Advanced Piping Products
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ProTek Wear Pad Test Reports

ProTek Composite Material

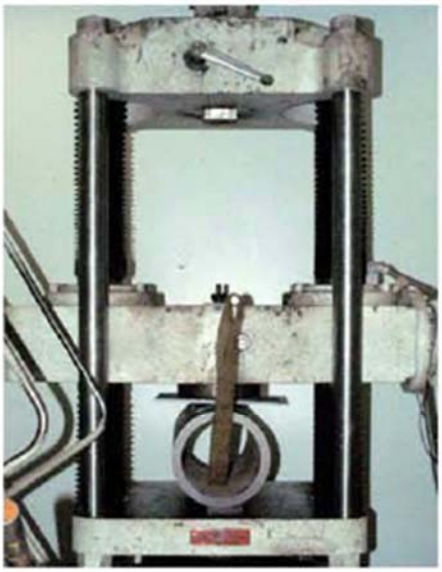
Compression Test – Mechanical Property

The ProTek Wear Pad compression test was requested by Chevron for their Mafumeira Norte Offshore Platform project. Compression testing demonstrates the wear pad's ability to withstand the large compressive loads it could be subjected to, such as from heavy pipe or structural components coming down on the pipe.

Test Specification: ASTM E8.

Product Tested: 10 inch wear pad (10" X ¼" X 60 deg. X 14") attached with APP Epoxy to a 2-foot long, 10 inch, schedule 120 double extra-heavy pipe.

Test Set Up: 8-inch wide flat composite piece (simulated I-beam) was placed transverse to the longitudinal axis of the pipe and ProTek Wear Pad.



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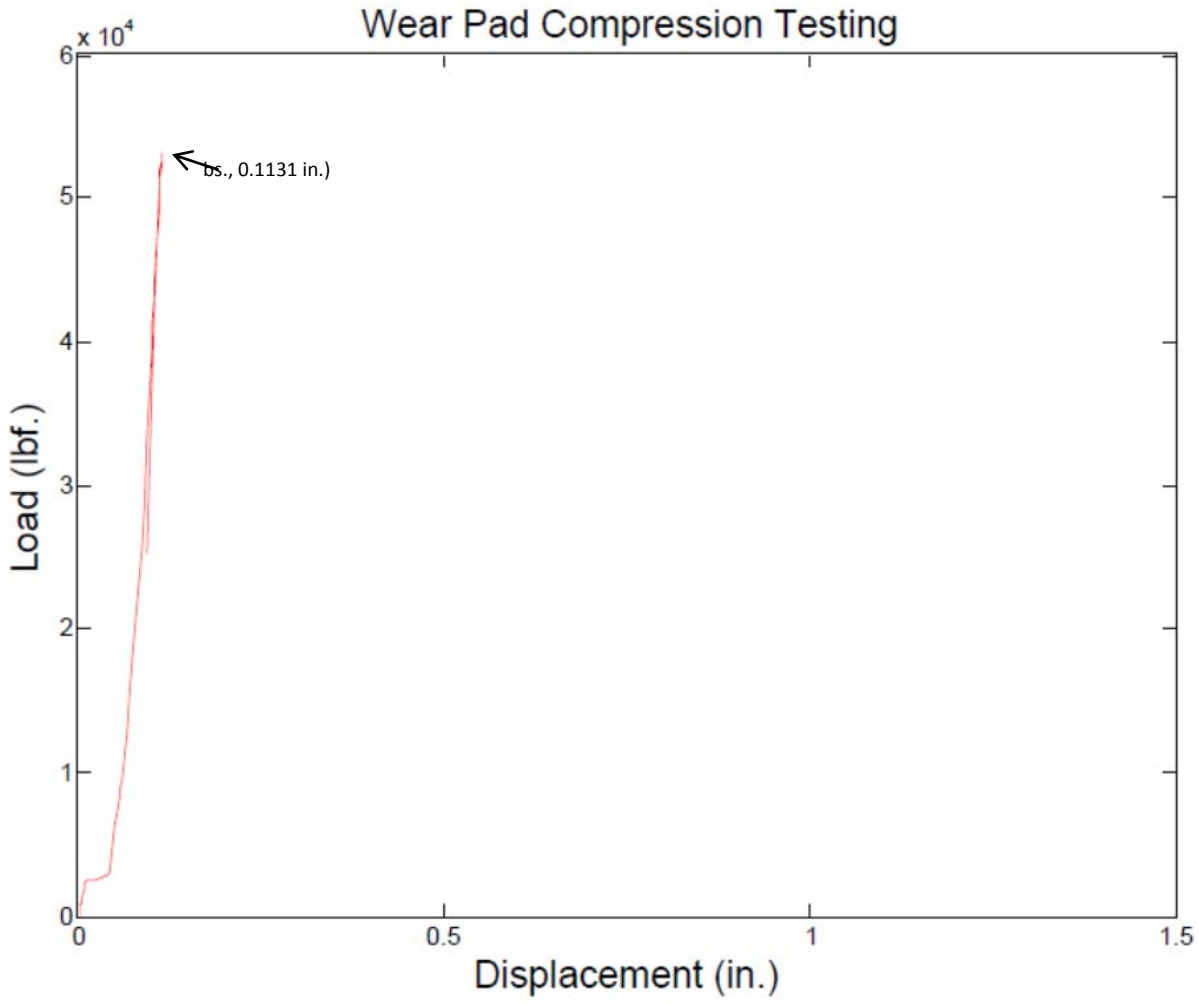
Compression Test Results: The Chevron test requirement was that the ProTek Wear Pad could handle a compressive load of 24,000 pounds. The results exceeded the test requirements by more than 220% with no evidence of damage incurred by the ProTek Wear Pad. The testing was stopped at 53,300 pounds due to ovalizing of the carbon steel pipe, not failure of the wear pad.

Chevron Minimum Requirement	Compressive Load	Exceeds Requirements
24,000 lbs.	53,300 lbs.	29,300 lbs.

Below is the load vs. displacement graph for the compression test:



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Frictional Abrasion Wear Test – Mechanical Property

Pipes are subjected to movement due to changes in temperature, load, or other operating variables. A frictional abrasion wear test demonstrates how APP ProTek Wear Pads are not affected by this movement and are engineered to last.

Product Tested: AeroTek Cradle (made out of ProTek Composite material) (15" X ¼" X 120 deg. X 14") (cradle ID X thickness X degrees of coverage X cradle length).

Test Set Up: AeroTek Cradle banded to a 4-foot long section of insulated 12-inch pipe. The pipe was insulated with 2 layers of 10-millimeter Aerogel Pyrogel XT jacketed with 3/16 inch corrugated aluminum. This apparatus was sitting on an I-beam with and 8-inch wide flange.

Test Procedure: Load of 3,000 pounds was applied to the cradle. The test apparatus was moved longitudinally across the I-beam (4 inches in each direction). This was to simulate thermal cycling over 20 years of operation, with a safety factor of 4.

Abrasion Wear Test Results: The cradle only exhibited slight dusting of the ProTek Wear Pad after 150 cycles.

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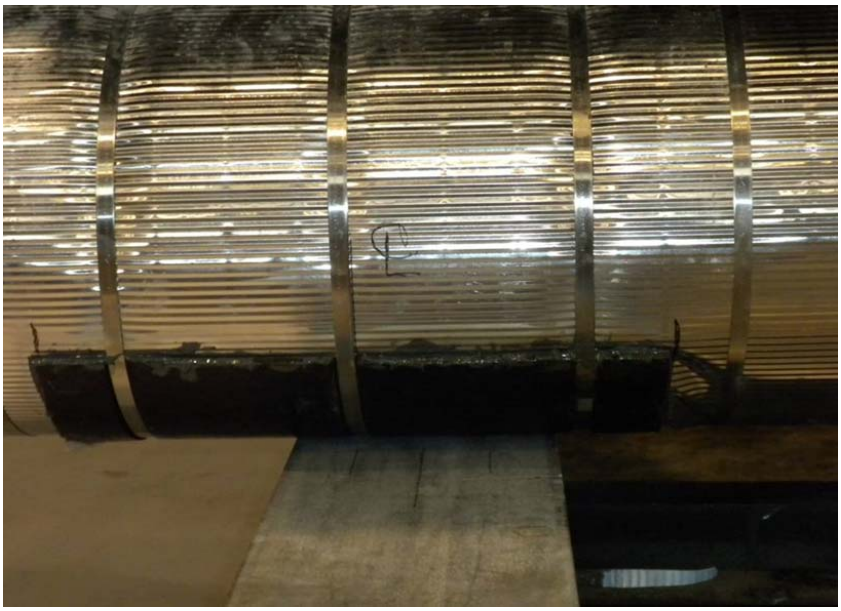
Below are photographs of the cradle after 150 cycles, signifying 20 years in service:



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APP Epoxy Adhesive

Shear Strength Test (Tensile) – Mechanical Property

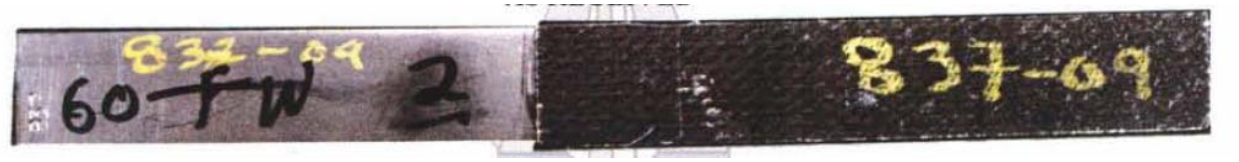
The epoxy we use was developed for aerospace applications and is specifically formulated to bond lightweight composites to metallic materials. These shear testing results demonstrate our epoxy's ability to withstand large loads in multiple directions without losing its adhesion integrity.

Test Specification: ASTM E8.

Test Type: Lap shear tensile test.

Test Set Up: APP ProTek composite material was connected to a flat piece carbon steel using APP Epoxy. The overlap section was 1 square inch.

Below is a photo of the test sample:



A tensile testing machine was used to determine the lap shear tensile strength of APP Epoxy.

Below is a photo of the tensile testing machine:

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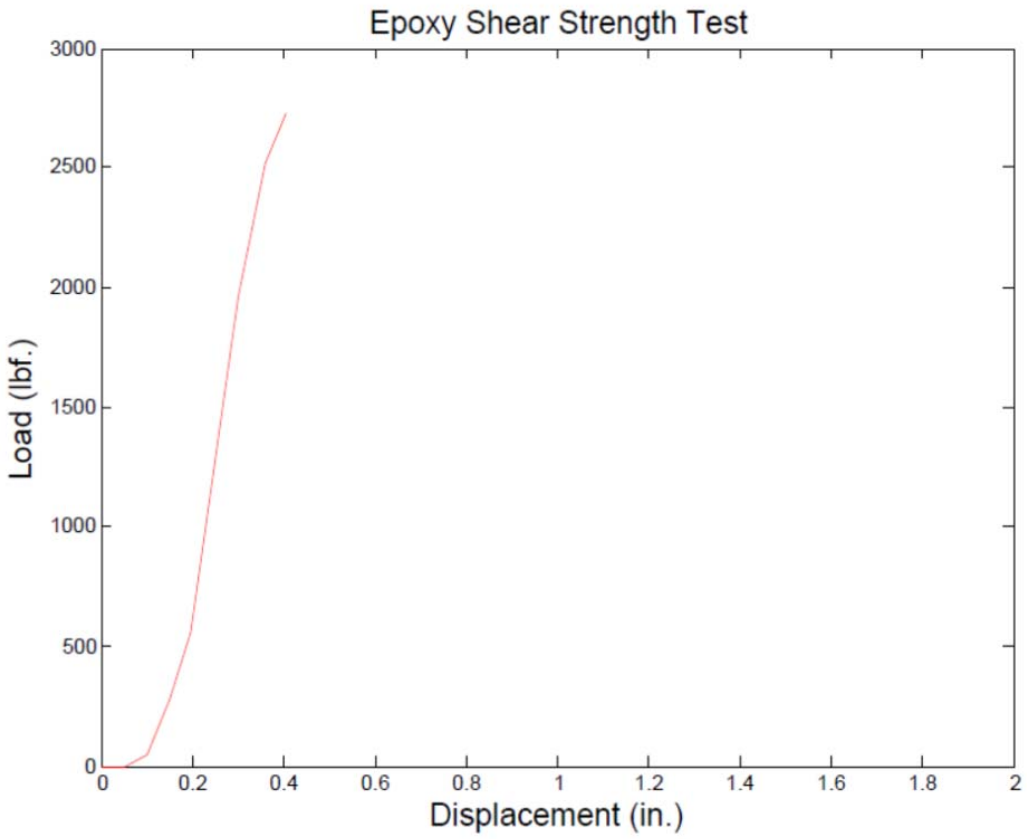
Test Results: The glue failed at a load of 2,730 pounds. The sample section was 1 square inch, meaning APP Epoxy exhibits a shear strength of 2730 psi. The test also demonstrated the epoxy's ability to expand more than 40 percent, meaning the material will flex with the piping system as opposed to failing upon loading and pipe expansion and contraction.

Tensile Test Results	
Ultimate Strength	2730 psi
Modulus	7300 psi
Tensile Elongation	41.3%

Below is the load vs. displacement graph for the shear strength test:



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APP Epoxy Adhesive

Shear Strength Test – Mechanical Property

Product Tested: 180 degree coverage ProTek Wear Pad epoxied to a 14 inch pipe. The wear pad had a raised 1” X 3” integral band. The client was using ProTek Wear Pads with a band as anchor points on their ships.

Test Set Up: Compression test machines were used to apply a load to the raised ring. This applied load simulated the force of an I-beam coming down on the integral band.

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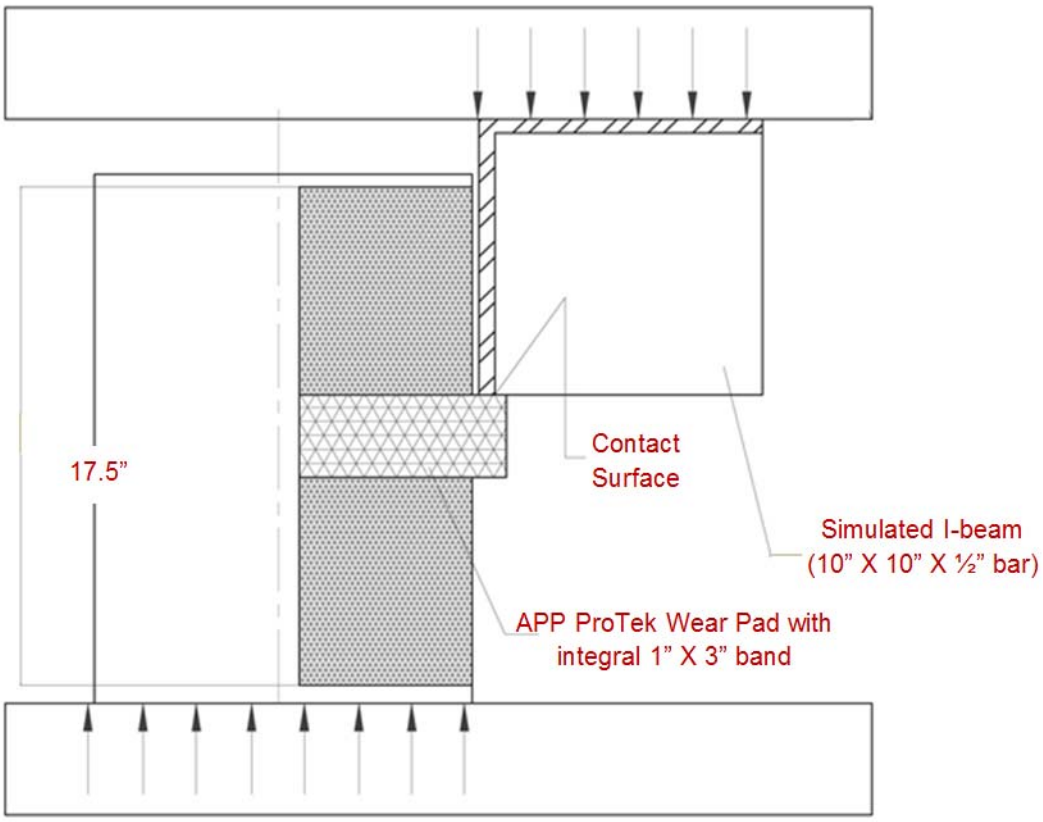
Below is a diagram of the test set up:



Test Results: The epoxy was found to be able to handle overlap shear loads in excess of 44,000 pounds. The test was ended at a load of 44,437 pounds because the raised ring had been point loaded and had begun to crack, but even at this high load, there was no epoxy failure or separation of the pipe from the wear pad.