# Precidium™ ECS vs HDPE Seam Testing

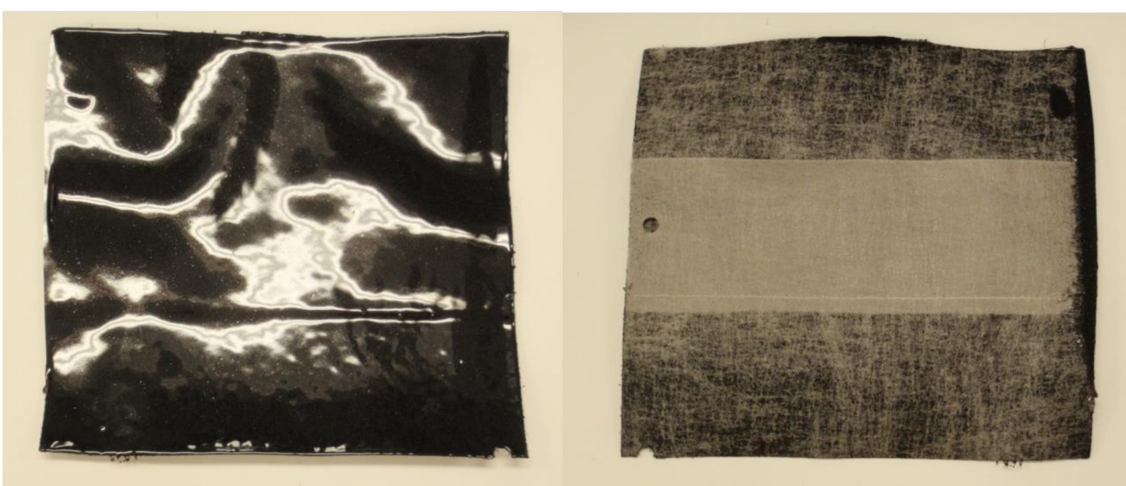
## *Background*

Both Polyurea and High Density Polyethylene (HDPE) are suitable and utilized for primary and secondary containment. HDPE sheets are fusion welded together in the field to create a liner, and repairs are often extrusion welded. Polyurea liners have the option of joining pre-sprayed sheets or spraying completely in place. Joints and repairs both utilize the same method, preparing the surface if necessary and then spray applying polyurea to a specified thickness. This method creates a seamless monolithic layer that is chemically bound to both sides of the seam.

The purpose of this test report is to determine behavior and properties of both polyurea and HDPE at seams.

## *Sample Preparation*

**Precidium™ ECS**, a pure polyurea with a 1:1 mix ratio, was sprayed on Typar geotextile to a thickness of 30-40 mils at a seam created by sewing together two separate sheets of Typar. Application was done using a Graco EXP-2 plural component proportioner equipped with a Fusion AP gun and AR4242 mix module. The sample was allowed to cure for seven days, at which point ASTM D-412 Die C dogbones were cut from across the seam as well as from open geotextile for baseline testing.



*Above:* Precidium™ ECS seam topside (left) and bottom (right)

A certified HDPE installer prepared field joints and field repair samples of textured 60 mil HDPE for testing. Both the joint and repair samples were tested by the HDPE installer using in the field techniques to ensure samples met usual industry requirements. Sample dogbones were cut using the same method as for the polyurea.

## *Test Method*

Tensile Strength and Elongation were evaluated as per ASTM D412.

## *Results*

**Tensile Strength at Maximum Load & Elongation at Break (ASTM D412)**

Samples of High Density Polyethylene (HDPE), **Precidium$^{TM}$ ECS** were made and tested as per ASTM D412 (Die C) using an Instron Universal Testing Machine. Crosshead speed was 500 mm/min. HDPE is generally tested at a lower crosshead speed of 50 mm/min; this is customary as the crystalline and generally more stiff nature of HDPE is not suited to fast deformation rates and yields better results at slower rates. Precidium$^{TM}$ ECS does not have this limitation and behaves uniformly under both fast and slow deformation conditions. Results in the table below are averaged results. Tensile strength was calculated using the thinnest point on the seam as measured with a calibrated digital microscope.

| Material | Tensile Strength | Elongation at Break |
|---|---|---|
| | (psi) | (%) |
| **Precidium$^{TM}$ ECS on Typar** | 2278 | 143 |
| **Precidium$^{TM}$ ES on Typar – Seam** | 2268 | 135 |
| **HDPE**** | 3627 | 150 |
| **HDPE Welded Seam** | 4566 | 2.5* |
| **HDPE Extrusion Weld Repair** | 4275 | 1.2* |

*Table 1:* Results of tensile and elongation testing

*The extensometer measures elongation across a specific gauge length. In the case of the seam and repair samples, the elongation took place at only one small stress concentration. Elongation at that point was greater than reported values, but was severely depressed compared to baseline HDPE samples.

**The HDPE was produced by a major North American Manufacturer

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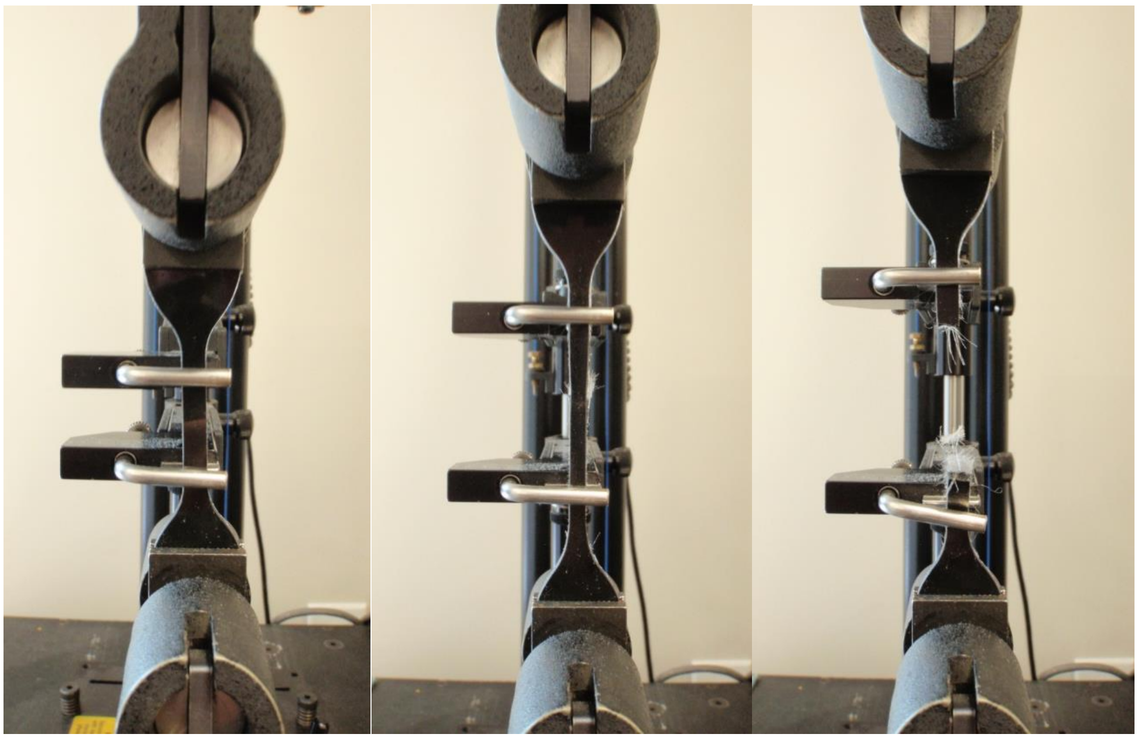
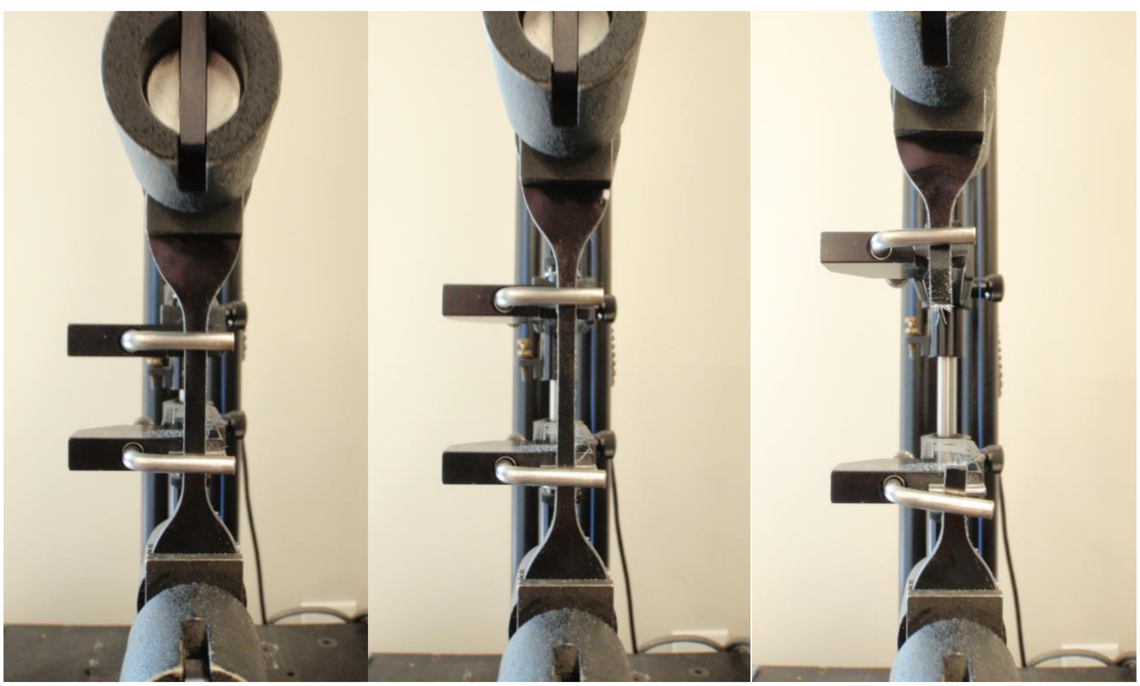
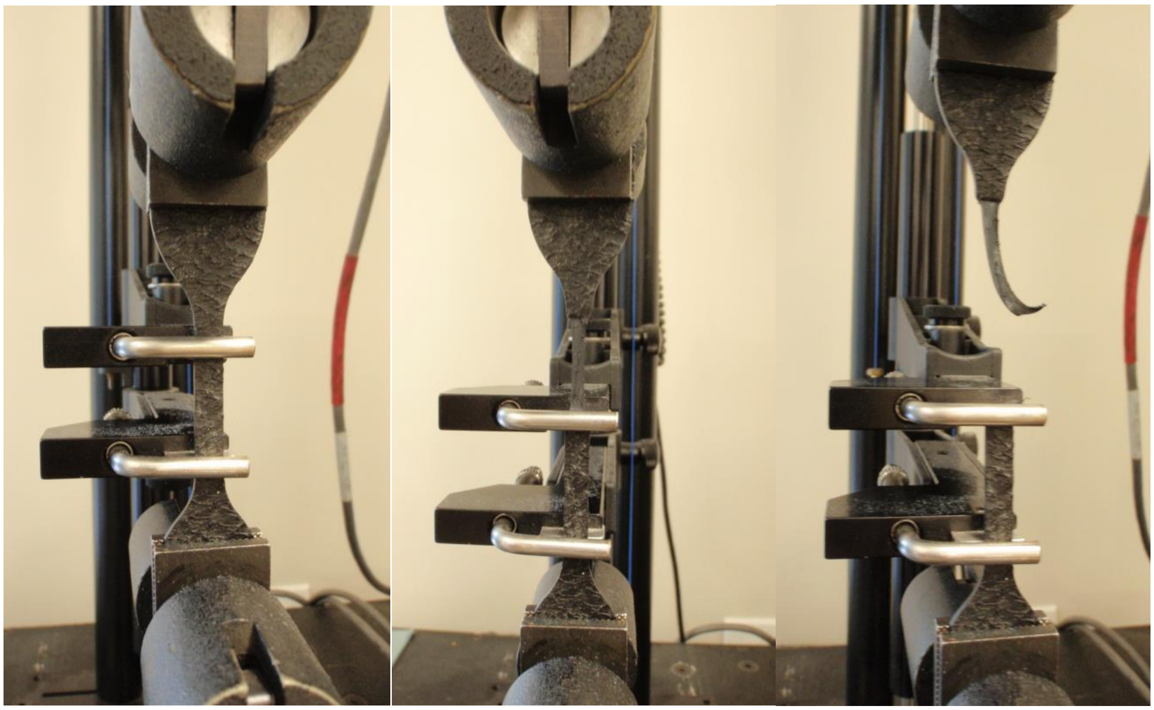


*Above:* ***Precidium™ ECS*** on Typar geotextile before, during, and after test



*Above:* ***Precidium™ ECS*** on Typar geotextile seam before, during and after test



*Above:* Textured 60 mil HDPE before, during and after test

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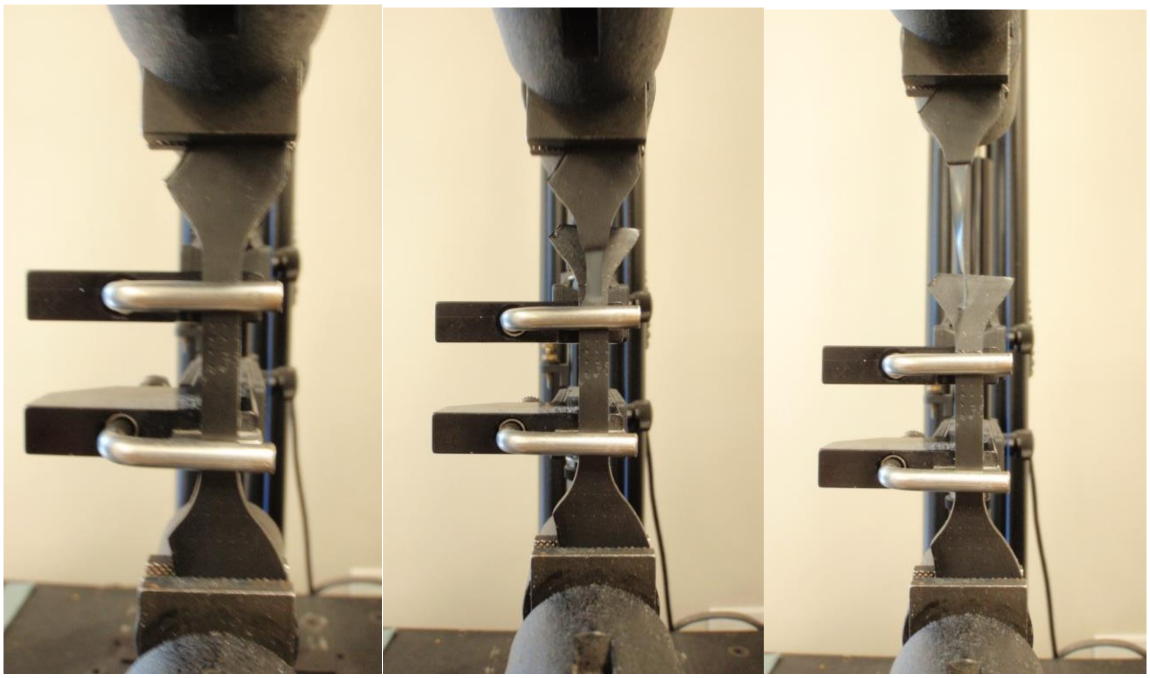
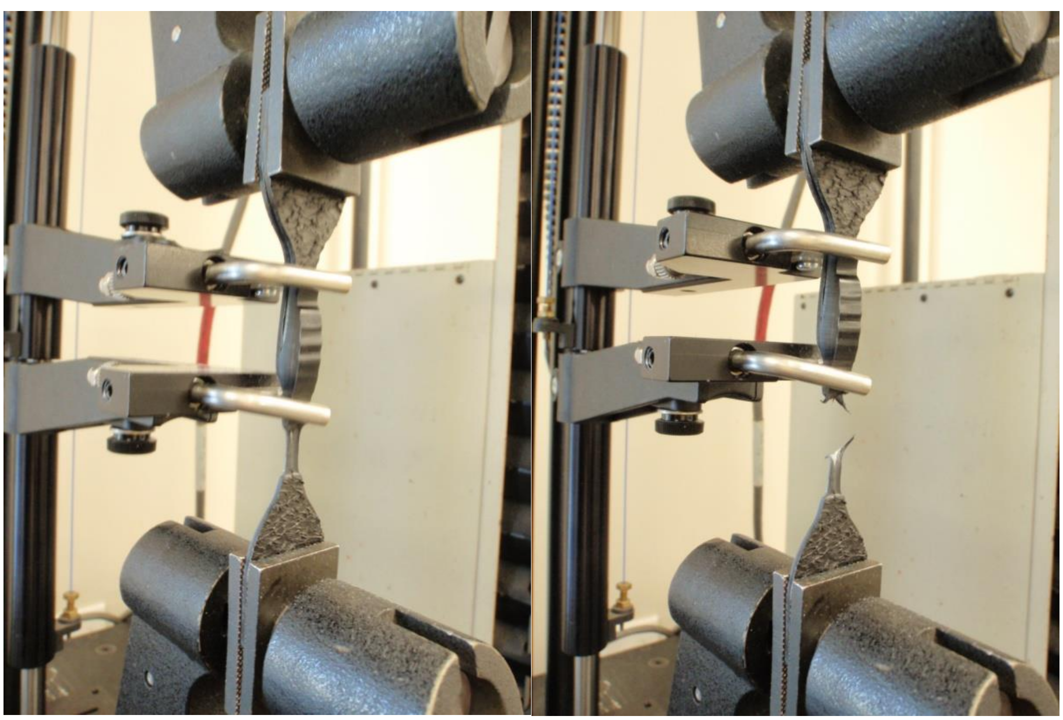


*Above:* HDPE fusion welded seam before, during and after test



*Above:* HDPE extrusion welding seam during and after test

## *Conclusions*

This testing showed polyurea as having a distinct advantage over both fusion and extrusion welded HDPE seams. When made following proper methods, the Precidium$^{TM}$ ECS seam exhibits almost identical properties to the rest of the membrane. This is the result of the seamless nature of polyurea. When sprayed within the recoat window, Precidium$^{TM}$ ECS will adhere to itself to a make a monolithic covering that has the same properties regardless of being on a seam or in the middle of a sheet. HDPE seams fail at the edge of the seam where a stress concentration forms and causes premature failure relative to HDPE from the rest of the sheet.

Also important to note is the difference in the amount of deformation between polyurea and HDPE. The polyurea samples spread the load out over the entire length and if not pulled to break would recover to almost the same size as before the load was applied. HDPE on the other hand begins to elongate from one spot when load is applied, and the elongation it completely plastic, which means even if it does not break it will not return to its initial state. This is critical when maintaining Directive 55, as a HDPE liner that is stressed and deforms may become too thin to meet the requirements. A polyurea liner would be able to take repeated stress and recover the majority of the thickness to maintain compliance.