

Update for QT-1300™ Developed to Extend Coiled Tubing Operating Envelopes

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Agenda

- Background
- Field Uses
- Equipment Compatibility Testing
- Sizes and Lengths Produced
- Welding
- Sour Gas Corrosion Testing
- Fatigue Testing

Background

- NOV Quality Tubing has developed QT-1300™ with a minimum yield strength of 130,000 psi (~896 MPa).
- Background on this development was initially shared presented at the Roundtable in 2010.
- Higher strength tubing can expand the operating envelope for coiled tubing.
 - Higher pressures
 - Higher axial loads

Coiled Tubing Then and Now

	1997 ¹	2009 and Beyond...
Maximum Pressure	5000 psi	Occasionally reaching/exceeding 10,000 psi
Maximum Length	15,000 feet	Exceeding 20,000 feet with long laterals
Required yield strength	70 – 90 ksi	100 and 110 ksi available Could you go higher?

1. ASM Handbook, Volume 19: Fatigue and Fracture. "Fatigue of Coiled Tubing." McCoy, Terry and Foster, Jerry. 1997: Materials Park, Ohio.

QT-1300™ is our newest offering in response to current demands



Field Successes

- OFFSHORE
 - North Sea (SPE 143079): TCP runs; guns retrieved instead of being dropped into a “rat hole”. Work has been ongoing since 2010
 - Gulf of Mexico: Intervention operations for shallow water in GoM
 - Contingency strings for Operators

Field Uses

- ONSHORE
 - Marcellus Shale in Northeastern USA. Tubing was used to 60+% of fatigue life and retired.
 - Bakken, Rockies and Eagleford in the USA. Coiled Tubing Service company has used 12 strings of QT-1300™ in various shale plays in the USA.
 - Successful operation with CT unit
 - Successful chemical cutting (behavior reported as similar to other CT grades) upon becoming stuck

Sizes and Lengths Produced

- Historically:
 - 1.750”OD & 2.000”OD
 - Wall Thickness from 0.134” to 0.203”
- New Offerings:
 - 2.375”OD
 - Wall Thickness up to 0.236”
- Lengths Produced:
 - In excess of 800,000 feet milled to date
 - 39 Strings produced to date

CT Equipment Testing

- Shear Testing
 - Successfully performed on 2.000”OD x 0.203”WT
 - Prior testing on SPE 143152
- Connector Testing
 - Customer connectors have been tested
 - Field trials have utilized connectors
- Injector Testing
 - Performed by HydraRig and presented in SPE 143152

Sour Gas Corrosion Testing

- Performance in sour gas is expected to be similar to CT-100 or CT-110 grades
- Testing is being performed by a development partner.
 - Results will be published as an SPE Paper
 - In general, the tubing has been successfully utilized in sour wells with inhibitors and scavengers

Tube-to-Tube Welding

- Tube-to-tube welding procedure has been developed for QT-1300™.
- Regionally based welders will be qualified by the end of the 2013.
 - Houston
 - Western Canada
 - North Sea (Aberdeen)
 - Middle East (U.A.E)
- Fatigue testing is ongoing, initial results indicate that tube-to-tube weld performance is similar to predictive results for QT-1000.

Bias Welding

- This grade was described as “high strength coiled tubing” in 2010.
- Refinements to the bias welding procedure have been made to create a weld capable of meeting strength expectations for QT-1300™.

Fatigue Performance Evaluation (2010)

- Fatigue testing on Standard Fatigue test Machine
 - In excess of 350 samples tested over 72” radius
 - 36 samples tested over 48” radius
- Standard set of ASTM E606 strain controlled fatigue tests
- Used to develop algorithm for Flexor and commercially-available fatigue modeling

Fatigue Performance Evaluation (2013)

- Newer set of fatigue testing will be performed using T-Bird Fatigue Machine
 - Both bias weld coupons and parent tubing
- Data will be incorporated into commercially-available and proprietary customer fatigue modeling software
- Expected completion by end of Q1 2014
- Implementation in commercially-available fatigue modeling software in 2014

Thank You For Your Attention



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