

# ASME PCC-2 & ISO 24817 Certification Document

Western Specialties Ultra-Wrap Repair System

Prepared for:  
**Western Specialties, LLC**  
Lake Forest, California

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## Executive Summary

Stress Engineering Services, Inc. (SES) was contracted by Western Specialties, LLC (WS), to perform an independent technical assessment of their new E-glass / epoxy composite repair system, Ultra-Wrap™ (Ultra-Wrap), with respect to the qualification requirements of ASME PCC-2-2015, Repair of Pressure Equipment and Pipe, Article 4.1, Nonmetallic Composite Repair Systems for Pipelines and Pipework: High-Risk Applications.

The ASME PCC-2 standard provides composite manufacturers and operators a comprehensive and uniform approach for the proper design of composite repair systems based on coupon material properties and overall system performance using full-scale testing. Included within this review of the WS Ultra-Wrap repair system is a comprehensive assessment to validate that the repair system is adequately designed in accordance with ASME PCC-2. The emphasis in the work performed by SES is on the repair of corrosion defects in high pressure transmission pipelines.

In addition to full-scale testing, SES performed numerous coupon tests to address performance variables including tensile strength, elastic modulus, glass transition temperature, shear strength, and cathodic disbondment. Coupon tests are important to qualify the components of a composite repair system before performing full-scale testing. However, coupon tests are not sufficient in and of themselves to qualify a system. The qualification of a composite system per ASME PCC-2 requires full-scale testing to evaluate the total performance of the system in repairing defects such as corrosion and dents. An example of full-scale testing involves the repair of a simulated corrosion in a pipe sample. The corroded test sample is repaired using a composite material having a specified thickness and length per the ASME PCC-2 design calculations. The test sample is pressurized to failure to determine if the composite material has adequate strength to achieve a minimum test pressure. Qualification in this regard involves limit state testing to ascertain the ultimate capacity of a reinforced corrosion section.

In addition to the testing required by ASME PCC-2, before SES certifies a composite repair system two additional tests are required. Both involve the repair of pipe samples made using 12.75-inch x 0.375-inch, Grade X42 pipe with 75% deep corrosion. The first test is a static pressure test to failure. Strain gages are used to measure both strain in the reinforced steel and also measure inter-layer strains in the composite material. The inter-layer strains are used to compute hoop stresses that are compared to the composite design stresses per ASME PCC-2. The second test involves pressure cycle testing a corrosion sample of the same configuration mentioned above to either failure or a run-out condition (i.e. 250,000 cycles). In this test, strain gages also provide useful information on the predicted long-term performance of the repair.

The comments below provide specific insights on the performance of WS Ultra-Wrap repair system including the ASME PCC-2 1,000 hour tests used to determine the long-term strength of the composite material and the two additional SES-required tests that were mentioned in the preceding paragraph. All of these tests are critically important in terms of qualifying the product performance.