



Evaluation of the CompsiSleeve™ Pipeline Repair System

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EXECUTIVE SUMMARY

Over the past three years Stress Engineering Services, Inc. has worked with Western Specialties and LMC Industrial Contractors, Inc. in evaluating the ComposiSleeve^{TM} pipeline repair system. The ComposiSleeve^{TM} system employs a hybrid technology combining advanced adhesives, steel half shells, and a water-activated urethane E-glass composite system. Each component in the system provides a vitally important role in reinforcing damaged sections of a pipeline. The main focus of the current report includes Stress Engineering's assessment of the repair of severe corrosion subjected to cyclic pressures and burst tests.

The evaluation process involved full-scale testing where the ComposiSleeve^{TM} repaired a test sample fabricated using 12.75-inch x 0.375-inch, Grade X42 pipe having a 75% deep corrosion section. The tests involved both burst and pressure cycle to failure tests. This sample type has been used in previous studies evaluating composite repair technology. For the past five years Stress Engineering Services, Inc. (SES) has been the Principal Investigator in four research programs co-sponsored by the Pipeline Research Council International, Inc. (PRCI) studying the performance of 13 different composite repair systems. One program in particular, MATR-3-4, is focused on evaluating the long-term performance of composite materials used to repair corroded pipelines. In this study strain gages were used to monitor strain in the steel beneath the composite materials. This permits SES to compare the relative performance of the competing composite technologies. These data are useful in comparing the relative performance of the ComposiSleeve^{TM} system to other repair systems.

During the burst testing phase of the current study, the strain in the steel beneath the ComposiSleeve^{TM} repair at a pressure level equal to 72% SMYS was measured to be 1,610 με, whereas the average for all composites in the PRCI study at the same pressure level was 4,497 με. At 100% SMYS the ComposiSleeve^{TM} and PRCI-average values were measured to be 2,370 με and 5,692 με, respectively. The ComposiSleeve^{TM} sample failed at a pressure of 4,374 psi, a pressure value that is approximately 2.5 times the operating pressure (72% SMYS) of the pipeline. In the pressure tests a total of four repair configurations were evaluated, including different E-glass material thicknesses, as well as one sample having no composite material with only the steel sleeves attached via adhesive to the pipe. Even this sample achieved significant strains reductions in the reinforced region of the pipe when compared to the PRCI average values.

In addition to the burst tests, SES performed a pressure cycle test on a ComposiSleeve™ sample having the same corrosion configuration as the burst test samples. This sample was pressure cycled from 36% to 72% SMYS until a failure occurred. SES has performed this type of test on eight different composite repair systems, with the cycles to failure for one sample being a low as 19,411 cycles. The ComposiSleeve™ failed after 767,816 pressure cycles had been applied. To achieve this number of cycles multiple weld repairs were required to the welds attaching the end caps to the test sample.

This report also provides details on three other programs evaluating unique applications of the ComposiSleeve™ system in reinforcing various pipeline features and anomalies. These include the repair of leaking pipes, reinforcing pipes subjected to bending loads, and evaluating an increase in overburden capacity of a reinforced pipeline.