One Leak Every 25.65 m² - The Critical Importance of Electrical Leak Detection on Flat Roofs

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Flat roofs with geomembrane liners such as PVC, TPO, and bitumen have become increasingly popular in modern construction. Their durability and cost-effectiveness make them a logical choice for various building types. However, their effectiveness heavily relies on the quality of installation and subsequent maintenance. One of the most reliable methods to ensure the integrity of these membranes is through electrical arc testing, such as the method employed by the eRaptor 2.0 PRO Arc-Tester by ELIS Technologies.

Leak Data Under the Microscope: Key Findings from 2024 Surveys

In 2024, one branch of ELIS Technologies conducted arc testing on a cumulative area of 148,910.5 m² across various flat roof installations. The inspection identified a total of 5,804 leaks or damages, equating to an average defect density of 0.0389 leaks per m² or one leak approximately every 25.65 m². This defect density underscores a significant vulnerability in membrane installations, even within professionally managed systems.

When analyzing the types of materials tested, preliminary observations reveal interesting general patterns regarding leak occurrence:

- **PVC Membranes:** Showed a lower frequency of leaks compared to other materials, attributed to their flexibility and resistance to tearing.

- **TPO Membranes:** Generally exhibited a balanced performance but were more prone to welding defects due to their thermal welding requirements.
- **Bitumen Liners:** Bitumen liners often showed higher rates of aging-related damage, especially in areas with extreme temperature fluctuations. However, the quality of bitumen liners varied significantly between manufacturers. Alarmingly, some products were found to have leaks (pores) straight from the factory, indicating inadequate quality control during production. This highlights the importance of selecting suppliers based on rigorous QA/QC processes rather than price alone. Cost should never be the sole deciding factor when choosing a bitumen liner supplier.

As we gather more detailed data, segmentation of results based on material type will be explored in a future article to provide material-specific insights and recommendations. This continued research aims to enhance our understanding of performance trends and guide industry best practices.

A detailed breakdown of the data reveals:

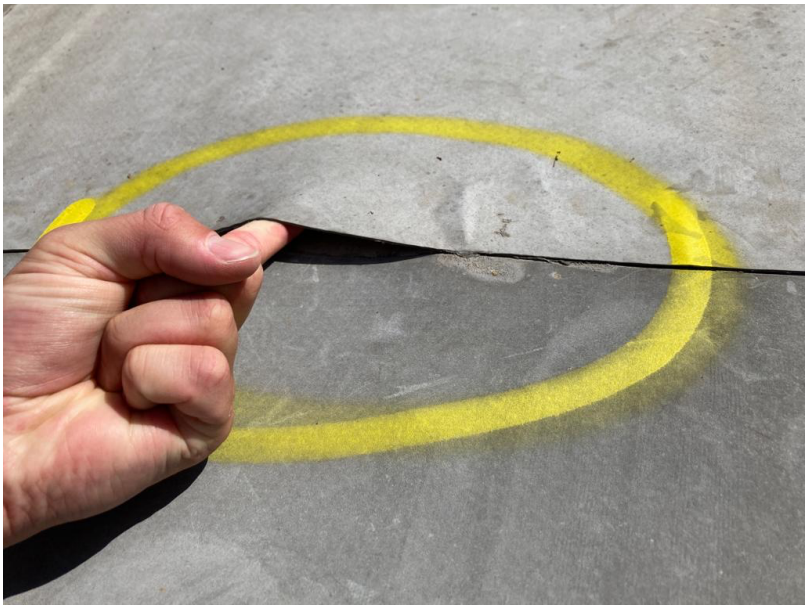
- **Total Area Tested:** 148,910.5 m²
- **Total Defects Found:** 5,804
- **Defect Density:** 0.0389 leaks/m²
- **Area per Defect:** 25.65 m² per leak

These figures highlight the importance of precision in both installation and post-installation quality assurance. The prevalence of defects reinforces the necessity for rigorous QA/QC measures and regular inspection protocols to maintain the long-term performance of roofing systems.

Leak Samples

PVC

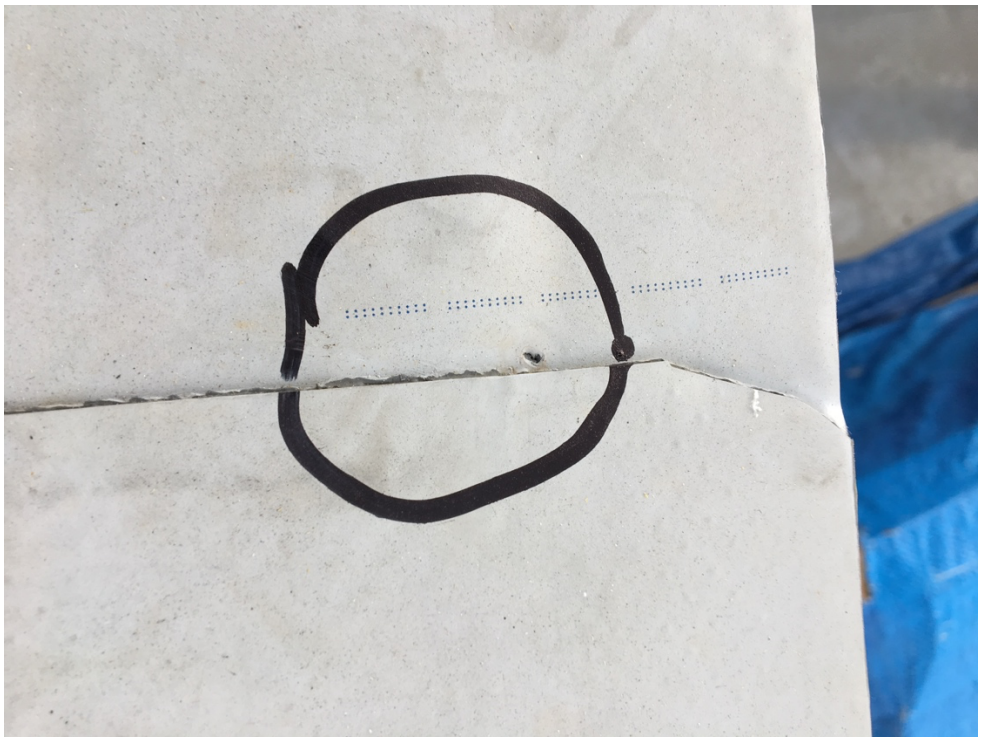
PVC liner mechanical damage – likely caused by a subcontractor or liner installer



PVC liner - poor welding

PVC liner - poor welding

TPO



TPO liner - poor welding/stress fracture

TPO liner - poor welding/stress fracture

Bitumen

Bitumen liner - poor installation/stress fracture

Bitumen liner - poor installation/stress fracture

Bitumen liner - poor installation/low quality material

Common Causes of Leaks

From our surveys, the primary causes of roof membrane leaks fall into four main categories:

1. **Subcontractor Damage:** Rooftops often become a hub of activity after the initial installation, with subcontractors installing lightning rods, solar panels, air conditioning units, and other equipment. Unfortunately, these activities can inadvertently damage the membrane, causing punctures or tears.
2. **Poor Welds:** Although less frequent, improper welds during installation remain a significant concern. The quality of welds can vary depending on the skill and experience of the installation crew. Selecting qualified and experienced teams is critical to minimizing such issues.
3. **Material Aging:** Over time, older membranes can suffer from wear and tear, leading to cracks, tears, or brittleness. Regular inspections are essential to identify and address these vulnerabilities before they escalate into significant problems.
4. **Material Quality Deficiencies:** In some cases, defects arise from the membrane's manufacturing process, suggesting insufficient quality assurance and quality control (QA/QC) protocols. Such issues underscore the importance of sourcing materials from reputable manufacturers.

The eRaptor 2.0 PRO Arc-Tester

The eRaptor 2.0 PRO Arc-Tester was developed for quality control of exposed geomembrane liners in compliance with ASTM D7953-20 standards. This technology provides precise and reliable leak detection, ensuring the integrity of the entire membrane surface. The process is as follows:

1. **Preparation:** The eRaptor 2.0 PRO Arc-Tester is grounded to the structure.
2. **Testing Process:**
    - The eRaptor sends modulated electromagnetic waves through the electrode.
    - The technician moves the eRaptor electrode across the membrane surface.
    - If the eRaptor detects a defect, it captures a modulated signal and sends it to the receiver for processing and evaluation.
3. **Defect Localization:**
    - The system alerts the technician to the proximity of a defect.
    - The technician performs a detailed survey to pinpoint the precise location of the damage.

The eRaptor is highly sensitive, capable of identifying even small leaks with exceptional precision, ensuring comprehensive quality control.

eRaptor 2.0 PRO with a Neoprene Electrode

Testing Recommendations

To maximize the effectiveness of flat roof membranes, we recommend the following testing sequence:

1. **Post-Installation Testing:** Conduct an initial test immediately after membrane installation to verify material quality and installation precision.
2. **Post-Subcontractor Testing:** Perform additional testing after any subcontractor work on the roof to identify potential damage caused during these activities.
3. **Annual Preventative Checks:** Schedule yearly inspections to detect wear and tear or incidental damage before they develop into significant issues.
4. **Emergency Inspections:** If a leak is identified, carry out immediate testing to locate the source and prevent further damage.

Conclusion

Electrical arc testing is an essential component of geomembrane roof maintenance. The data from last summer's surveys clearly demonstrates the value of regular inspections in identifying and addressing leaks promptly. By incorporating routine testing into maintenance schedules, building owners can extend the lifespan of their flat roofs, minimize repair costs, and ensure long-term performance.

For professionals in the geosynthetics industry, the message is clear: the integrity of a roof membrane cannot be taken for granted. Electrical leak detection, such as the eRaptor 2.0 PRO Arc-Tester, should be a cornerstone of any quality assurance program.

For more information on eRaptor 2.0 PRO Arc-Tester technology and its applications, contact ELIS Technologies or visit our website.

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