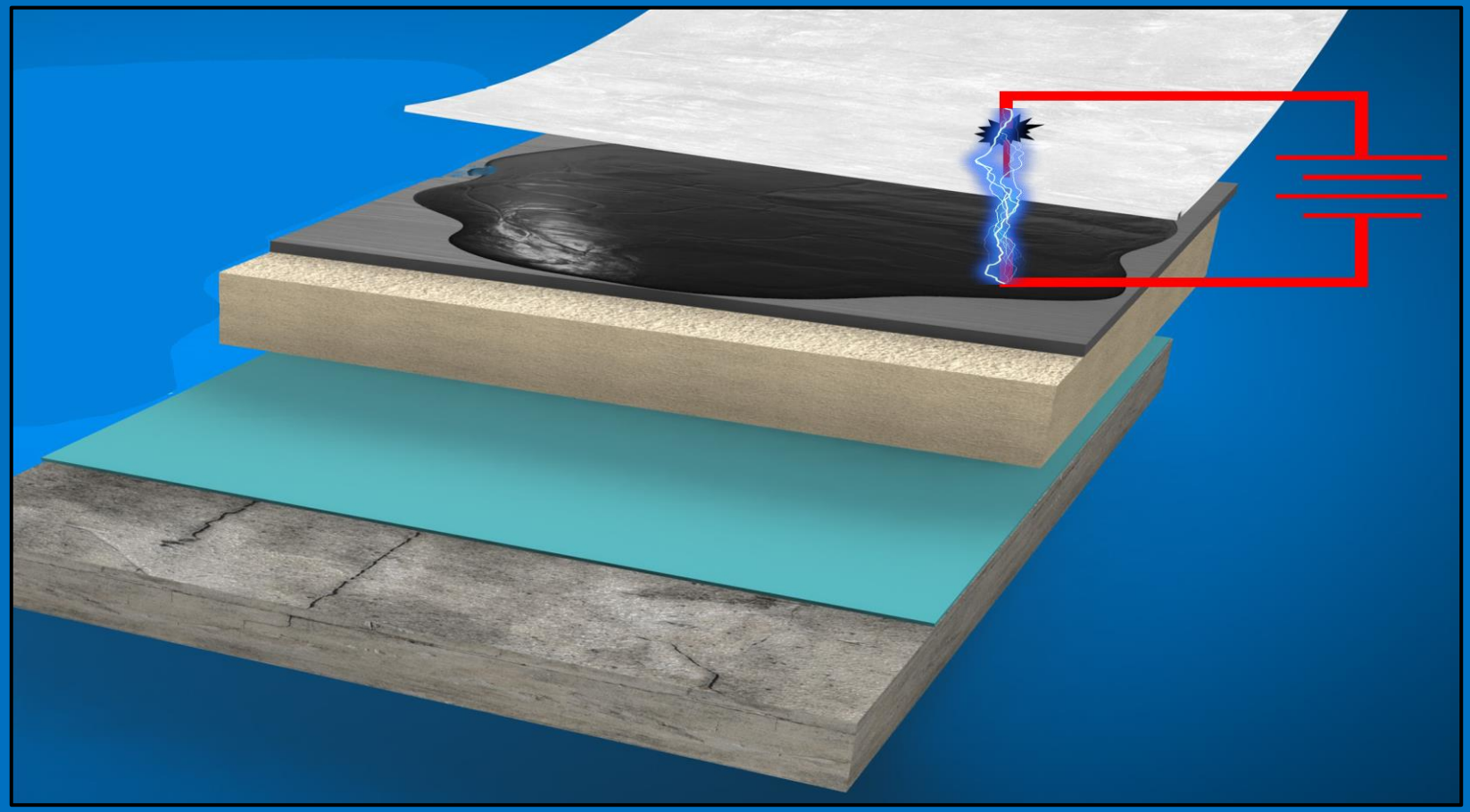
- ELD pinpoints the source of hidden moisture intrusion BEFORE costly damage occurs (QC)
- ELD locates damage caused by trades and improper membrane installations
- ELD assists with finding membrane damage in existing buildings (forensics)
- ELD can be performed for the life of the membrane
- ELD benefits the building owner by reducing insurance claims and consequential damages
    - 70% of construction litigation is caused from water intrusion
    - Common causes of roof failure:
        - Improper installation / trade damage
        - Design issues
        - Materials
        - Lack of maintenance

Physics of Leak Detection - Waterproofing



ELD applies an electrical current to the top of an exposed membrane. The electrical current must flow through the breach and touch an electrically grounded substrate, such as structural concrete.

Physics of Leak Detection - Roofing



ELD applies an electrical current to the top of an exposed membrane. The electrical current must flow through the breach and touch an electrically conductive medium, such as a conductive primer.

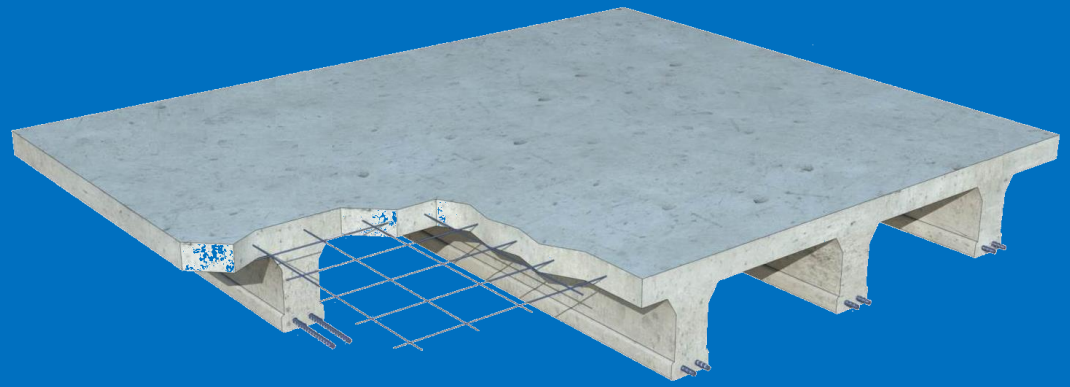
ASTM Standards

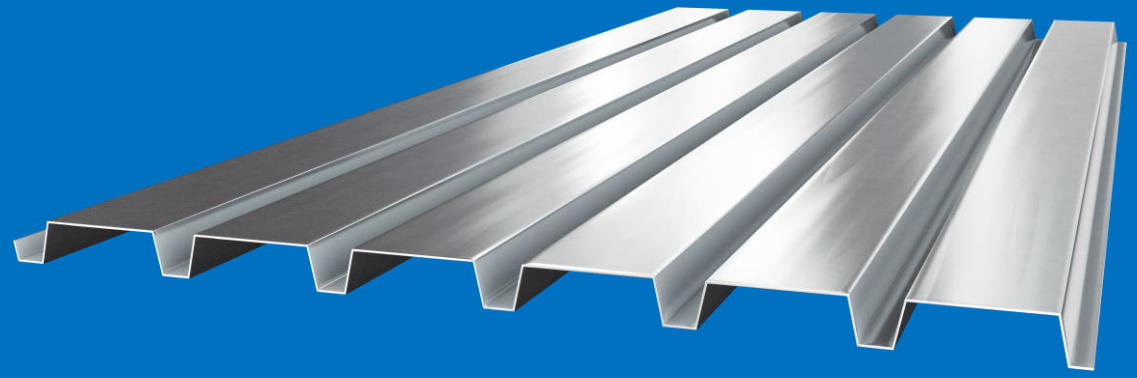
- D7877- Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes (2014)
  - Low Voltage Scanning Platform
  - Low Voltage Electric Field Vector Mapping
  - Low Voltage Vertical Roller
  - High Voltage Spark/Holiday Testing

- D8231- Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes (2019)
  - Low Voltage Scanning Platform
  - Low Voltage Vertical Roller

ELD Basic Requirements

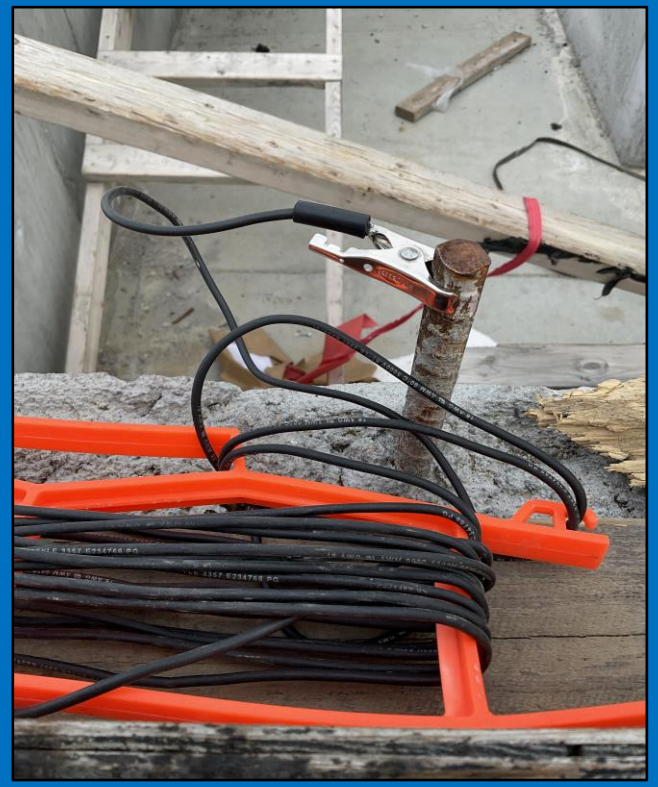
- A conductive substrate directly below the membrane

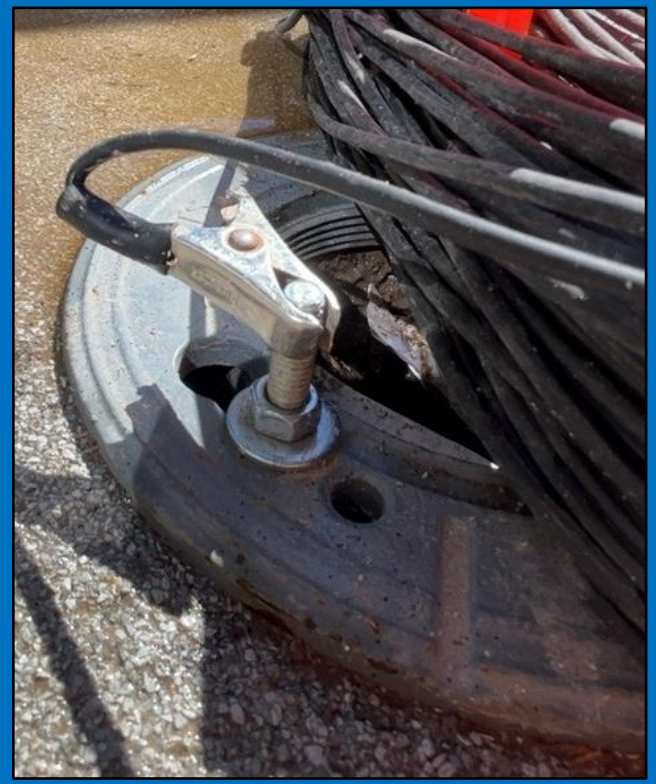


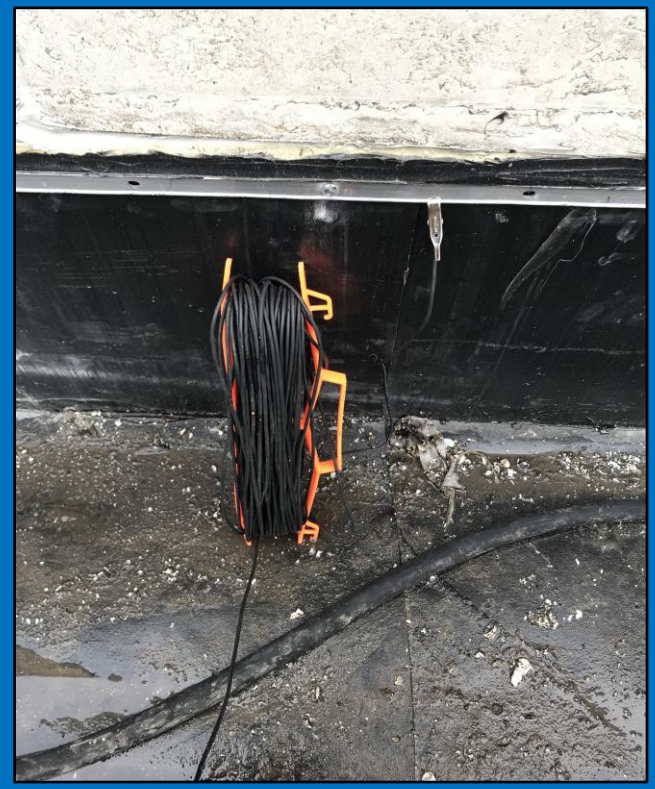


ELD Basic Requirements

- A ground connection to the conductive substrate

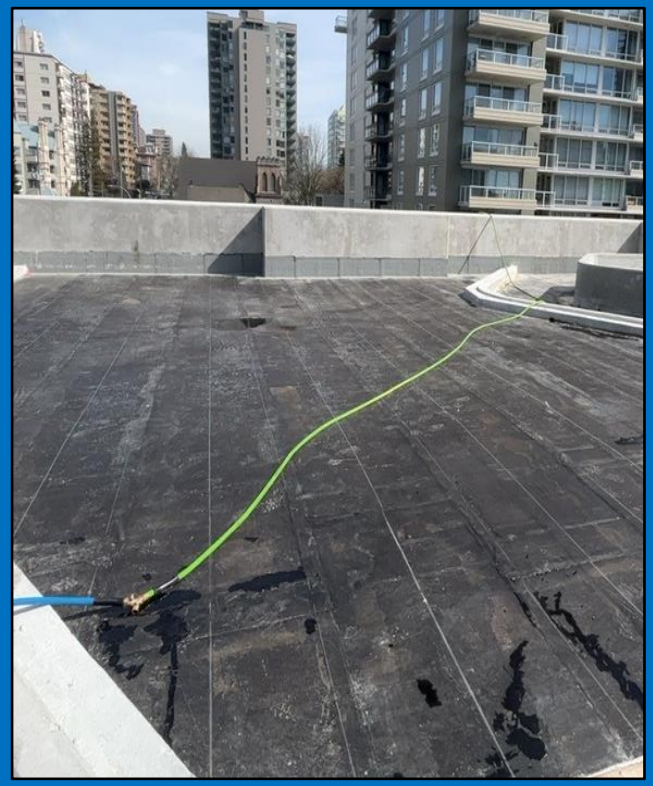


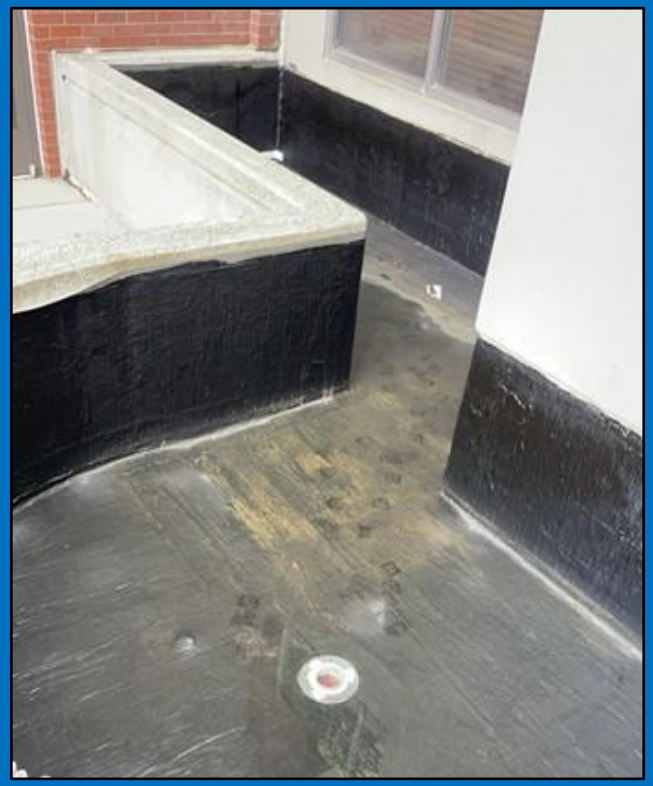




ELD Basic Requirements

- An exposed membrane (no overburden)



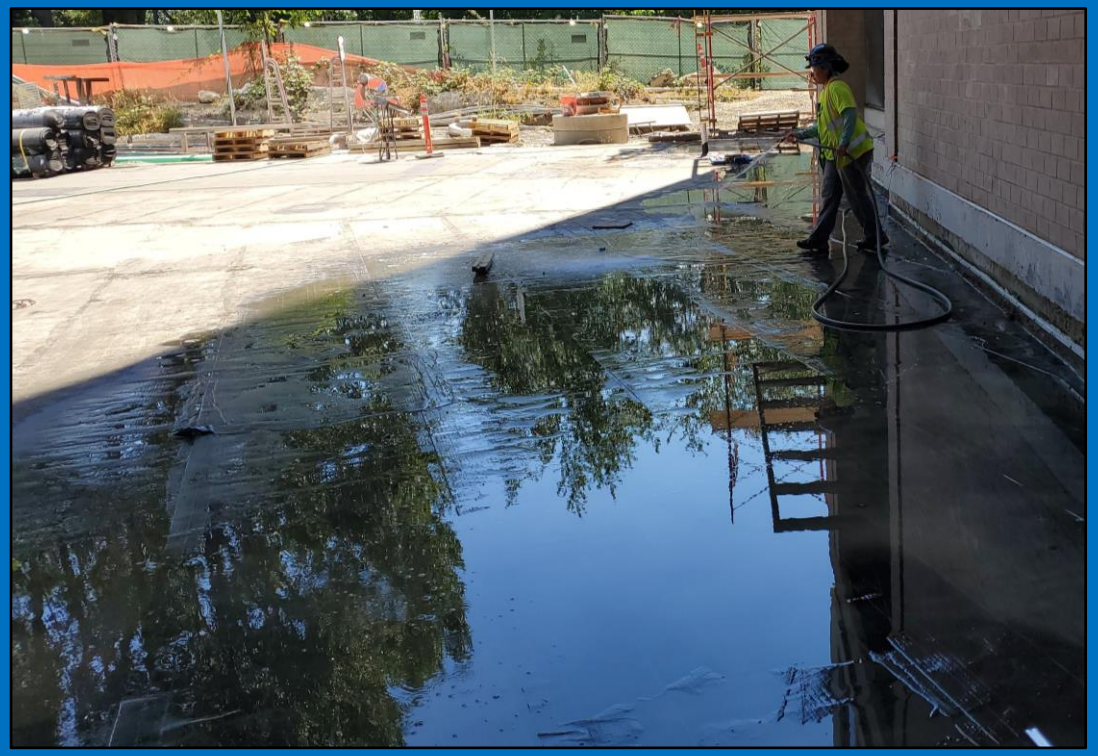


ELD Basic Requirements

- An exposed membrane (no staged materials/trash)

ELD Basic Requirements

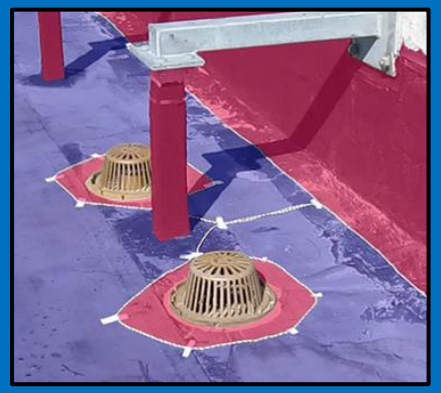
- An electrical path from the surface of the membrane to the conductive substrate



High Voltage

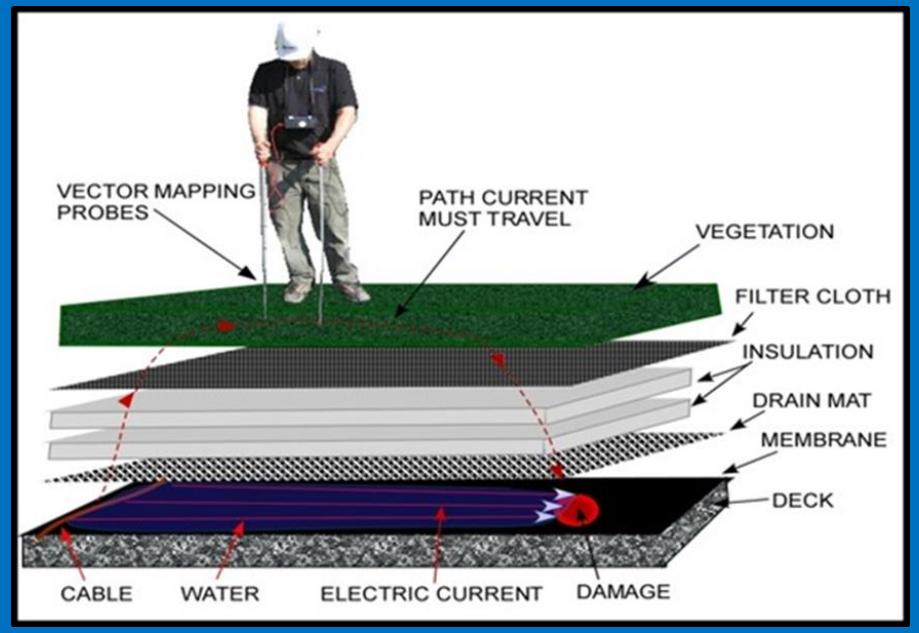
- ASTM D7877, Section 9
- Testing must be performed in dry conditions
- Operator must adjust voltage in accordance with membrane thickness
  - If voltage is set too high, equipment can burn a hole in the membrane
  - If voltage is set too low, equipment can miss breaches
- Can fail to detect seam voids (requires a direct vertical air gap)
- Requires a non-conductive membrane
  - Unable to test semi-conductive membranes such as Black EPDM

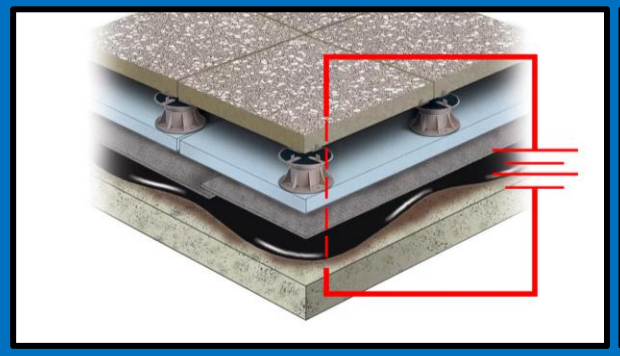
Vector Mapping

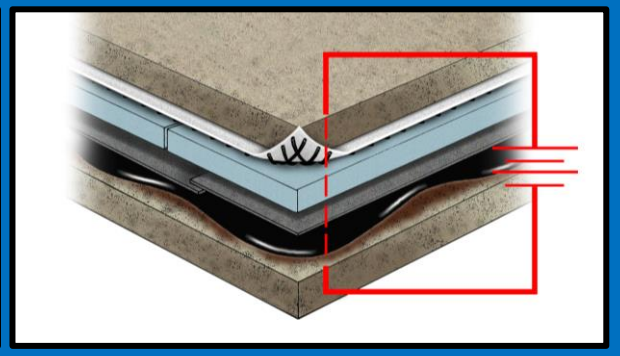


- ASTM D7877, Section 7
- Testing area must be isolated with a perimeter wire (charged with 40 volts) and all grounded penetrations must be isolated
  - Unable to test transitions, details or around penetrations
- Requires a continuous layer of water on the membrane within the perimeter wire
  - A gap in water coverage can result in missed breaches
- Using probes, electronics point towards a drop in voltage
  - Sees the sum of the entire area at once
- Unable to reliably test vertical surfaces
- Requires a non-conductive membrane
  - Unable to test semi-conductive membranes such as Black EPDM

Vector Mapping Through Overburden (Invalid ELD)

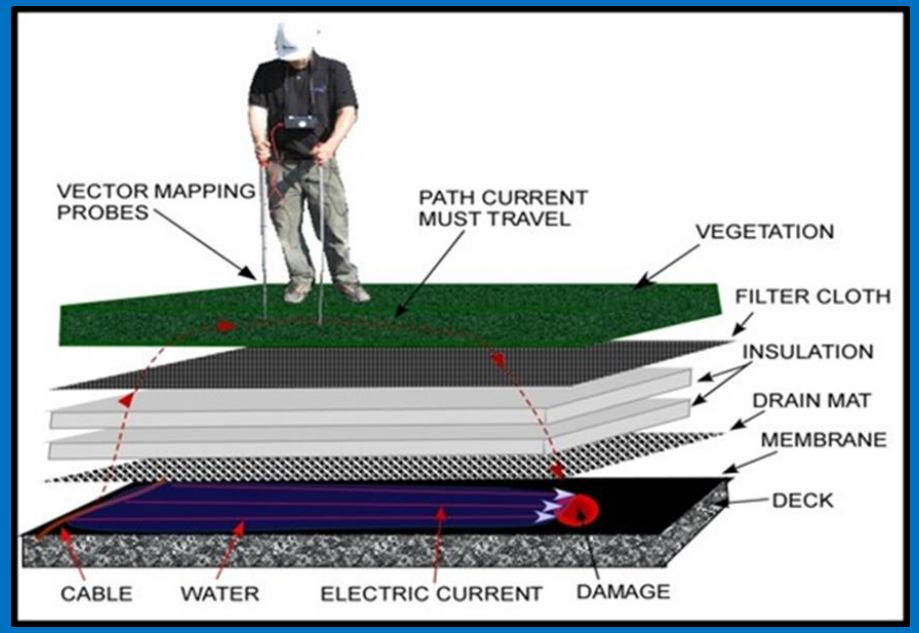


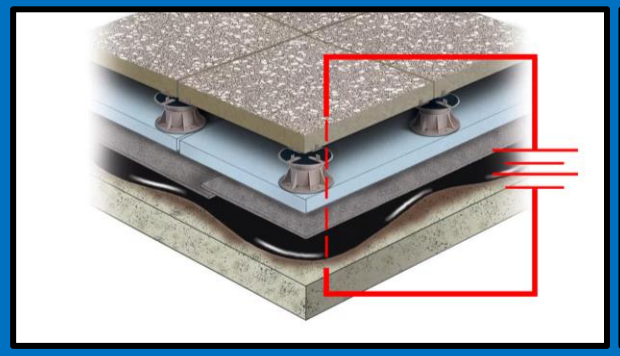


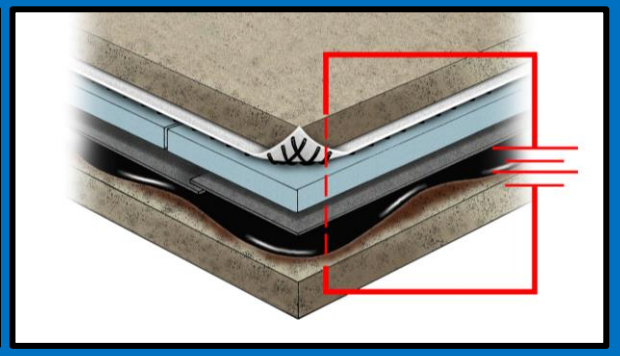


- ASTM D7877, Section 7.5
- Electrically insulating layers above the membrane (i.e., drain mat, root barrier, insulation) will interrupt the electrical path
  - Testing through overburden is invalid and unreliable as it requires a continuous water path from the top of the overburden, to the membrane, and a direct electrical current (water path) to each breach.
- Unable to test through an electrically conductive topping slab
- Pavers on pedestals have an air gap which blocks the electrical path

Vector Mapping Through Overburden (Invalid ELD)







- "There is no known commercial technology existing that will detect and locate a flaw in a membrane under a layer of overburden." Buckleys

Scanning Platform

- ASTM D7877, Section 6
- ASTM D8231, Section 6
- Testing area must be wet
- Unable to test vertical surfaces
- Capable of testing both non-conductive and semi-conductive membranes, such as Black EPDM
- FM Approved

Vertical Roller

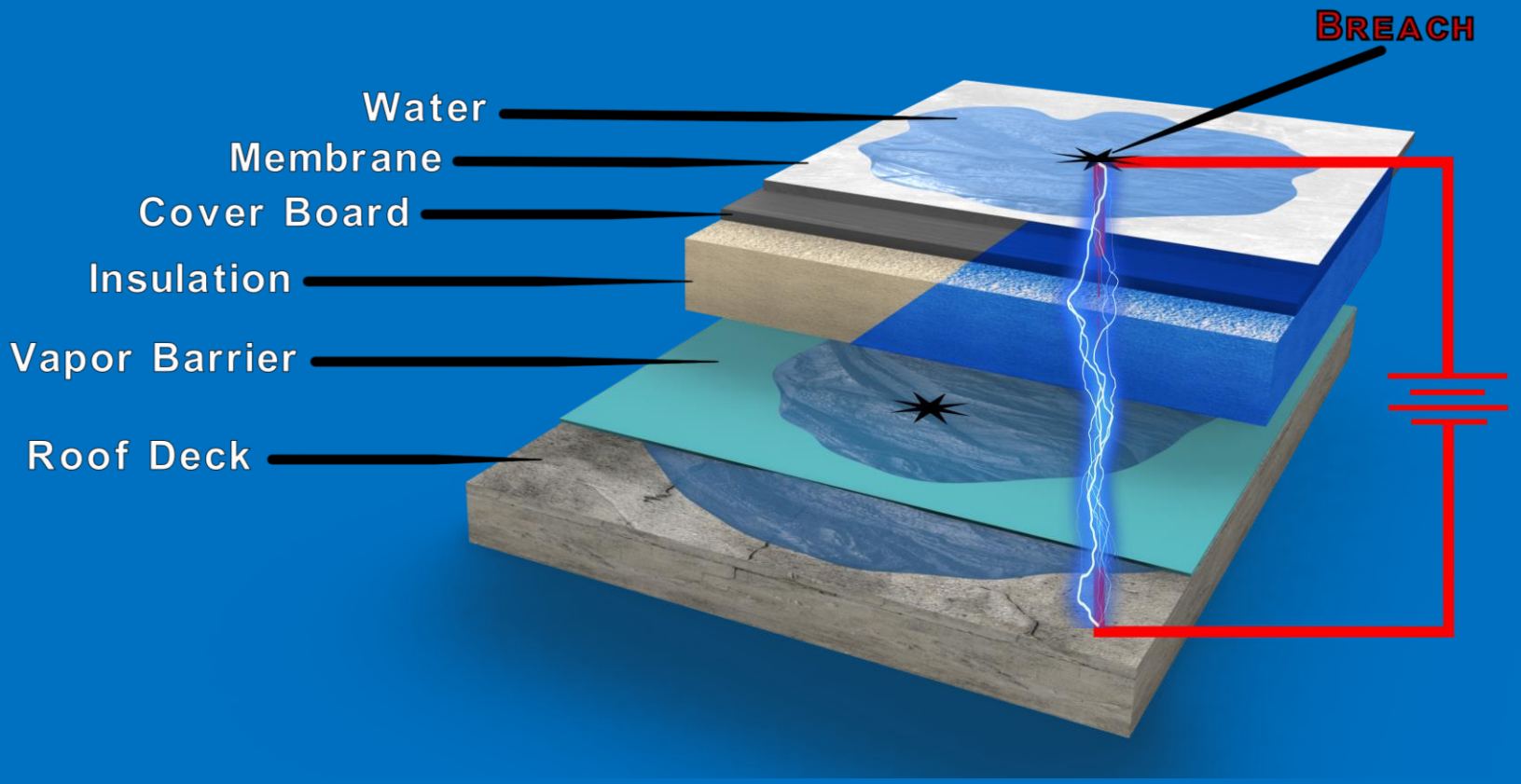
- ASTM D7877, Section 8
- ASTM D8231, Section 7
- Roller must be wet
- Used for testing verticals, transitions, details and small horizontals
- Requires a non-conductive membrane
  - Unable to test semi-conductive membranes such as Black EPDM
- FM Approved

	Vector Mapping	High Voltage	Scanning Platform	Vertical Roller
COMPARE				
Tests Inverted Assemblies	✓	✓	✓	✓
Tests Conventional Assemblies	✓	✓	✓	✓
Tests in Dry Conditions	✗	✓	✗	✗
Tests in Wet Conditions	✓	✗	✓	✓
Pinpoints Breaches	✓	✓	✓	✓
Tests Horizontals	✓	✓	✓	✓
Tests Verticals, Transitions & Details	✗	✓	✗	✓
Time Efficient	✗	✓	✓	✓
Good for Seam Void Detection	✓	✗	✓	✓
Tests Conductive Membranes	✗	✗	✓	✗
FM Approved	✗	✗	✓	✓

Specification Tips – ELD testing

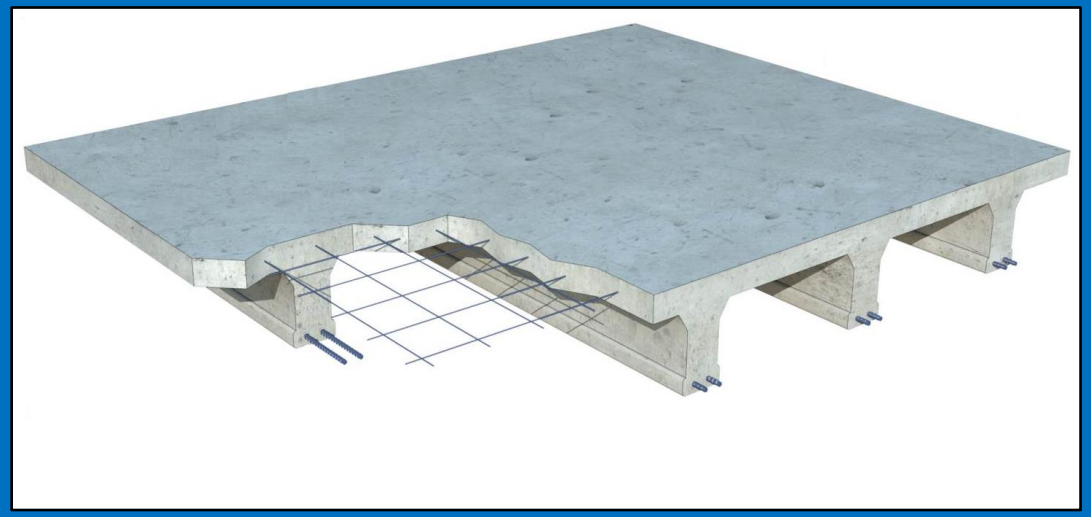
- Electronic Leak Detection (ELD) is almost always specified in the field quality control section in division 07
  - Language should be generic: “Area shall be leak tested by means of Electronic Leak Detection (ELD) per ASTM Guide D7877 and ASTM Practice D8231”
  - Include when the test is to be performed: “ELD testing is to be performed immediately prior to the placement of overburden”
- Conventional roofing requires additional language for adding a conductive medium to enable ELD
- Black EPDM specs should only call for testing using the scanning platform method
  - “Area shall be ELD tested by means of the low voltage scanning platform in accordance with ASTM D8231”
- Only the scanning platform and vertical roller are FM approved ELD testing methods

Forensic Electronic Leak Detection Testing

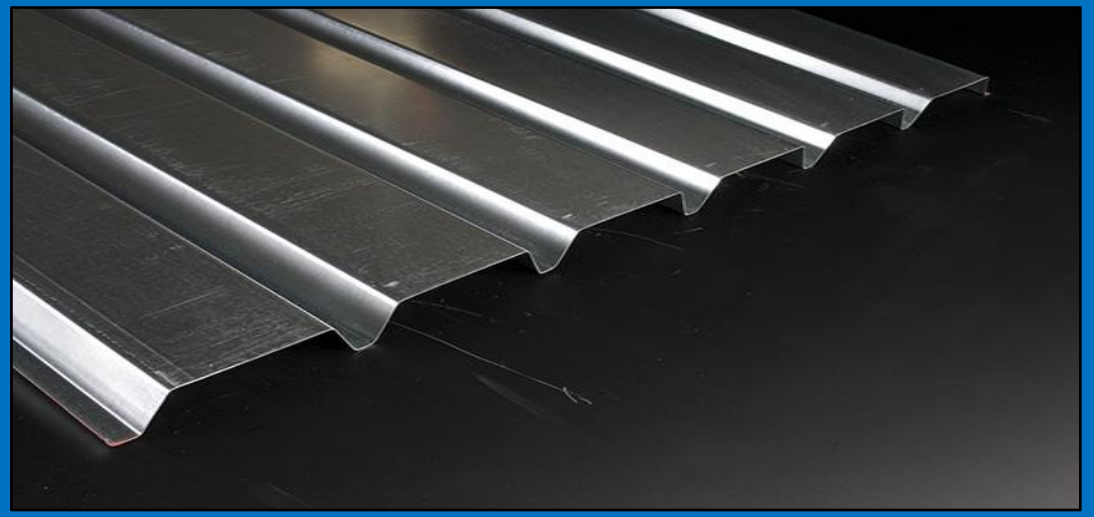


ELD can be used to locate active leaks. Testing will require a conductive deck (concrete or metal), and a water path from the breach to the conductive deck.

Electrically Conductive Substrates



Structural Concrete



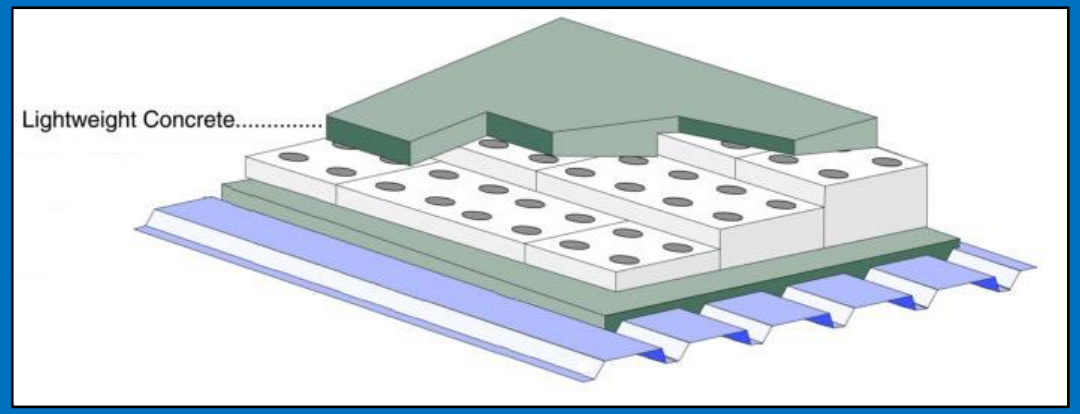
Metal

In new construction, ELD requires a conductive substrate to be located directly below the membrane.

Electrically Insulating Substrates

Requires the addition of a conductive medium to enable ELD

- Coverboard
- Insulation
- Wood
- Lightweight Concrete/LWIC



ASTM D7877 Section 4.4: In roof assemblies where the membrane is installed over electrically insulating materials 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.

Conductive Primer

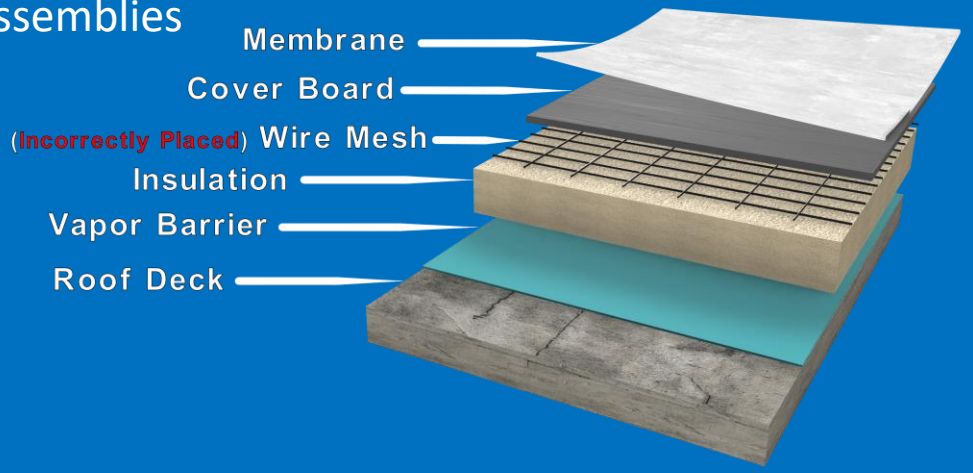
- Tested and approved by membrane manufacturers
  - Utilized on:
    - Fully-adhered
    - Torch down
    - Mechanically fastened
    - Fluid applied
    - Loosely laid assemblies
- UL listed
- FM approved

Conductive Felt

- Issues with adhesion
  - Utilized on:
    - Mechanically fastened
    - Loosely laid assemblies

Conductive Mesh or Grid / Grounding Screen

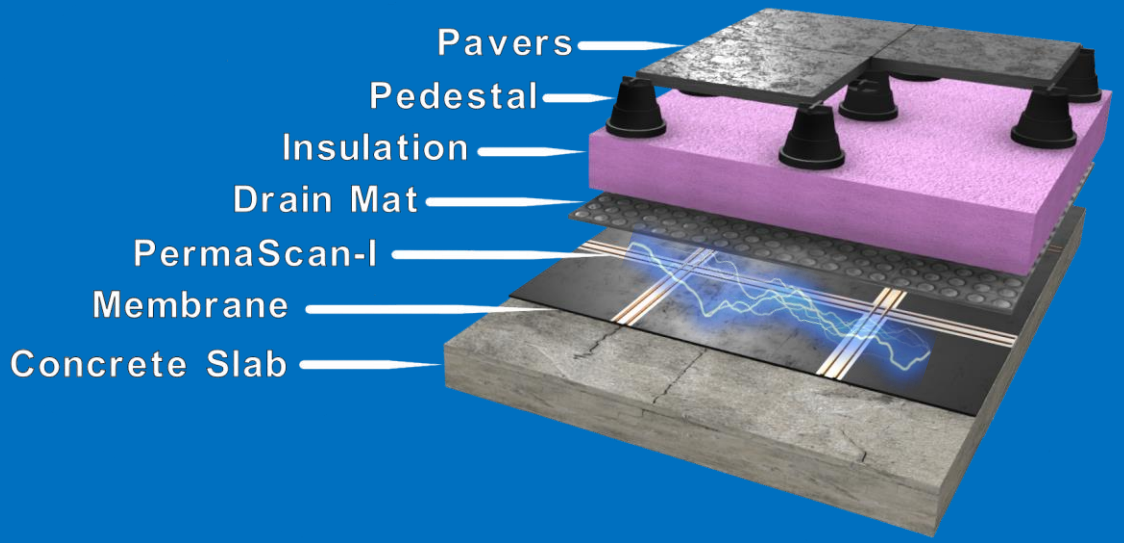
- Aluminum or Stainless Steel
- Issues with adhesion, punctures membranes and corrodes
- Often installed improperly below coverboard or insulation
- Utilized on:
  - Fully-adhered fleeceback
  - Loosely laid assemblies

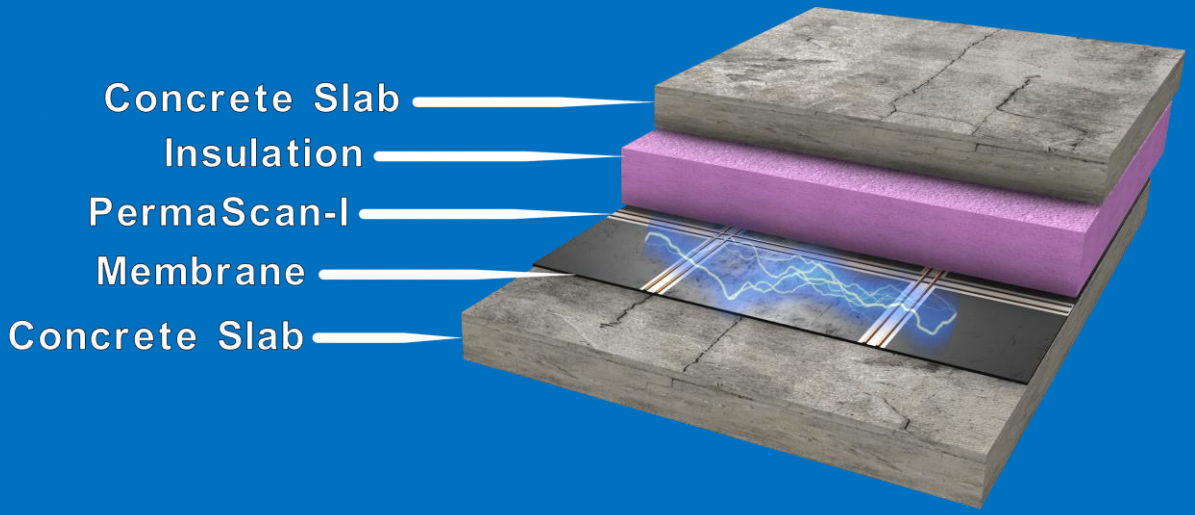


Specification Tips – Conductive Medium

- Conventional roofing requires additional language for adding a conductive medium to enable ELD
  - Applicable for assemblies where the substrate will be non-conductive (ie. coverboard, insulation, wood or LWC/LWIC)
- Spec should state where the conductive medium is to be installed
  - “Conductive medium to be installed on top of the substrate directly below the membrane per ASTM Guide D7877 and ASTM Practice D8231. Placement below the coverboard or insulation is not acceptable”
- Spec should also require the conductive medium to be tested and approved by the membrane manufacturer
- FM projects will limit which membrane manufacturer can be used

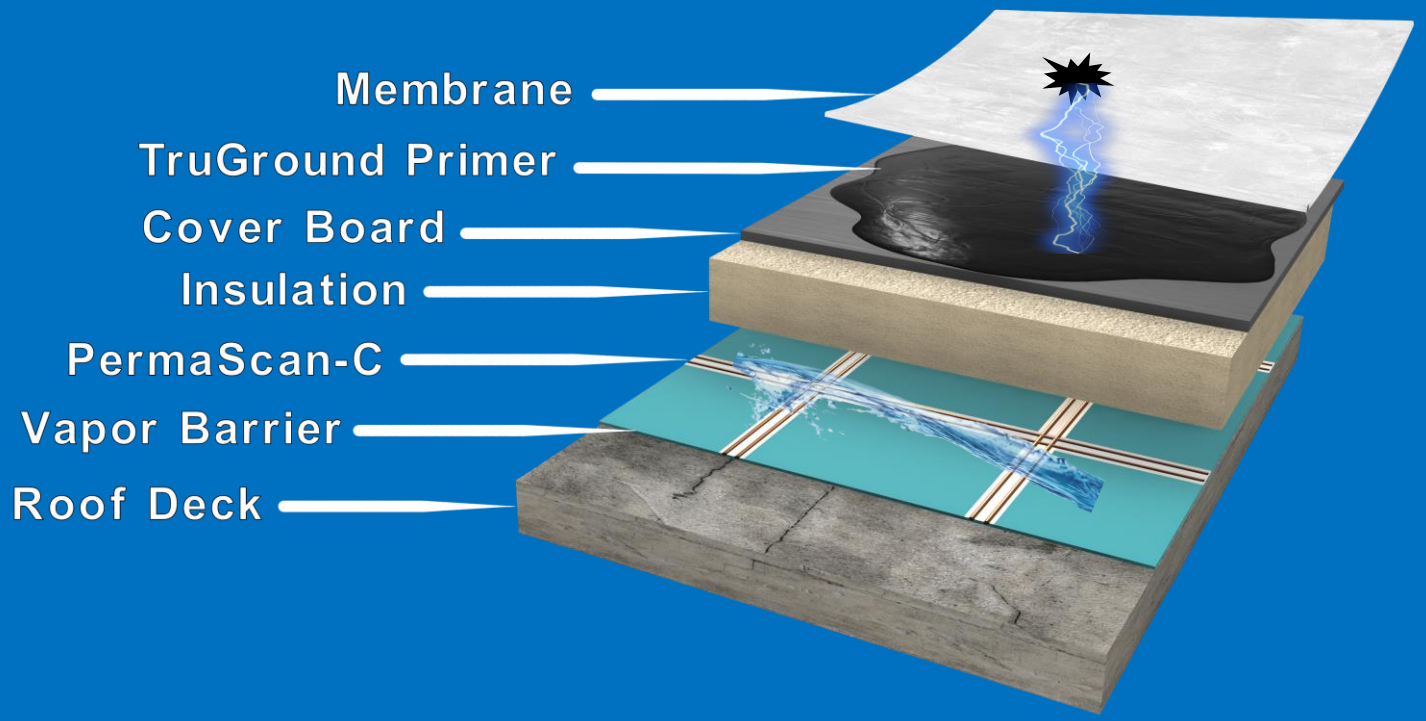
Leak Detection Systems





Embedded, continuously monitored leak detection systems are installed on the membrane surface after ELD testing has been performed. The system actively monitors for breaches in the membrane.

Moisture Detection Systems



Embedded, continuously monitored moisture detection systems are installed on the vapor barrier. The system can be adapted for moisture monitoring within walls, interstitial spaces and the building envelope. The system actively monitors for the physical presence of moisture.

This system is FM Approved.

Detec Systems

855-753-3832
sales@detecsystems.com