

NACE Testing with Proven Internal and External Coatings



Challenge

The oil and gas industry has worked to protect oilfield equipment from the different operational environments to improve longevity of CAPEX and rental equipment for profitability, safety, and environment for both the operator and the service provider. Huge strides have been made over the past 2-3 decades in equipment grades, strengths, connections, and protective coatings.

Plastic and epoxy coatings have been applied to the internal diameter for tubing and drill pipe over this time period as a protection from corrosion. With more than 20 years of global service, TK-34XT™ liquid epoxy coatings have proven to be a very reliable product for drilling, completion, fracking, acid stimulation, and high temperature (in excess of 400 degrees F) applications. It has been the standard for drill pipe, completion pipe, and workstrings for the past 20 years.

External diameter tubular coatings to mitigate corrosion have been more challenging for the industry due to durability during operations, flexibility for inspection, and cost drivers. Over the past 5 years Workstrings International has proven an external coating, Rust Grip™, which has met these challenges for the industry and has saved significant cost, time, and tubular life with no operational issues.

The Tuboscope TK-34XT™ internal coating is normally applied a single time after the pipe manufacturing process. The Rust Grip™ external coating is applied by cleaning and preparing the external surface. The coating is applied with an airless spray system providing a complete and uniform coverage. The external coating is reapplied between deployments.

As the industry explores new areas and further develops existing fields, H₂S has become more prominent in the design parameters. In existing fields where water flooding has created a mild presence of H₂S, this can still pose a challenge for equipment and even for permitting the projects. In exploration areas having increased levels of H₂S or CO₂ has always been very challenging for equipment, safety, as well as regulatory. The common internal coatings such as TK-34XT™ have never been declared as sour service protection especially because it is not always declared “new condition”. The external coating is relatively new to the industry and does not have a history in a sour environment.

The major goal when operating in a sour service environment is to **control the environment** so there is no, or minimal, contact of the equipment with wellbore fluids containing H₂S or CO₂. It is often a challenge to control the grade of all equipment in service to the level of protection (or design). High concentrations of H₂S with increased exposure time will cause an issue with any grade of metal. As the internal and external coatings are not a perfect shield for the tubulars, they are a barrier. Especially in a mild sour service environment, Region 1 or Region 2, where higher grade tubulars could be deployed with applied internal and external coatings and the environment controlled. Posed with this challenge, Workstrings took the initiative to have NACE testing done on TK-34XT™ internal coating and Rust Grip™ external coating which are their standard tubular coatings.

Test

The test was conducted per NACE TM0177-2016 Method A tensile test to determine the sulfide stress cracking (SSC) resistance of various steel samples coated and uncoated. The pipe manufacturer’s standard vendors for test sample preparation and NACE testing were used for this project. NACE samples were prepared from the weld area of V-150 grade pipe. The weld area seems to be of most concern among operators and the NACE samples would include tool joint, pipe, and HAZ areas. Solution D was chosen which is defined as 7% H₂S and 80% stress level for 720 hours of exposure.

Test Results

Specimen	Type of Coating	Stress Level (ksi)	Test Result	# Hours at Failure
1	Uncoated	96	Failed	123.6
2	Uncoated	96	Passed	N/A
3	Uncoated	96	Failed	328.8
4	RustGrip®	96	Passed	N/A
5	RustGrip®	96	Passed	N/A
6	RustGrip®	96	Passed	N/A
7	TK-34XT™	96	Passed	N/A
8	TK-34XT™	96	Passed	N/A
9	TK-34XT™	96	Passed	N/A

Sulfide Stress Cracking (SSC) Test Results for the Steel and Coating Products
(75°F Test Temperature)

Conclusion

This testing is positive for the coatings in that there were 2 uncoated high grade 150ksi samples that failed the testing while all 3 Rust Grip™ samples passed and all 3 TK-34XT™ samples passed. These results show that the coatings create a barrier to the metal. For mild sour service environments, Region 1 and Region 2, the coatings could be beneficial for deploying higher grade tubulars for operations, especially in conditions where higher strength tubulars are required and no sour service options are readily available. This can lower the total cost of ownership for both operator and service provider by using available tubulars with proper coating.

These coatings have proven themselves very successfully as barriers to corrosion in standard environments of salt-based fluids from seawater to heavy completion fluids with no additional chemicals. With the benefit of both the internal and external proven coatings the testing shows benefits as a barrier in a Region 1 and Region 2 sour service environment. With the environments controlled with pH and scavengers, the potential for improved mitigation is increased.

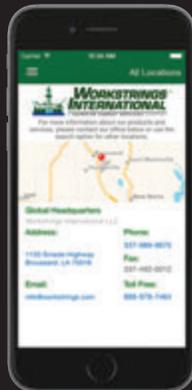
Note: The coating manufacturers are not promoting these coatings as sour service products. There will always be imperfections in the coating process and imperfections due to normal handling and operations.



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