State-of-the-Art Techniques for Pinpointing Roof Leaks and Moisture Damage

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IR ANALYZERS
Vector Mapping
INFRARED • ELD FUSION® • NUCLEAR

Selecting the Appropriate Non-Destructive Testing Technology – First Question: What Do We Need to Know?

Methodologies:

1. **Infrared, Nuclear and Capacitance Moisture Scans – Locate and document extent of wet materials (wet insulation) in the system. Can help locate leaks, but is not designed or intended for that purpose.**

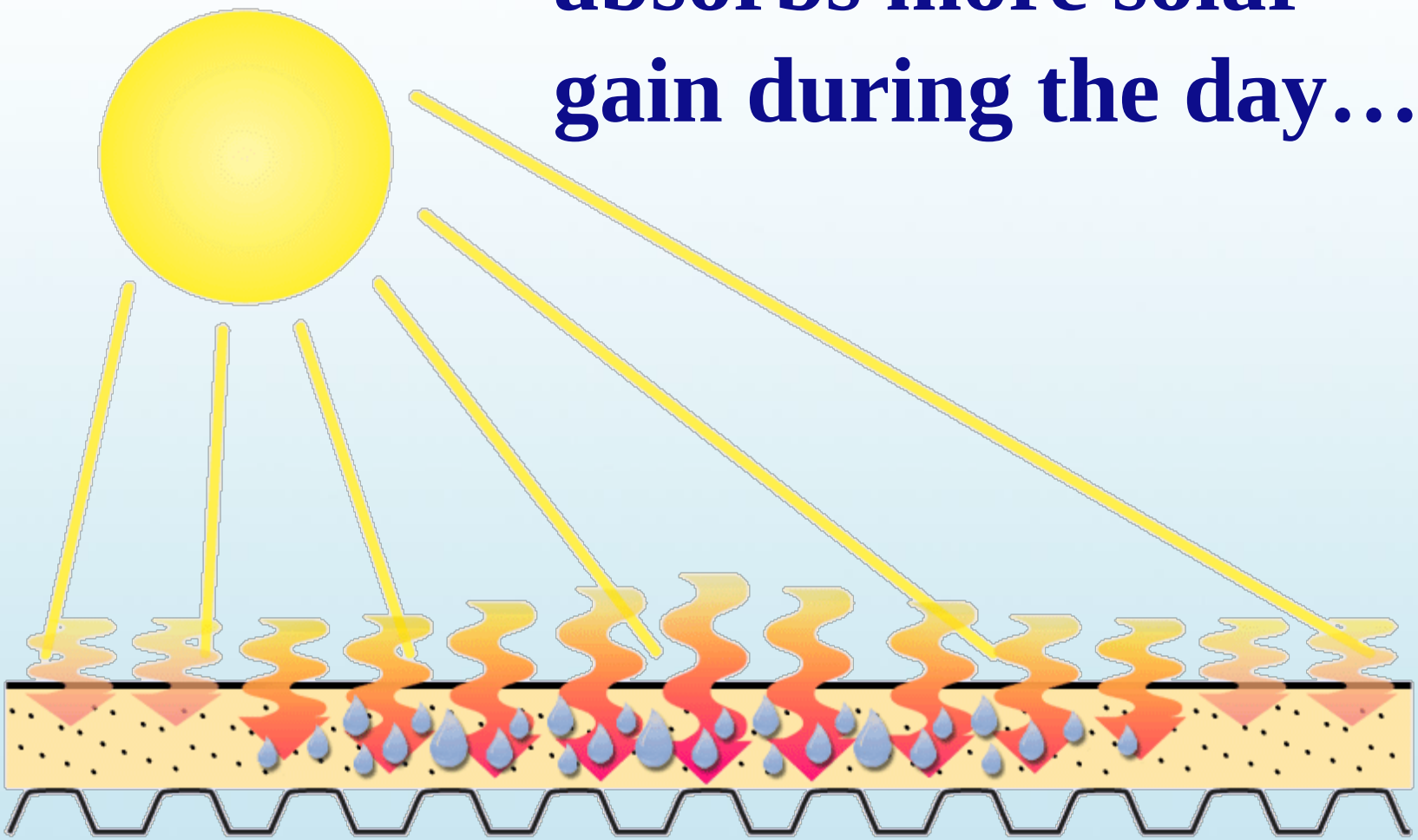
2. **Electronic Leak Detection – Pinpoints breaches (holes) in roofing and waterproofing membranes. Finds leaks - does not define the actual location and extent of moisture damage.**

Roof Moisture Analysis: Infrared, Nuclear & Capacitance / Impedance

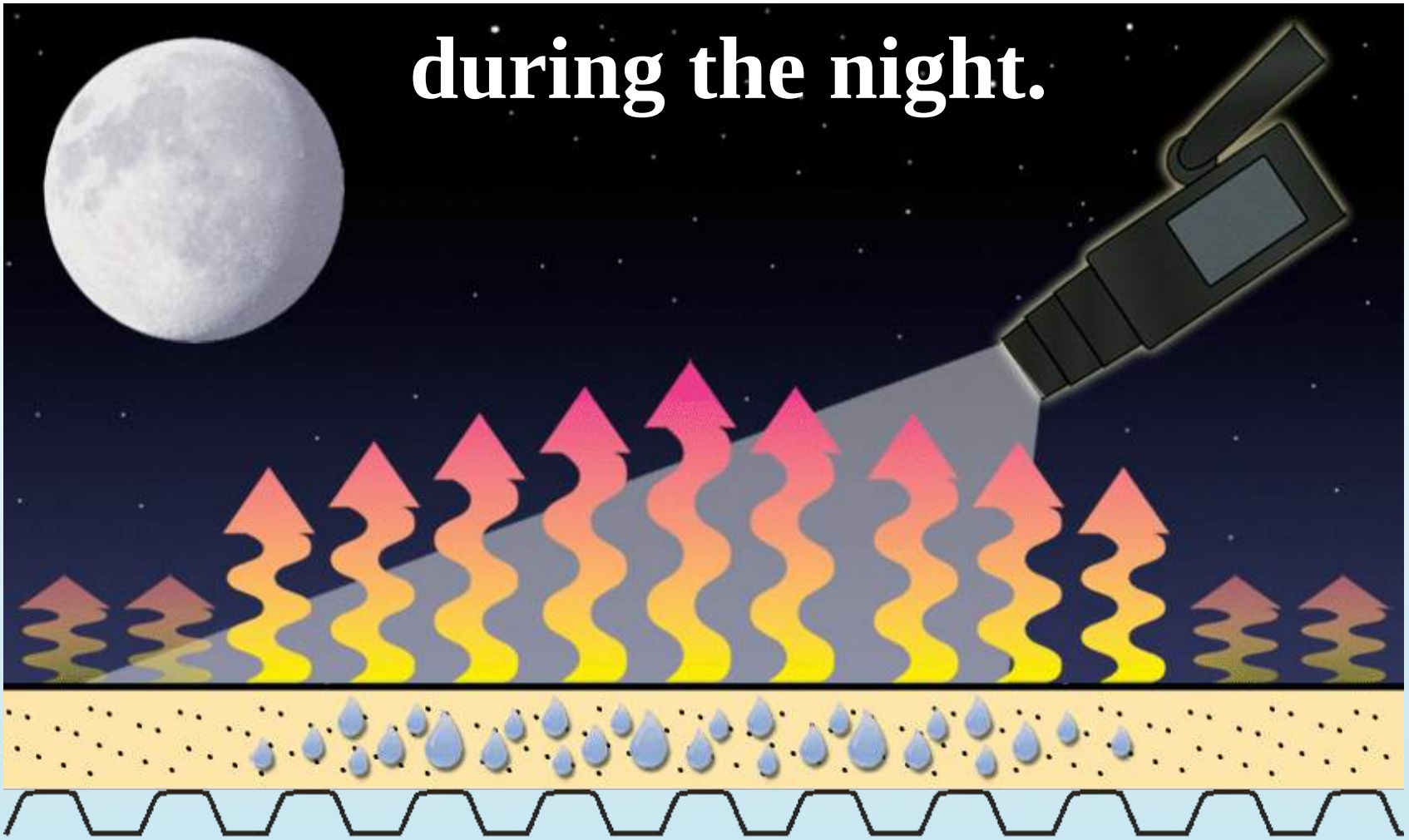
Locates and documents water-damaged insulation in all types of roofing systems:

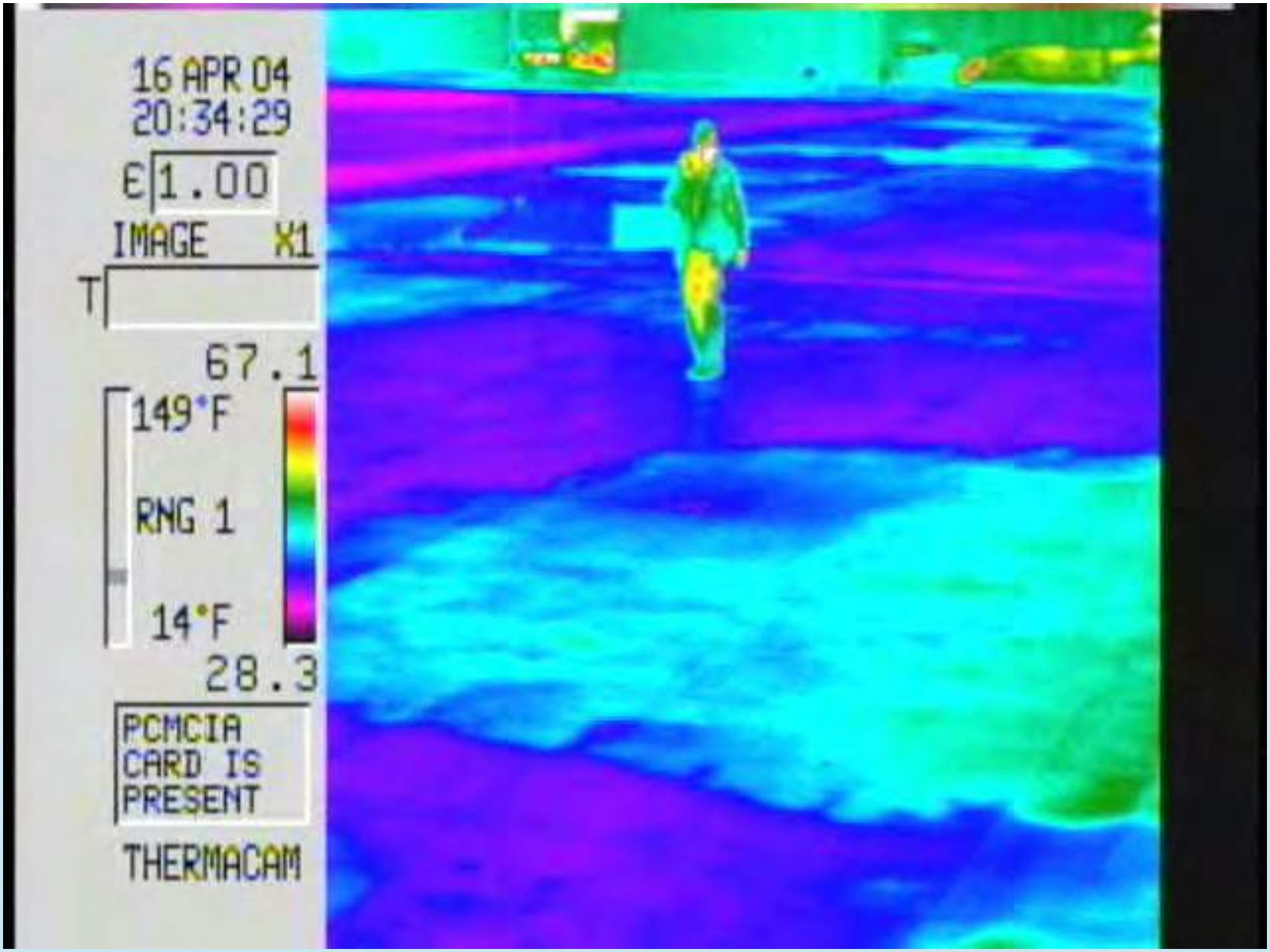
- **Smooth Surface**
- **Graveled**
- **Ballasted**

Infrared Testing: Wet insulation absorbs more solar gain during the day…



...and releases more stored solar heat

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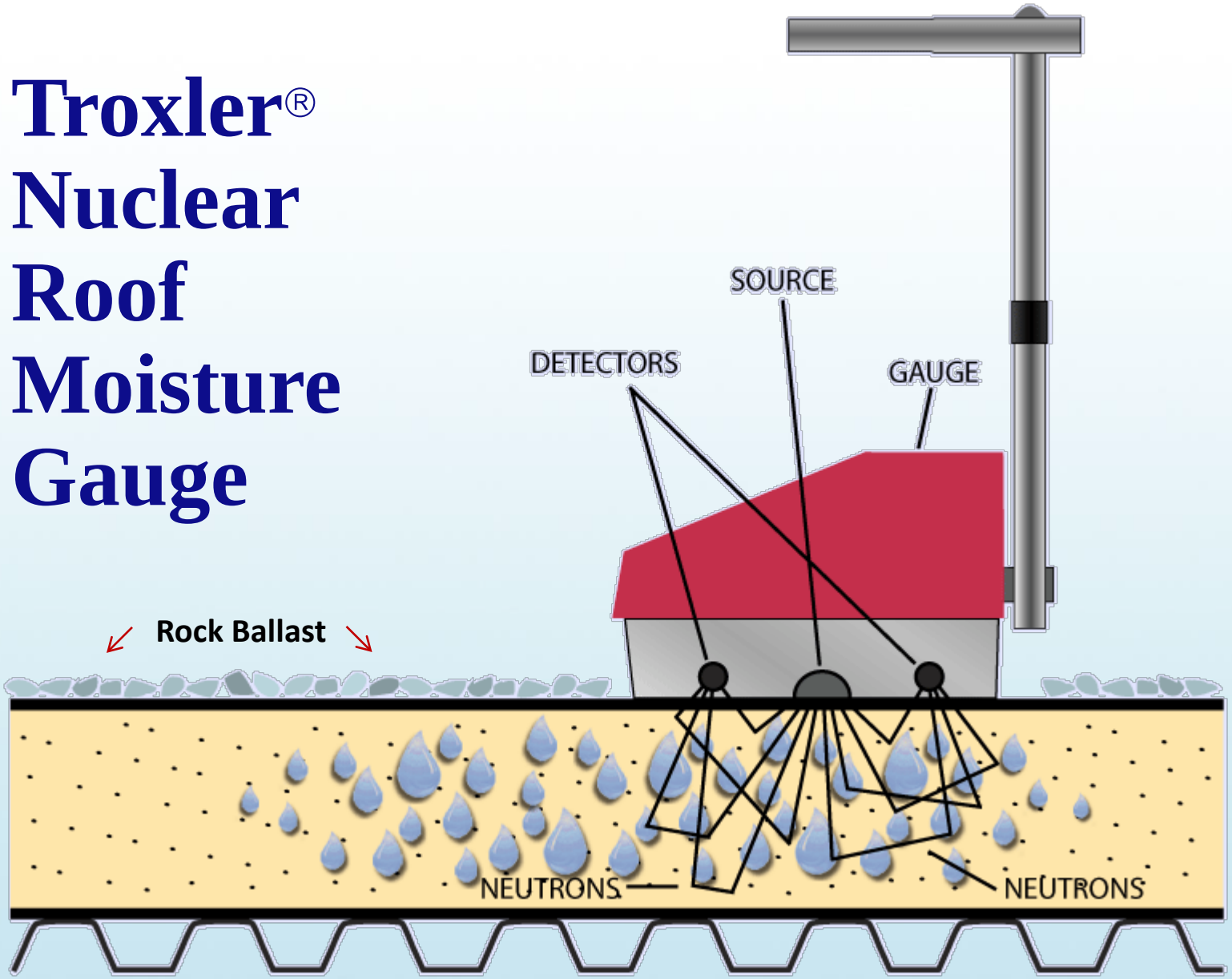
Troxler® Nuclear Roof Moisture Gauge

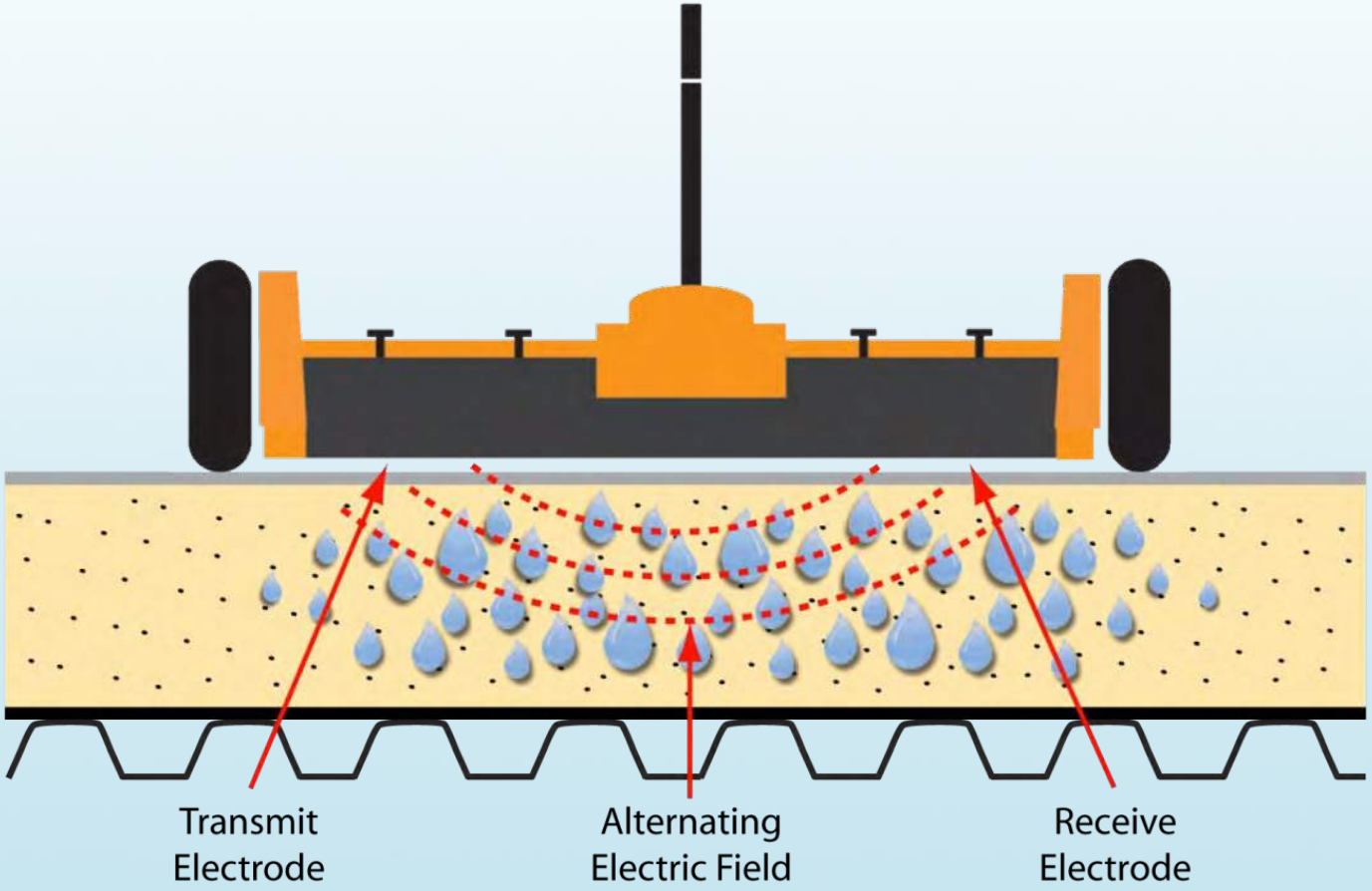


Technician Using Nuclear Roof Moisture Gauge

Roof Moisture Surveys; The proven scientific method for evaluating the roof's internal condition

- Surveys are independent and un-biased. Testing firms should not sell or install any roofing materials.
- The only goal is to give the owner accurate information about the true condition of the roof.

Capacitance
Roof Moisture Surveys



Infrared, Nuclear and Capacitance Moisture Surveys - Typical Applications:

1. Many manufacturers require testing existing roof systems to pinpoint locations and extent of moisture damage for removal, before re-roofing materials or coatings are applied.

2. Condition Assessment – Provides accurate information about the condition of the system for prioritizing multiple roofs, and budgeting.

3. **Construction Damage – Pinpoint locations and extent of water damage**

4. **Quality Assurance Testing – Unbiased tool for integrity testing of newly installed roofing materials.**

5. **Dispute Resolution – Scientific, objective approach establishes and documents the true condition of the system. Data-based evaluation - not judgment or opinion based.**

Electronic Leak Detection

Electronic Leak Detection – How Does It Work?

An electrical current is introduced above the membrane, and it will connect to a ground under the membrane only where there are breaches.

Two conditions must be met for the testing to be effective.

1. The membrane needs to be non-conductive and separate the two sides of our circuit.

Fortunately, almost all roofing and waterproofing membranes are non-conductive, and are good candidates for ELD.

Typical non-conductive membranes

Thermoplastics:

- **PVC – Polyvinyl Chloride**
- **TPO – Thermoplastic Polyolefin**

Modified Bitumen

Built-up Roofing

Fluid Applied Rubberized Asphalt

Polyurethanes, Resins

EPDM (Special Case)

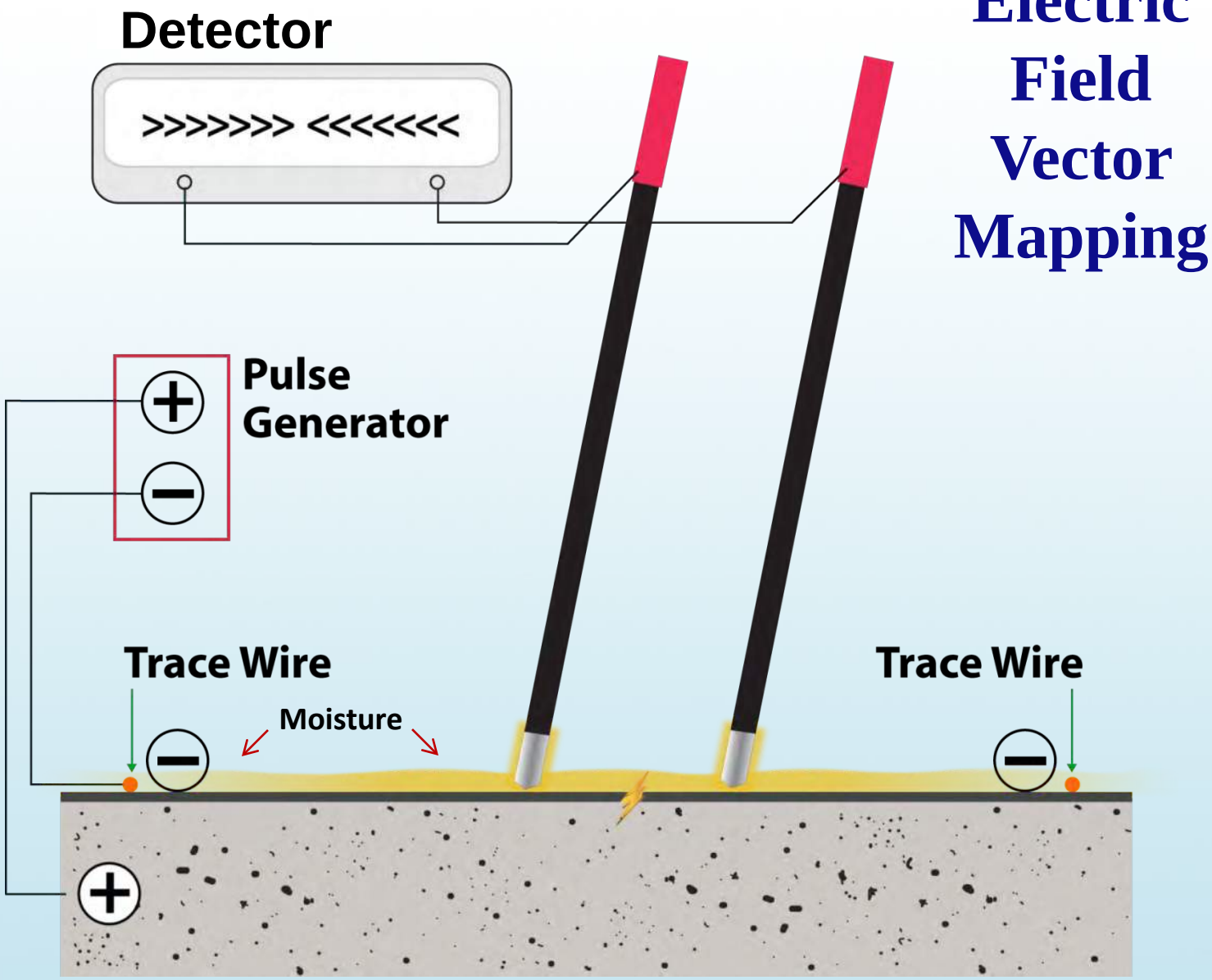
2. To complete the circuit, a ground must be available to receive the electrical current.

For example, structural reinforced concrete decks and steel decks will readily accept the current that passes through a breach.

Three Types of Electronic Leak Detection

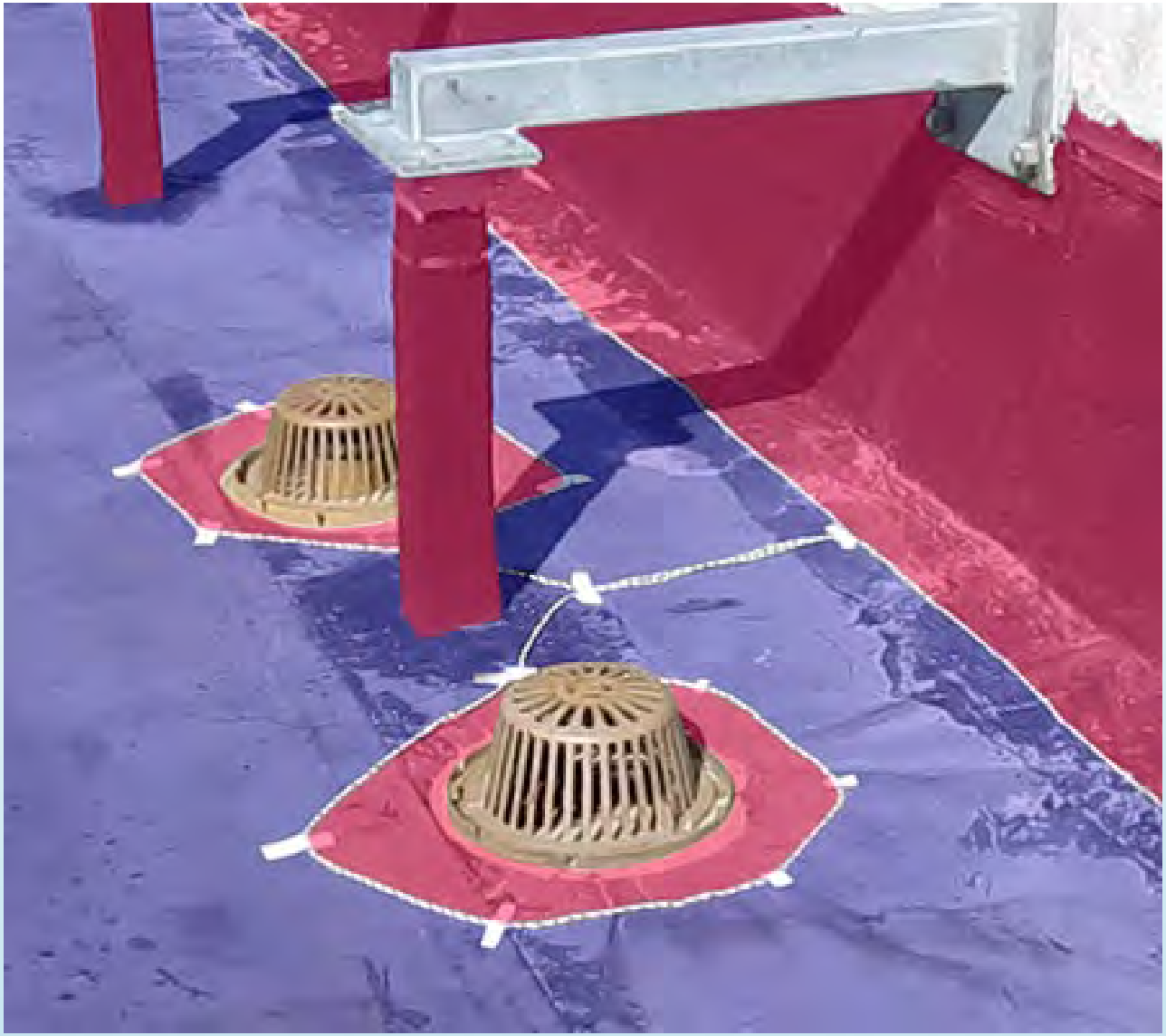
1. EFVM – Electric Field Vector Mapping (Wet Testing)

Electric Field Vector Mapping



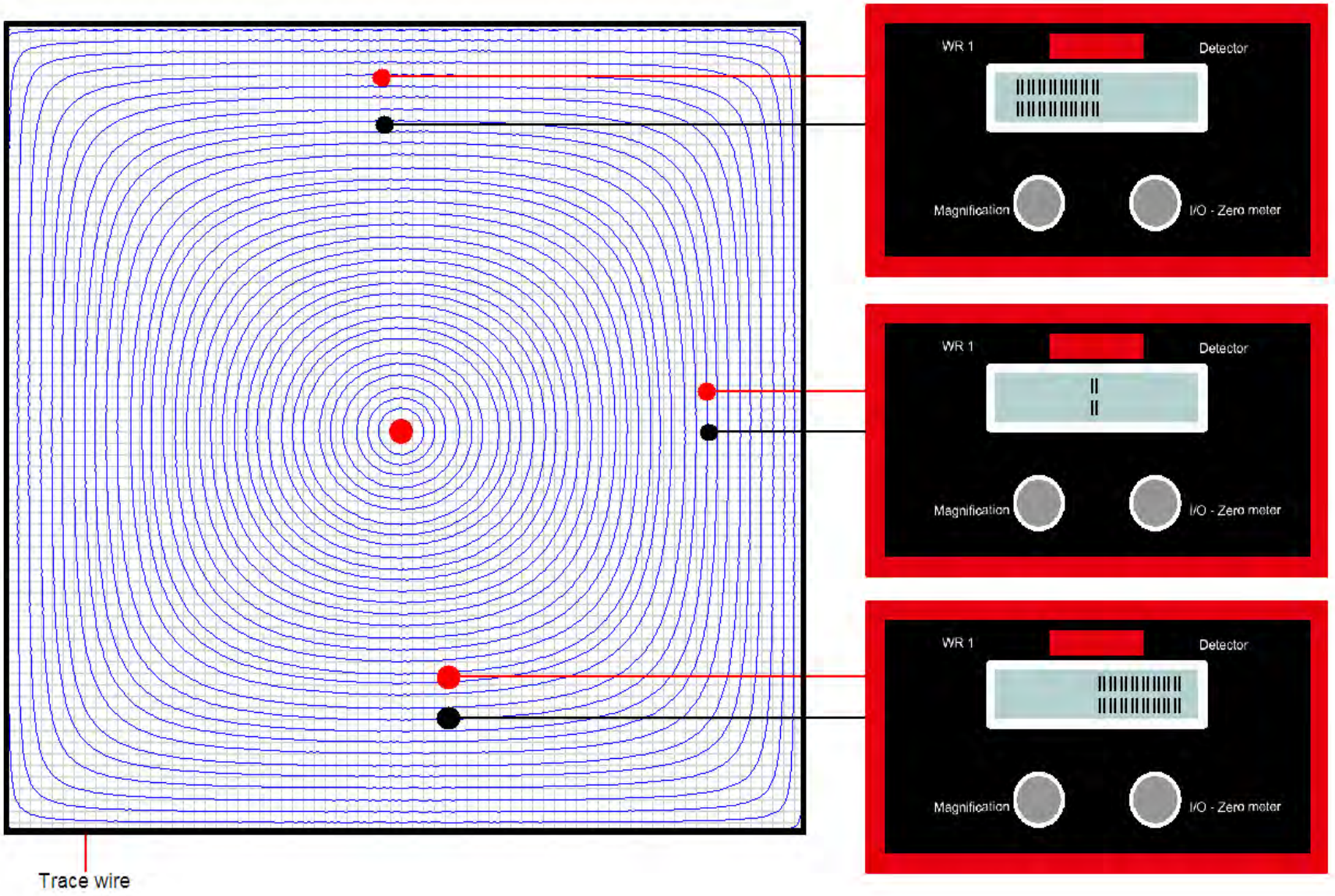
Isolation Loops

- Unflashed metal penetrations must be isolated from the testing field to prevent unintentional grounding.
- Areas inside the isolation loops and outside the boundary wires are not in the test bed.

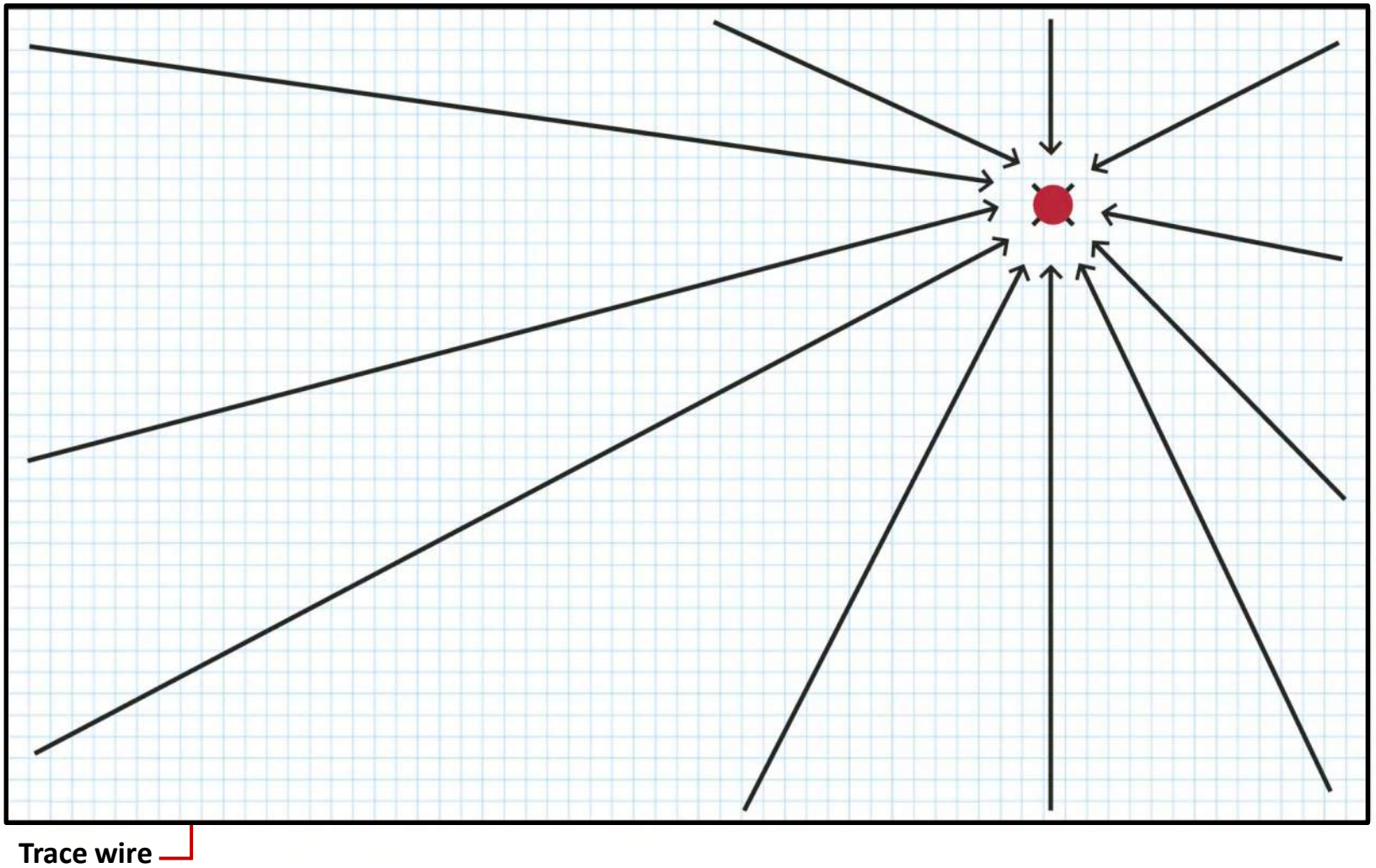


Connection Boxes

Installed above the overburden to provide access to trace wire after placement of green roofing, pavers, etc.



Test bed – no breaches


Trace wire

Applications: Electronic Leak Detection is ideal for

- Integrity testing of new roofing and waterproofing membranes - much safer, faster, accurate and usually less expensive than flood testing

- Pinpointing and documenting areas of construction damage to facilitate repairs

- Establishing Build Quality to protect contractors

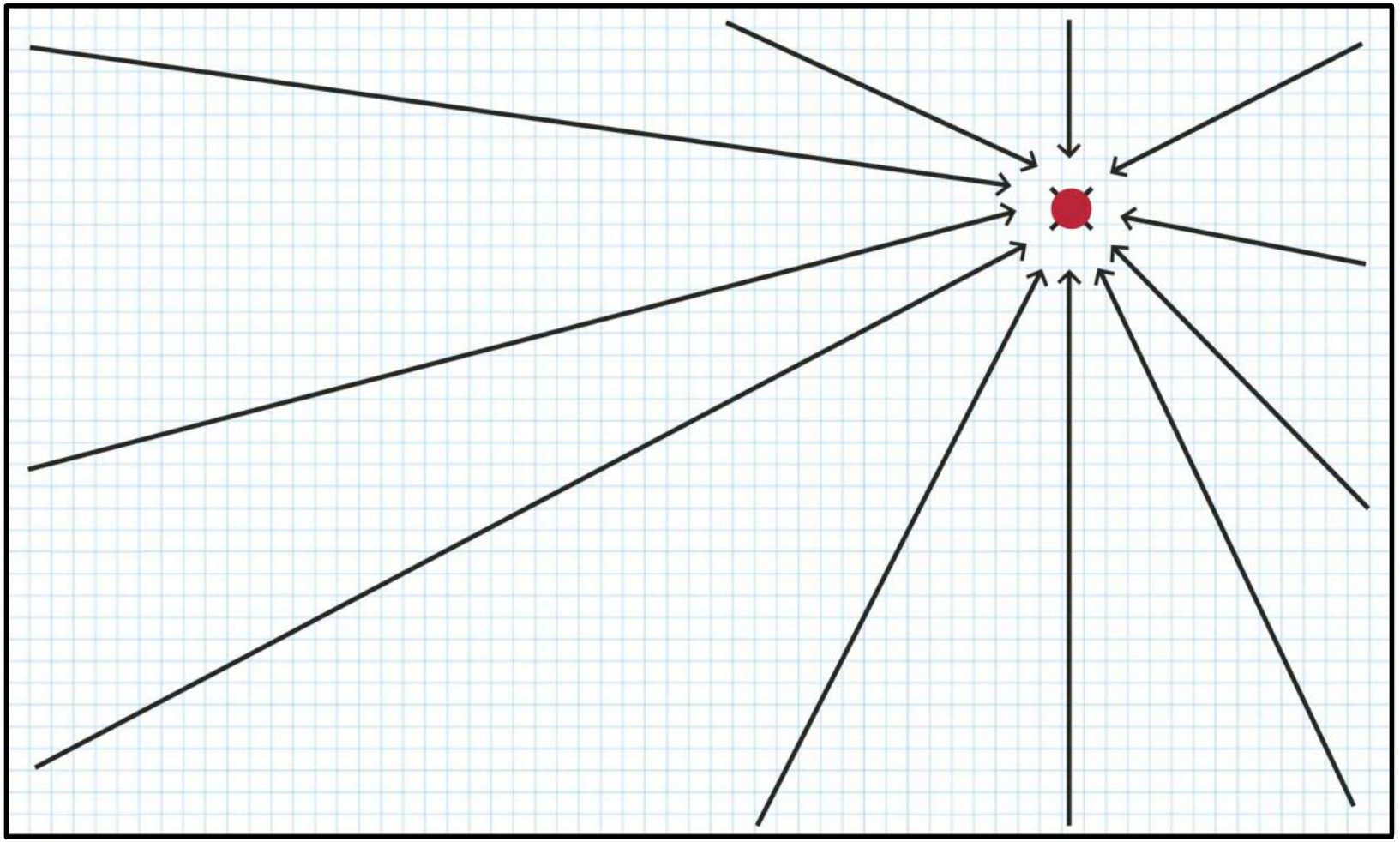
- **Leak Detection in waterproofing membranes with some types of overburden**
- **Pinpointing leaks in traditional insulated roofing systems – breaches can be quickly located, repaired and retested**
- **Dispute resolution – Scientific, objective approach establishes and documents the true condition of the system. Data-based evaluation – not judgment or opinion based.**

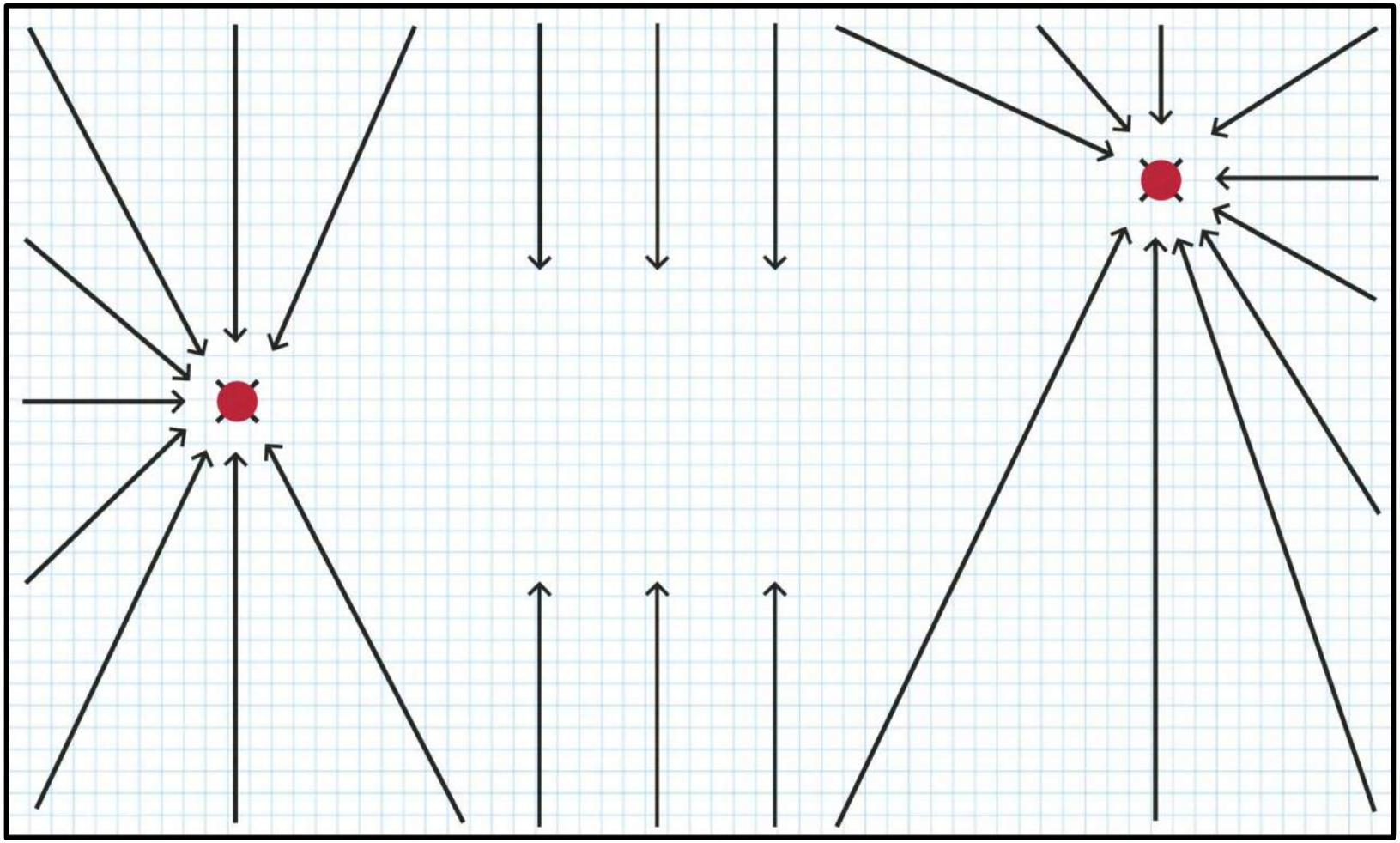
Challenges with EFVM through overburden

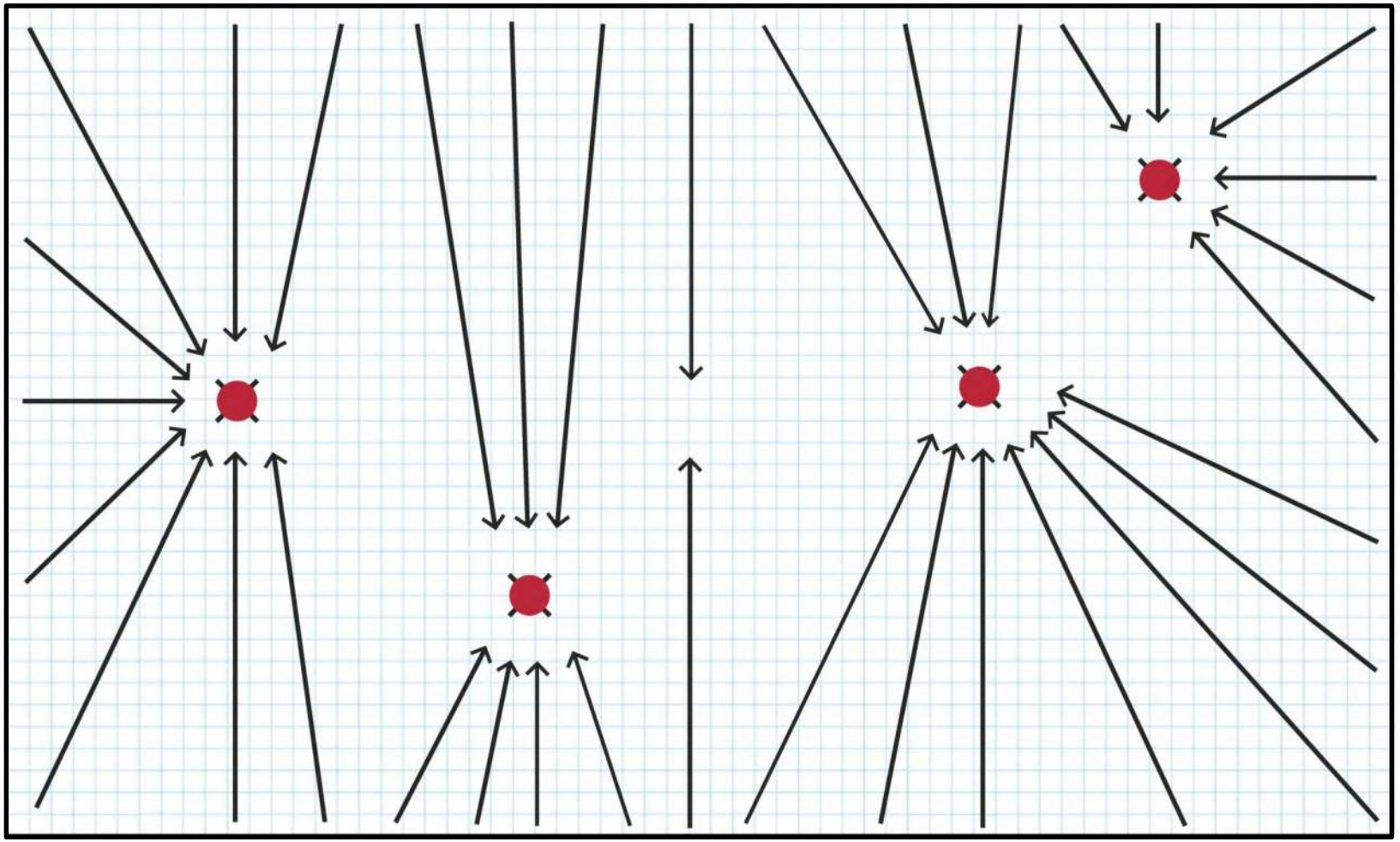
- Technician cannot be certain that all areas of the membrane are wet. Dry areas will not be tested.

- Testing is performed at 38 Volts DC with low amperage. Electrical signal weakens as overburden becomes thicker.

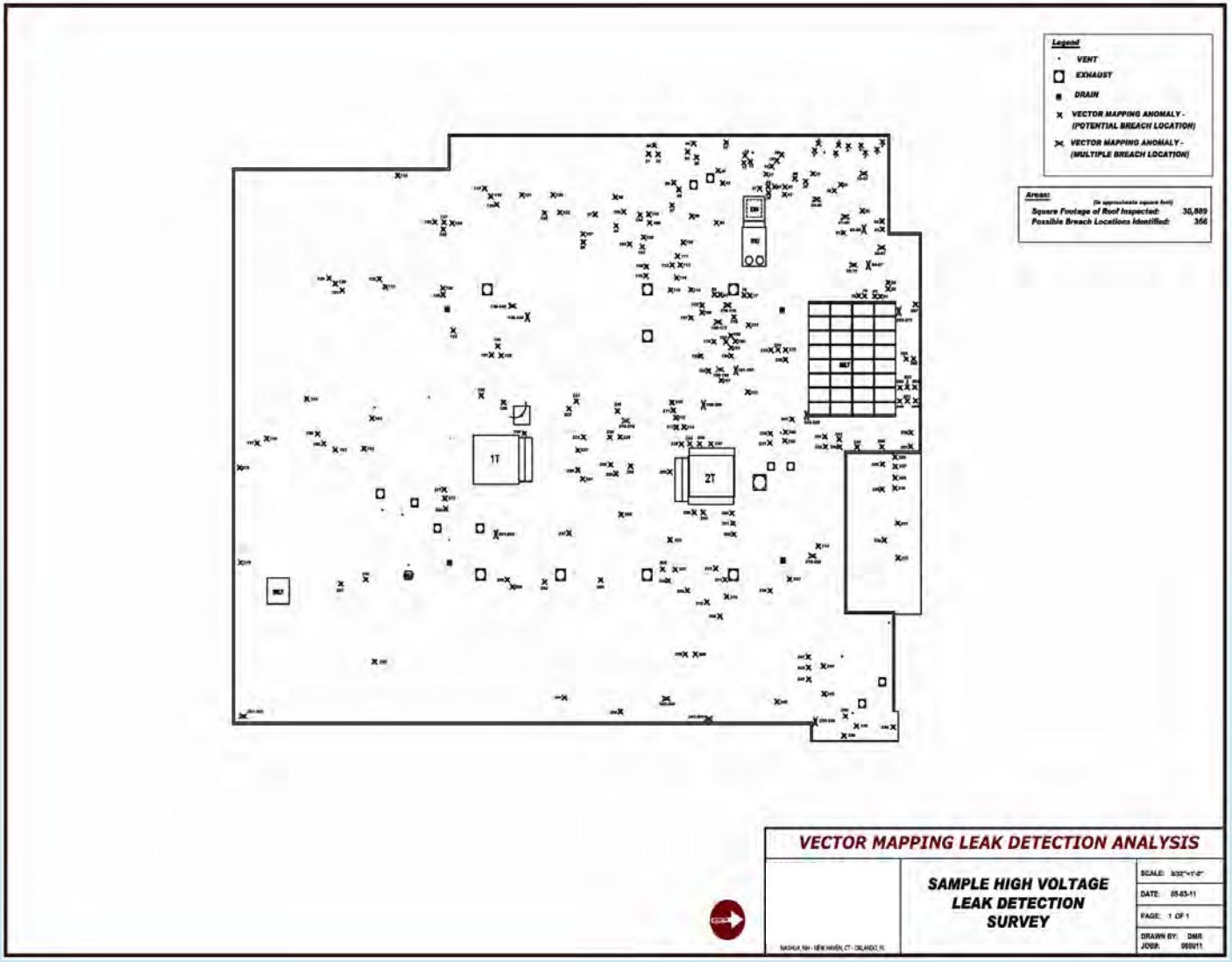
- The assembly may contain lightning protection systems, metal conduit, or other objects that create unintentional grounding, hampering or eliminating the ability to test.







Electronic Leak Detection Locates 366 Breaches



2. High Voltage Electronic Leak Detection (Dry Testing)

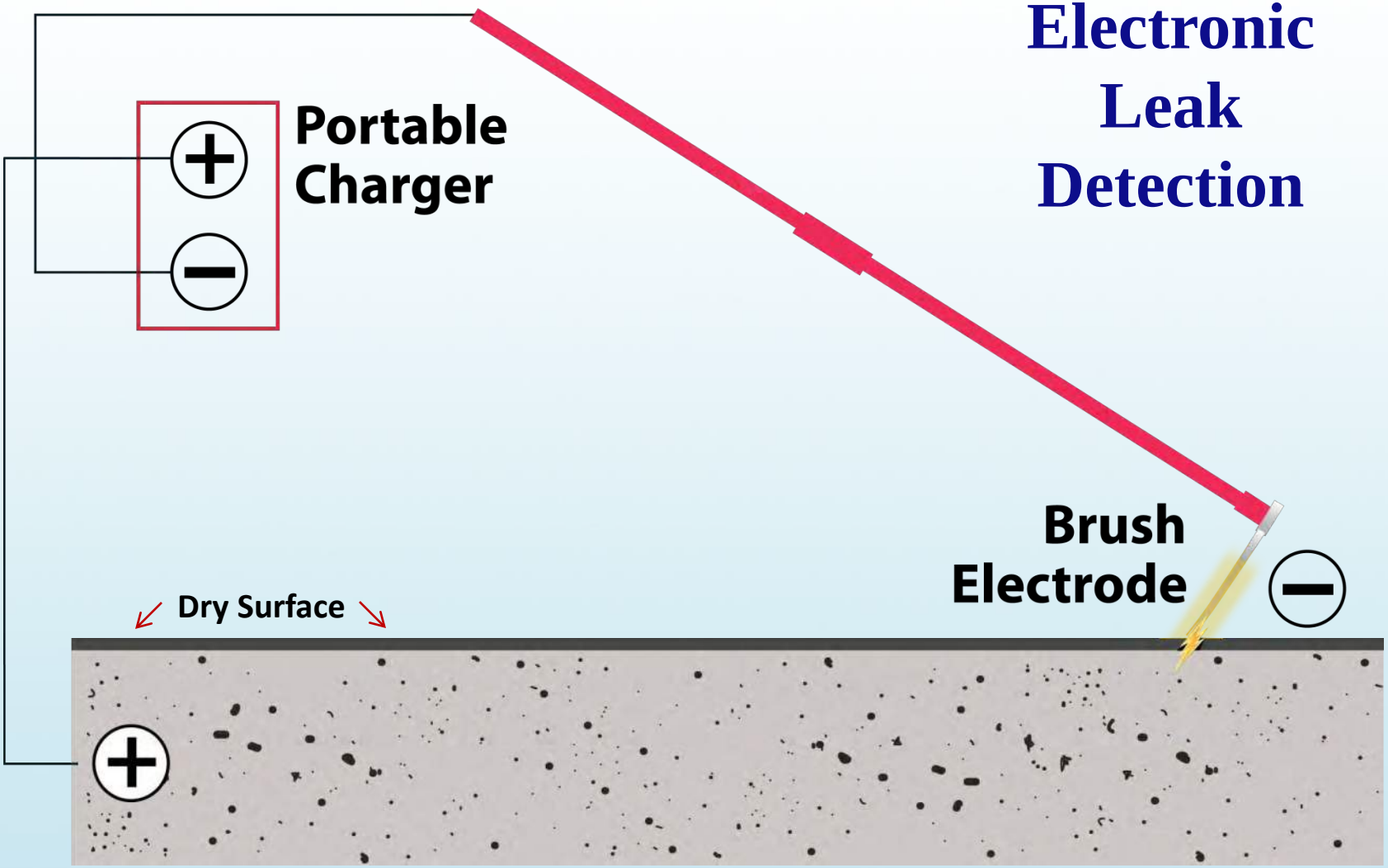
High Voltage ELD

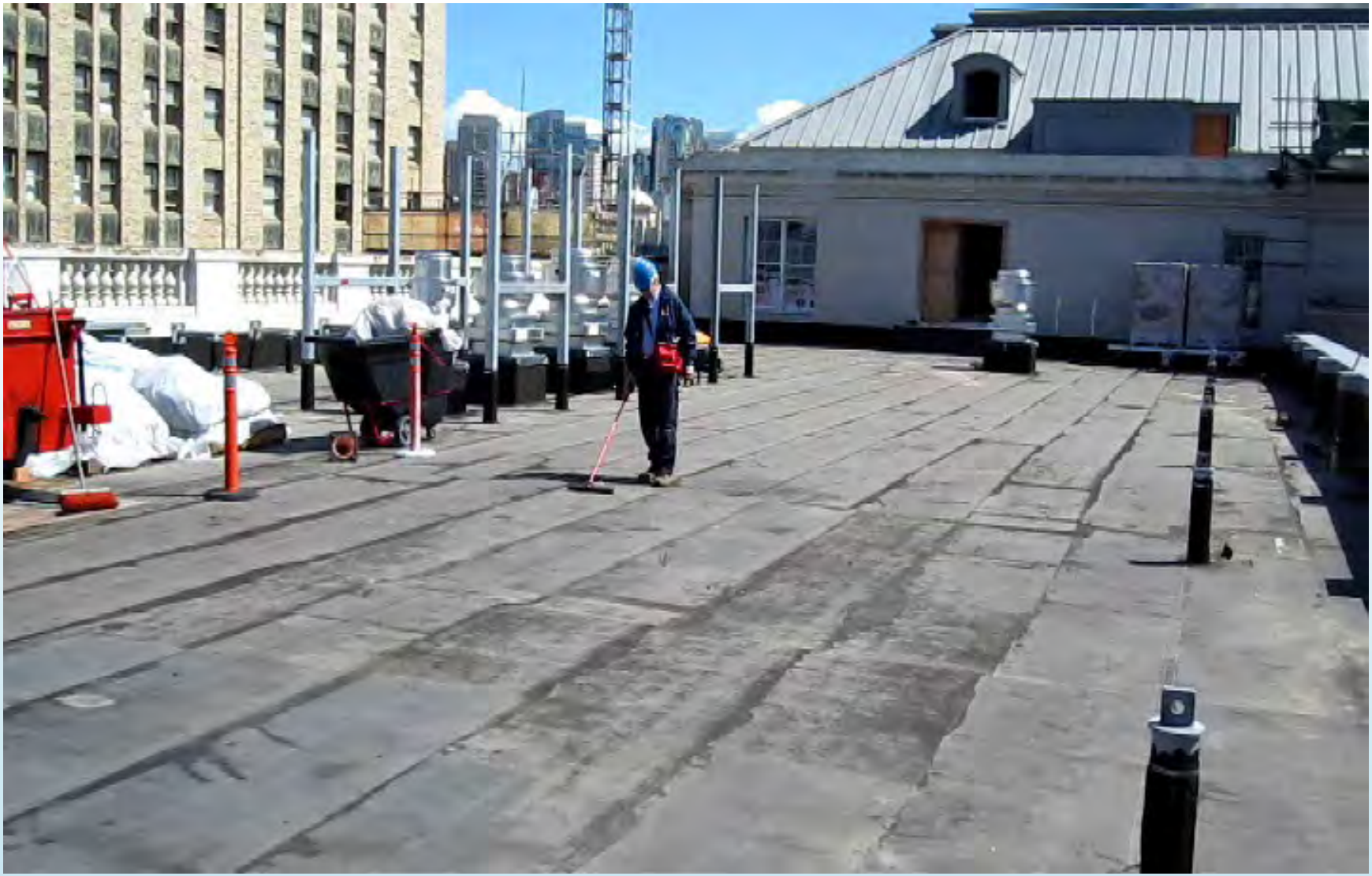
Works on the principle of Arcing – Arcing is current flow through a normally non-conductive medium such as air.

The equipment provides various testing voltages

- Adjustable from 1,000 to 30,000 volts DC
- Can test from extremely thin coatings of a few mils up to 5/8” thick membranes
- Virtually no amperage, so there is no danger to technician, membrane or building

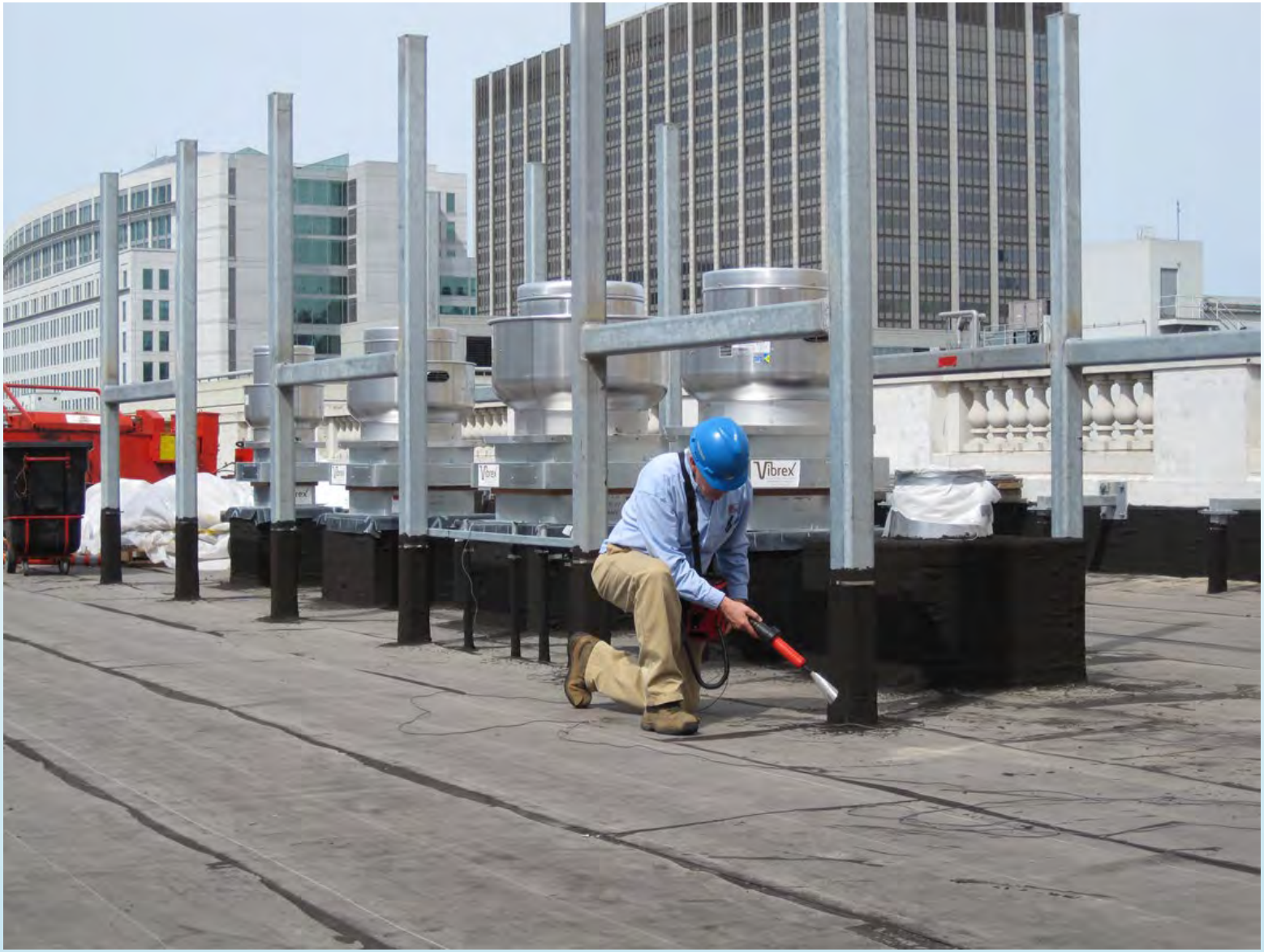
High Voltage Electronic Leak Detection

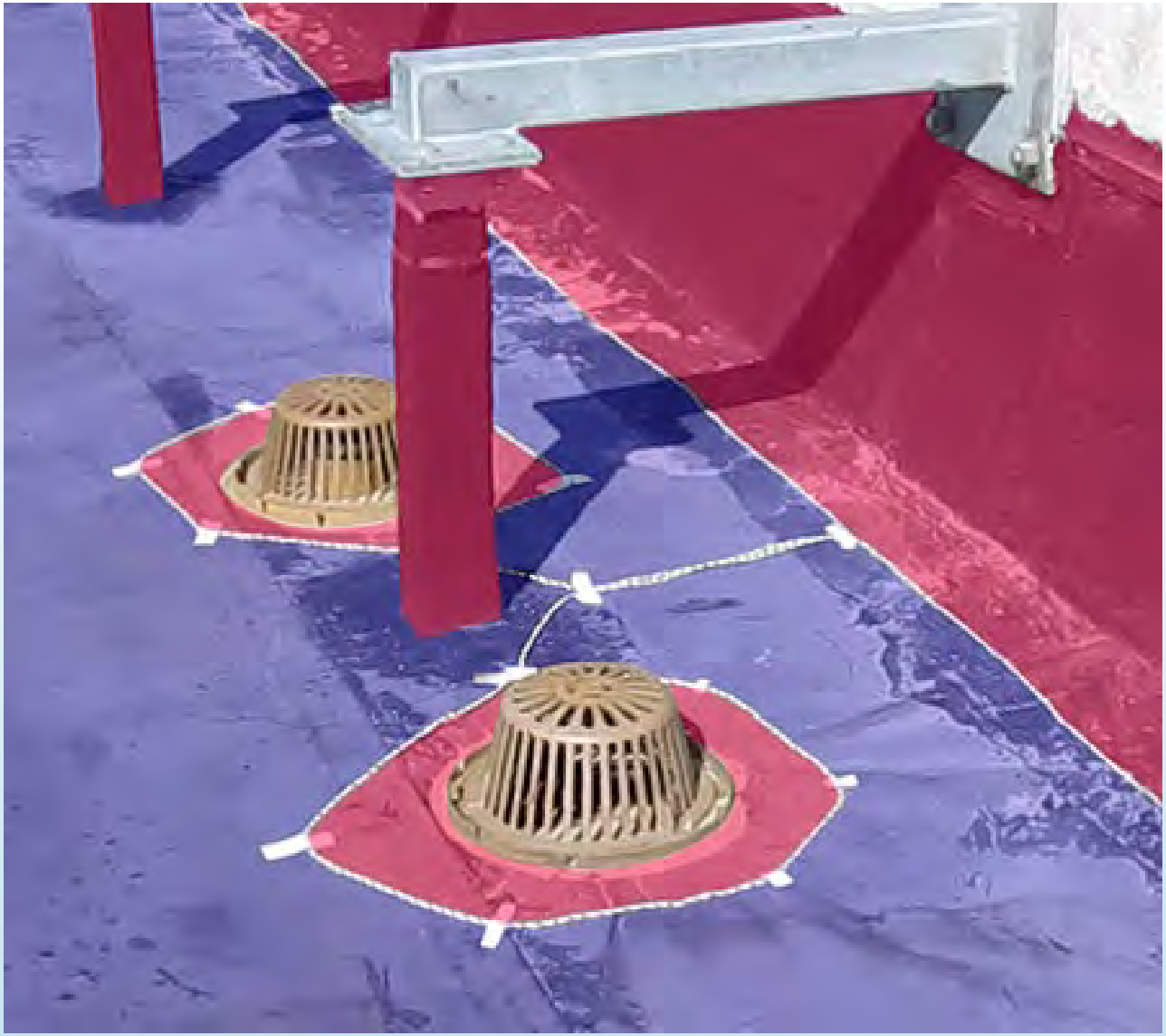




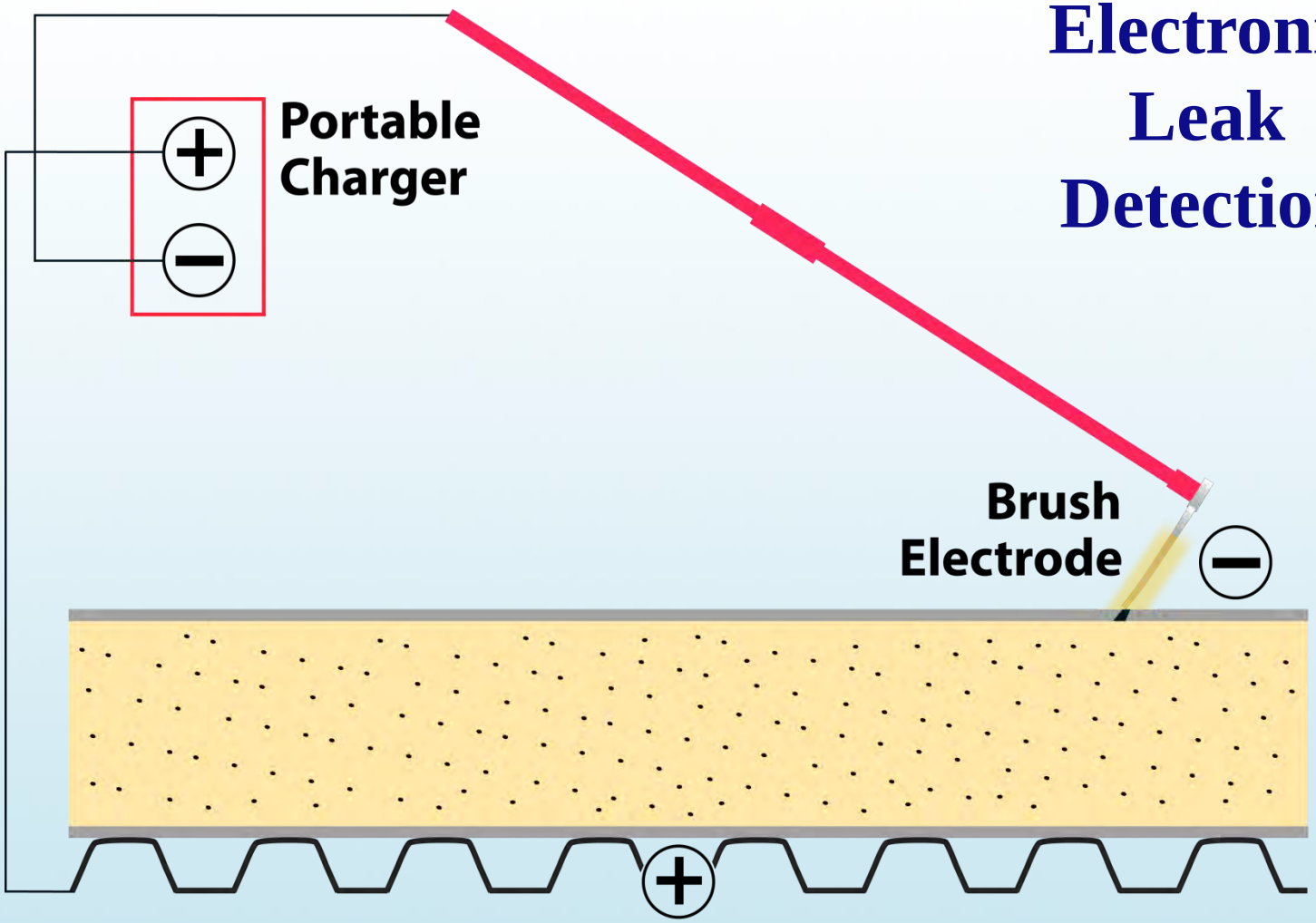
High Voltage Electronic Leak Detection is ideal for vertical surfaces and transitions.

- Parapet walls
- Flashings, curbs
- Horizontal to vertical transitions
- Foundation waterproofing

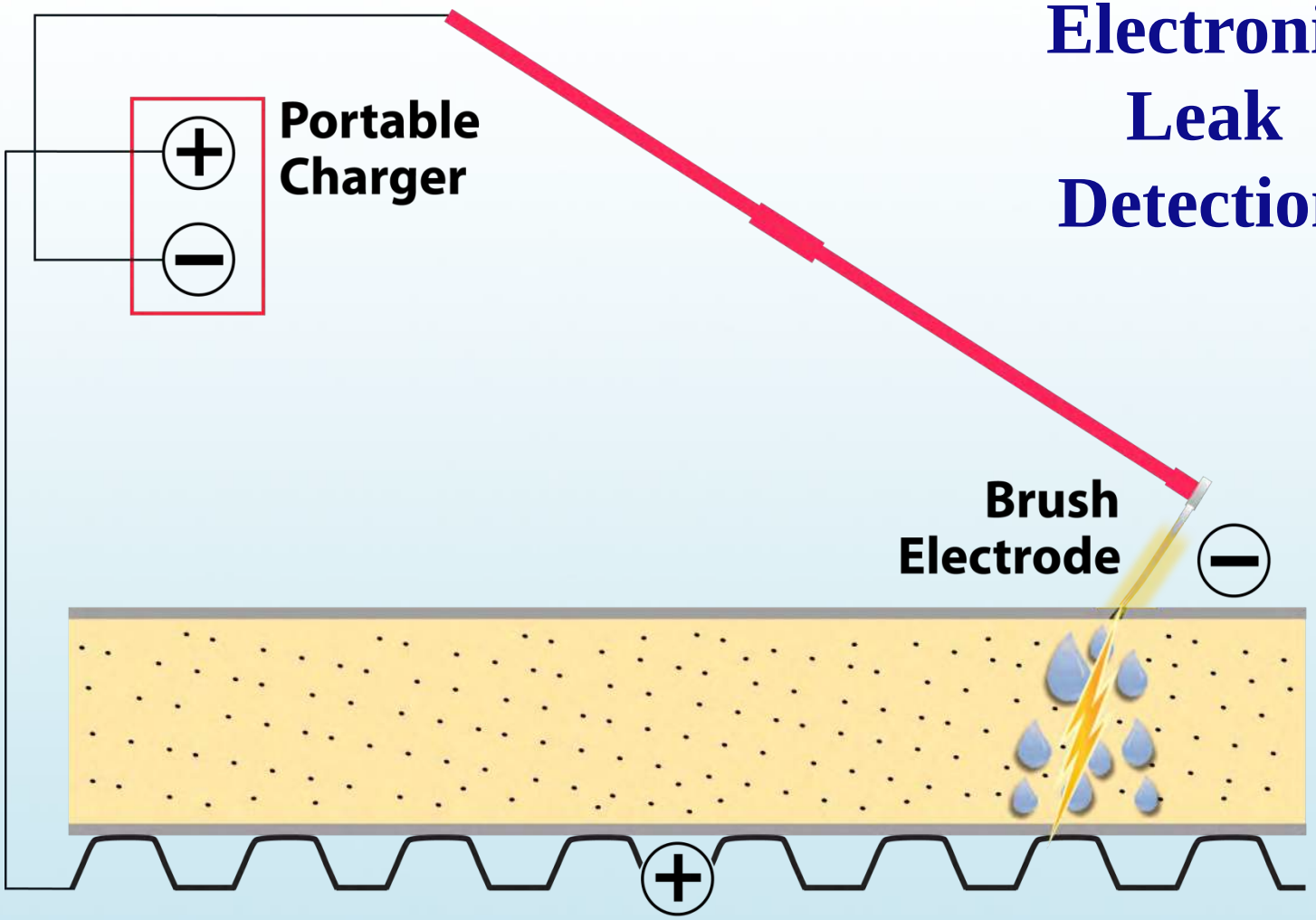

Vibrex



High Voltage Electronic Leak Detection

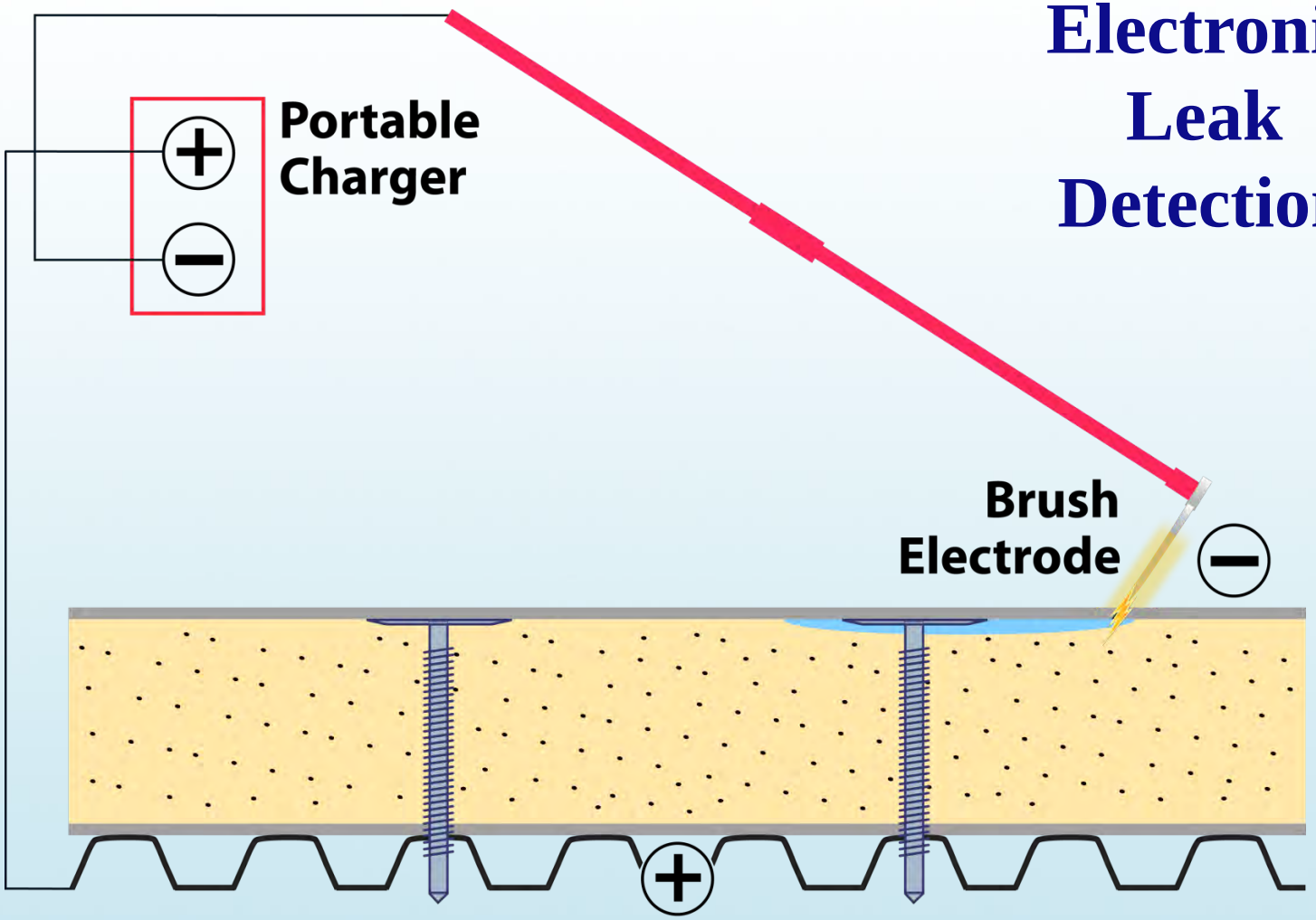


High Voltage Electronic Leak Detection



ELD on Insulated Systems

High Voltage Electronic Leak Detection



3. Low Voltage Platform Scanning - RMIS (Wet Testing)

What about Insulated Systems?

ASTM Standard D7877

- **How can we be sure that accurate ELD tests can be conducted on conventional insulated systems?**

ASTM Standard D7877 requires: "placing a conductive material directly under the membrane" when the electrical path to the conductive deck is interrupted.

Alternative Grounds for Insulated Systems:

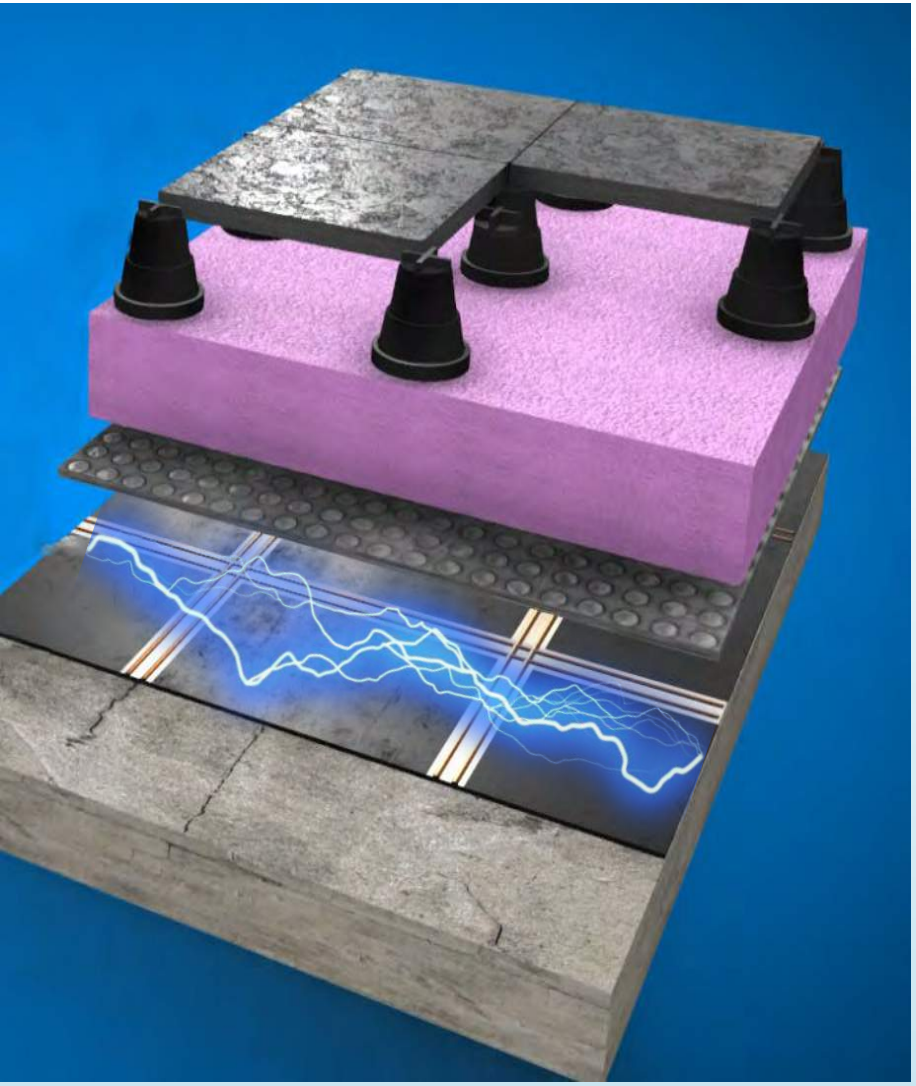
- Electrically Conductive Primer
- Conductive Wire Mesh


DensDeck

Continuously Monitored, Embedded Breach Detection Systems

24 / 7 / 365

Computer Monitored Systems



Breach Detection Systems

24/7 Continuously monitored systems

Combining High and Low Voltage Technologies

1st – Utilize High Voltage ELD (dry testing) as the integrity test on vertical surfaces, flashings, transitions and close to metal penetrations.

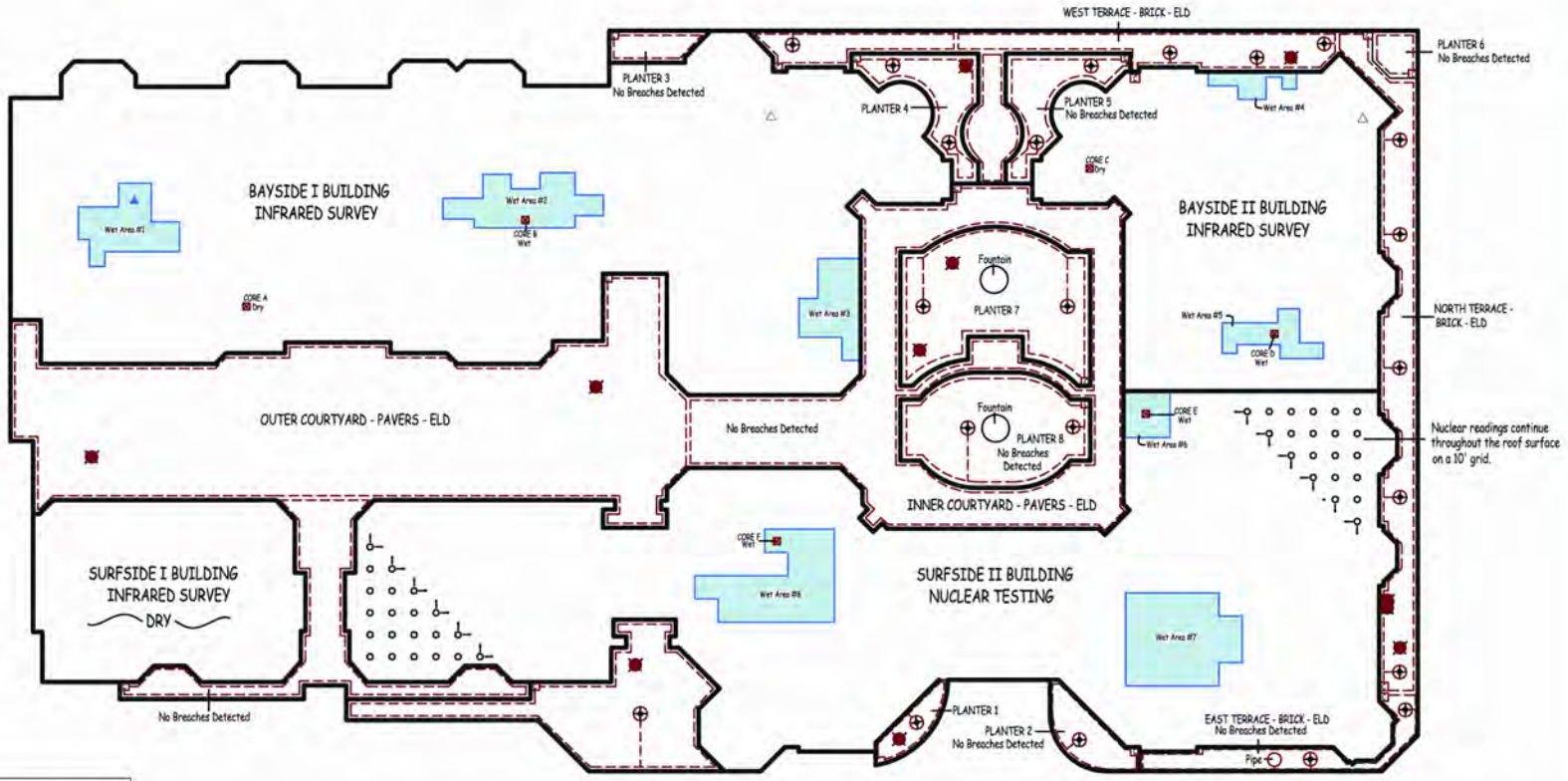
2nd – Place trace wire and test the field of the membrane with Electric Field Vector Mapping technology (wet testing).

3rd – Trace wire and connection boxes are provided to enable future Electric Field Vector Mapping with the overburden in place.

Best Practices

- **Ideal procedure; Technician has multiple test technologies and uses the best technique(s) to fit the testing specification, weather conditions and the assembly being surveyed.**

- **Ideal procedure; Roofing contractor is on site during the inspection to repair any defects. These repairs can then be quickly retested so that when the ELD Technician completes the testing the membrane can be Certified Breach-free.**



Legend

- CORE SAMPLE
- MOISTURE PROBE - WET
- MOISTURE PROBE - DRY
- NUCLEAR DATA POINT
- WET INSULATION
- TRACE WIRE
- ISOLATION LOOP
- CONNECTION BOX
- VECTOR MAPPING ANOMALY - POTENTIAL BREACH LOCATION
- DRAIN
- NIC NOT IN CONTRACT

Area Tested with Vector Mapping:
(in approximate square feet)

Square Footage of Membrane Inspected:	14,892
Possible Breach Locations Identified:	11

Area Tested with Infrared:
(in approximate square feet)

Square Footage of Roof Inspected:	18,048
Square Footage of Wet Area:	1,868
Percentage of Wet Area:	10.4%

Area Tested with Nuclear:
(in approximate square feet)

Square Footage of Roof Inspected:	11,193
Square Footage of Wet Area:	950
Percentage of Wet Area:	8.5%

BREACH FREE CERTIFICATION:

During the inspection, all membrane breaches located were repaired while the Vector Mapping Technician was on site. Re-testing in these repaired areas revealed no alarms. At the completion of the testing, all areas in the contract exhibited no breaches.

INFRARED & NUCLEAR ROOF MOISTURE ANALYSIS
HIGH VOLTAGE ELECTRONIC LEAK DETECTION
LOW VOLTAGE VECTOR MAPPING

200 BAYBERRY CIRCLE
HILTON HEAD, SC

SCALE: 3/32"=1'-0"
DATE: 09-21-12
PAGE: 1 OF 1
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Thank you!