REDEFINING PRESSURE-TESTED PERFORMANCE: TESTING A CRITICAL VULNERABILITY IN PRE-APPLIED SHEET WATERPROOFING

Executive Summary

The standard industry hydrostatic pressure resistance test (ASTM D5385) fails to determine the entirety of sheet pre-applied waterproofing membrane system performance in real-world below-water table conditions. Based on field experience and understanding of key system details, EPRO developed a novel testing approach targeting the most critical vulnerability in sheet membrane systems: the T-lap seam. At these junctures, three separate waterproofing sheets converge and present installation challenges requiring accessory detailing and seaming. Upon review of publicly available information, the end laps and seams (T-lap) of a sheet waterproofing system have not been subjected to ASTM D5385. Therefore, more research is needed to determine whether the performance of a T-lap seam is equal to or greater than the rest of the system. Demonstrating EPRO's commitment to go above and beyond existing testing standards, EPRO subjected their own PreTak pre-applied sheet waterproofing membrane to their modified ASTM D5385 method to prove its performance in real-world below water table conditions.

1. Introduction

Waterproofing is a critical aspect of modern construction, essential for protecting structures from water ingress, preventing damage, and ensuring a structure's longevity. Hydrostatic pressure poses a significant challenge to waterproofing systems, particularly in below-grade structures exposed to high water table conditions. The ability of a waterproofing membrane to withstand such pressure without leakage is a key indicator of its performance and durability. In particular, the integrity of seams, especially complex configurations like T-lap seams in sheet membrane systems, is paramount, as these are often the most vulnerable points for water infiltration other than penetrations and/or other complex detailing locations.

This document details the rigorous testing of the PreTak membrane, a waterproofing sheet membrane designed to provide waterproofing performance for structures built in high water table conditions utilizing a novel and more significant approach to hydrostatic pressure resistance testing.

2. Significance of Seam Integrity and Test Configuration

ASTM D5385 is a widely recognized and respected standard for evaluating the hydrostatic pressure resistance of waterproofing membranes. While it provides a robust framework for assessing membrane performance, it is important to note that the test is not typically performed on complex seam configurations, such as T-lap seams, which are necessary in sheet membrane installations. T-lap seams, where three layers of membrane overlap at a perpendicular intersection, present a more challenging scenario for maintaining watertight integrity under hydrostatic pressure.

EPRO developed a new and novel approach, modifying the ASTM D5385 to prepare test specimens which include overlapped membrane longitudinal laps and end laps, forming a T-lap seam intersection. These test specimens are then tested to the ASTM D5385 standard with incremental increases in hydrostatic pressure to test the overall seam assembly hydrostatic pressure resistance at the T-lap seam.

3. EPRO PreTak Pre-Applied Sheet Waterproofing Membrane Test Material

PreTak is a 46 mil (1.2 mm) thick composite membrane, engineered for pre-applied waterproofing in horizontal underslab and vertical shoring wall applications, commonly known as blindside waterproofing.

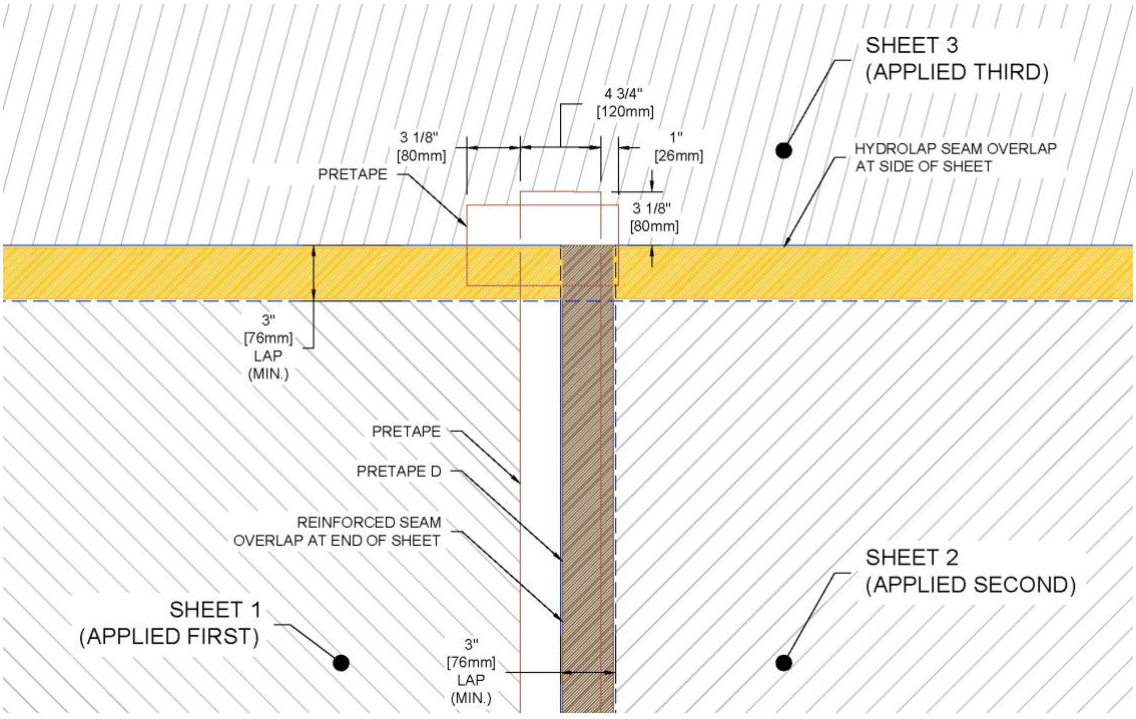
(Figure 1. – PreTak underslab and blindside wall waterproofing cross section.)

PreTak is comprised of an approximately 30 mil (0.76 mm) thick High-Density Polyethylene (HDPE) film. This HDPE layer is combined with a 16 mil (0.41 mm) layer of pressure-sensitive adhesive (PSA). The PSA bonds integrally to freshly placed concrete or shotcrete, fully adhering the PreTak membrane to the positive side of the structural element to prevent lateral water migration.

PreTak features a factory-applied adhesive selvedge, known as HydroLap, which facilitates an aggressive acrylic adhesive-to-adhesive bond at the membrane's edge overlaps.

The end lap seam, where HydroLap is not present, is reinforced using a system of double-sided tape (PreTape D) applied inside the seam and single-sided tape (PreTape) centered over the seam edge. Both PreTape and PreTape D are comprised of high-tack acrylic pressure-sensitive adhesives, contributing to a robust and watertight lap seam.

When these end lap seams come together in the field, the T-lap seam is a potential weak point in sheet waterproofing systems and should receive extra attention due to its critical importance in system continuity. As seen in the figure below, the HydroLap seam runs horizontally and the end lap seam runs vertically, forming a “T”, also known as a T-lap seam.

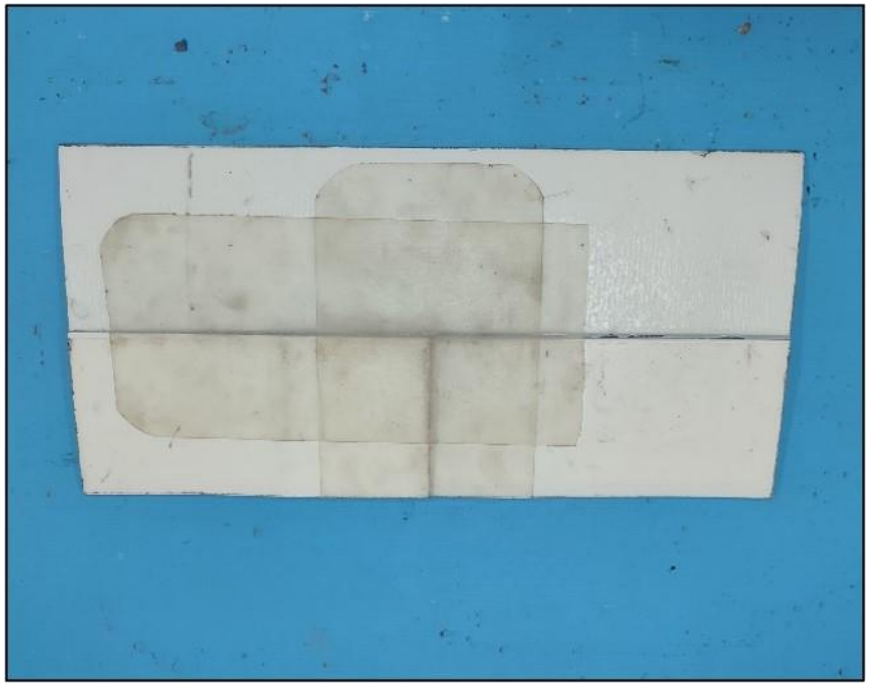


(Figure 2. – Plan view of T-lap seam configuration with successive PreTak sheets labeled.)

2. Test Material and Methodology

2.1 Test Material

Three separate T-lap seam samples of prepared PreTak membrane were submitted for testing.



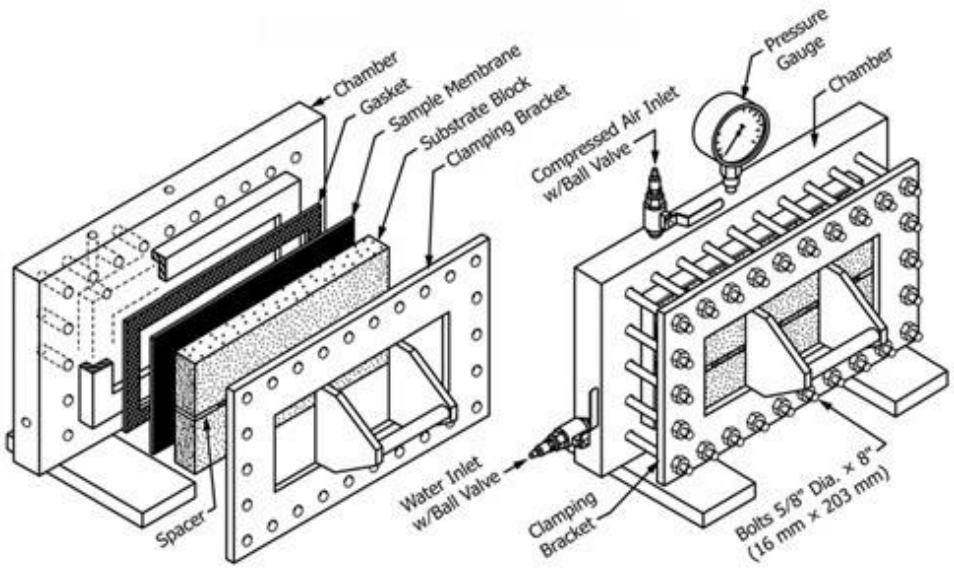
(Figure 3. – Test specimen with T-seam configuration. PreTape visible over seam.)

2.2 Method

The hydrostatic pressure resistance test was conducted in strict adherence to a modified ASTM D5385M-20 (ASTM D5385): Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes. ASTM D5385 measures the hydrostatic resistance of a waterproofing membrane under controlled laboratory conditions, providing a structured framework for assessing its ability to resist water penetration under specified hydrostatic pressures. The modifications, as outlined in the test report, specifically involved the preparation of samples with T-lap seam configurations and the casting of concrete directly against the membrane during sample preparation. The use of fresh-cast concrete versus the test prescribed concrete patio block best represents the real-world application of a pre-applied waterproofing membrane and allows for a more accurate evaluation of the membrane's performance in its intended use. The T-lap seam configuration subjects hydrostatic pressure to the most critical junction within a pre-applied waterproofing sheet system.

2.3 Apparatus

The hydrostatic testing equipment utilized included a chamber, a clamping bracket, and the necessary gasket and fasteners to form the complete assembly. A conditioning room with forced-air circulation maintained the temperature within a maximum variation of ±4°F (±2°C) from the test temperature. The compressed air source provided pressure up to 100 psi (690 kPa) and was regulated by an air pressure controller capable of 15-psi (103-kPa) increments.



(Figure 4. – Test apparatus schematic. Ref. ASTM D5385-20.)

2.4 Specimen Preparation

Three identical separate test block specimens were prepared following the guidelines of ASTM D5385 with noted modifications:

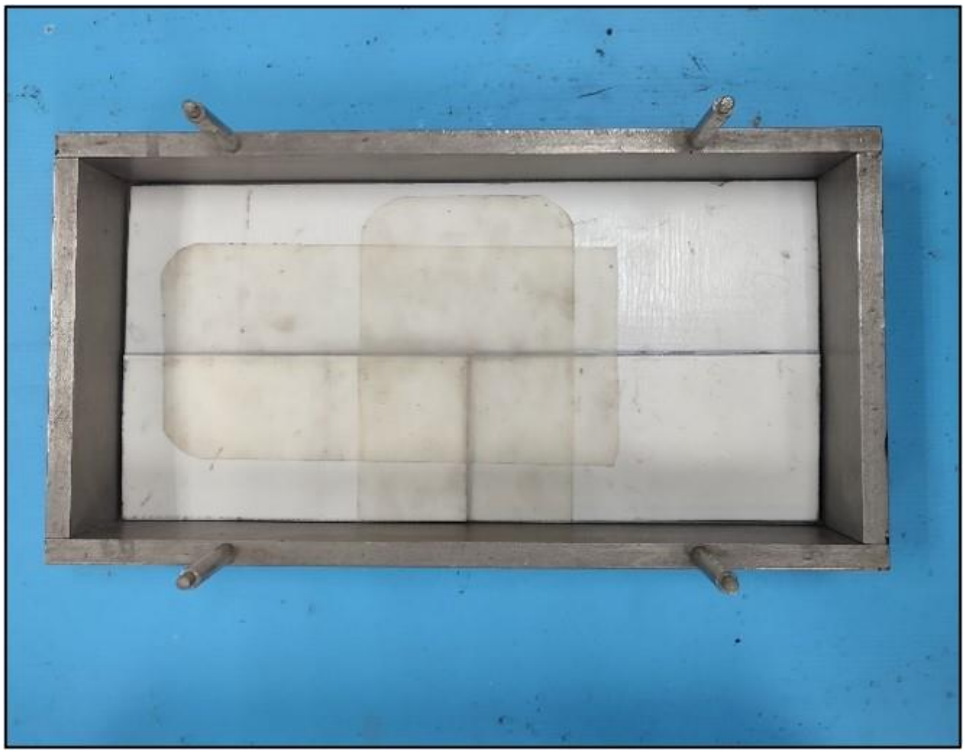
Sample Size: 23.6 in.×16.1 in. (600 mm × 410 mm)

Membrane Lap Width: 3.1−3.3 in. (80−85 mm)

Tape Lap Width: 4.7 in. (120 mm)

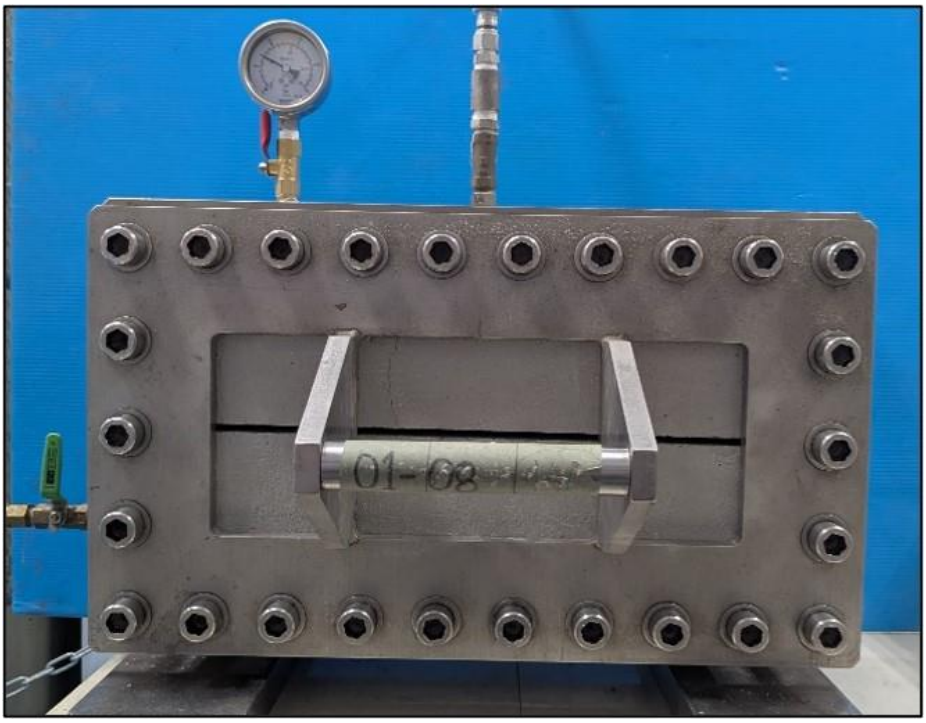
Overlapped Membrane Sample: Three overlapped membrane samples were prepared with each piece of the PreTak membrane trimmed to the required dimensions for test block preparation. This preparation specifically included the formation of T-lap seam overlap configurations to assess the membrane's performance at these critical seam junctures.

Test Block Specimen Preparation (Concrete Casting): A metal frame mold was utilized to prepare the test block according to the standard dimensions. The trimmed membrane samples were laid on the base of the metal frame with their adhesive surface facing upwards. Fresh concrete was then poured directly onto the adhesive surface of the membrane. The concrete mixture was designed to meet the requirements of a 5800 psi (40 MPa) compressive strength with a target density of 150 pounds per cubic foot (2400 kg/m³) and a nominal maximum coarse aggregate size of no greater than 3/4 inch (20mm). The design was developed in accordance with ACI 211.1-91, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.[2]



(Figure 5. – Metal frame for concrete casting with test specimen.)

- **Conditioning:** After the cast concrete hardened, the test block specimen was removed from the metal frame mold and air-cured for at least 28 days at lab ambient conditions before kerf cutting and testing.
- **Kerf Preparation:** A kerf approximately 1/8 in. (3.2 mm) wide and 1/4 in. (44 mm) deep was cut lengthwise down the center of each conditioned test block specimen. Three such blocks were prepared for the membrane testing.



(Figure 7. – Test apparatus with kerf shown.)

2.5 Test Procedure

The testing procedure involved a systematic application of increasing air pressure to the test specimens:

1. **Initial Monitoring:** The assembly was monitored for 30±0.5 minutes for any leaks through the joints between the blocks at 0 pressure.
2. **Pressure Increments:** Pressure was applied with increments of 15±1 psi (approximately 103 kPa).
3. **Pressure Maintenance:** Each pressure increment was maintained constant for 60±0.5 minutes.
4. **Maximum Pressure:** The test continued up to a maximum pressure of 100±1 psi (690 kPa), with the last pressure increase being 10±1 psi.
5. **Leakage Observation:** Throughout the test, all three specimens (S1, S2, S3) were continuously monitored for any signs of water leakage.

3. Test Results

The results of the hydrostatic pressure resistance test demonstrate the performance of the PreTak membrane under gradual increases in hydrostatic pressure. The table below summarizes the observations at each pressure increment:

Test Pressure (kPa)	Test Pressure (psi)	Test Pressure (Foot head)	Specimen S1	Specimen S2	Specimen S3
0	0	0	No Leakage	No Leakage	No Leakage
103	15	33	No Leakage	No Leakage	No Leakage
206	30	67	No Leakage	No Leakage	No Leakage
310	45	100	No Leakage	No Leakage	No Leakage
415	60	134	No Leakage	No Leakage	No Leakage
517	75	167	No Leakage	No Leakage	No Leakage
621	90	201	No Leakage	No Leakage	No Leakage
690	100	234	No Leakage	No Leakage	No Leakage

No water leakage was observed across any of the three test specimens at the maximum applied pressure of 234 ft head (690 kPa). This outcome confirms the PreTak membrane's high hydrostatic pressure resistance at the T-lap seam.

Conclusion

A waterproofing membrane's overall effectiveness is only as strong as its weakest seam. To address this, EPRO developed a novel and more rigorous test method, modifying the ASTM D5385 standard to specifically evaluate the most critical junction, the T-lap seam.

The successful "no leakage" result at the maximum applied pressure of 234 ft head (690 kPa) demonstrates that the EPRO PreTak membrane, its integrated HydroLap seam technology and accessory tapes provide superior hydrostatic pressure resistance. This performance is a testament to the membrane's reliable adhesion and inherent strength at its most vulnerable point.

This outcome highlights EPRO's commitment to delivering high-quality, dependable waterproofing solutions that exceed conventional testing standards and provides confidence for demanding below-water table applications.

Further testing, including a method for testing lateral water migration resistance under hydrostatic pressure at the T-lap seam, is now in development. The added element of lateral water migration resistance will provide an even more stringent understanding of pre-applied waterproofing membrane performance in hydrostatic conditions. EPRO will be setting a new benchmark for the industry.

[1] ASTM D5385M-20, "Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes," ASTM International, West Conshohocken, PA, 2020.

[2] ACI 211.1-91, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.