

# Best Practice for Storage of Coiled Tubing

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# Agenda

- Background of CT Storage
  - Industry Best Practices
  - API Requirements/Suggestions
- Experimental Tests
  - The Opportunity
  - Test Plan
  - Results
- Conclusions

# Background/History

- CT Storage
  - Never a first choice but sometimes unavoidable
  - The primary issue is corrosion
- Industry Best Practices
  - Covered
  - No fluids in the ID
  - OD coating/inhibition
  - ID inhibition
  - No fluids on the ID
  - Inert gas atmosphere on the ID
  - Plug to resist diffusion of oxygen into the ID

# Background/History – API Documents

- What do the API documents exist for this purpose?
  - API 5ST – Specification for Coiled Tubing (new CT)
  - API RP 5C8 – Care, Maintenance, and Inspection of Coiled Tubing (used CT)
- API 5ST - Interpretation
  - Chapter 14: Coatings
  - 14.1: Requires an external protective film
  - 14.2.1: If no external film is applied, cover the CT
  - 14.2.2: Fill the ID with a dry nonreactive (inert) gas
- API RP 5C8 – Interpretation
  - 6.3.2c: Inhibit, blow dry with inert gas, and seal for storage
  - 7.1.1: After use, purge with nitrogen and cap the ends
  - 7.1.2: Use anti-freeze on the ID for cold climates; use a coating on the ID for long-term storage

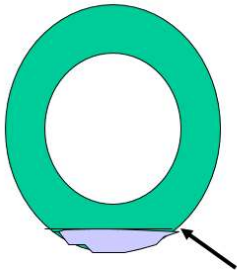
# Background/History

- Manufacturer Best Practice
  - Add External Coating at Manufacturing
  - Leak Detect with Pressure (use controlled water)
  - Purge with Nitrogen and a wiper ball
  - Add Internal Inhibition (or anti-freeze for cold climates)
  - Cap Ends
  - Cover until shipment
- Used String Best Practice
  - After operations, purge with nitrogen and a wiper ball
  - Pump internal inhibition (and biocide if necessary)
  - Cap ends
  - Additional steps if storing for an extended period

# Background/History – Literature Review

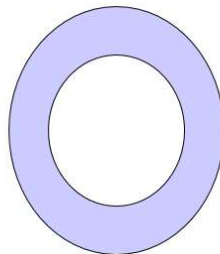
## Water Film / Vapor in Coiled Tubing Wrap on Reel

Water Condenses At Night



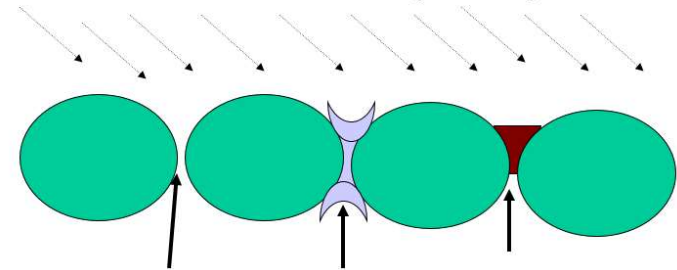
Corrosion Accentuated at Liquid  
- Vapor Interface

Water Vaporizes During Day



## External Corrosion Problem (Coiled Tubing Wraps on Reel)

Rain and Industrial Pollution (acid rain)



Crevice – Site  
for crevice  
corrosion

Meniscus to  
concentrate  
pollutants

Dirt / debris – Site  
for under deposit  
corrosion

# Background/History – What Can Go Wrong?



# Experimental Tests

- What happens when everything goes right?
- The Opportunity: Industry Downturn → Stock strings
- Test Plan
  - Select strings at least 1 year old
  - Cut portions from the start, end and the middle (including bias welds)
  - Low Cycle Fatigue Test
  - Evaluate for corrosion pitting if necessary
  - Look at a variety of OD and grade combinations



# Experimental Tests

- Test Strings

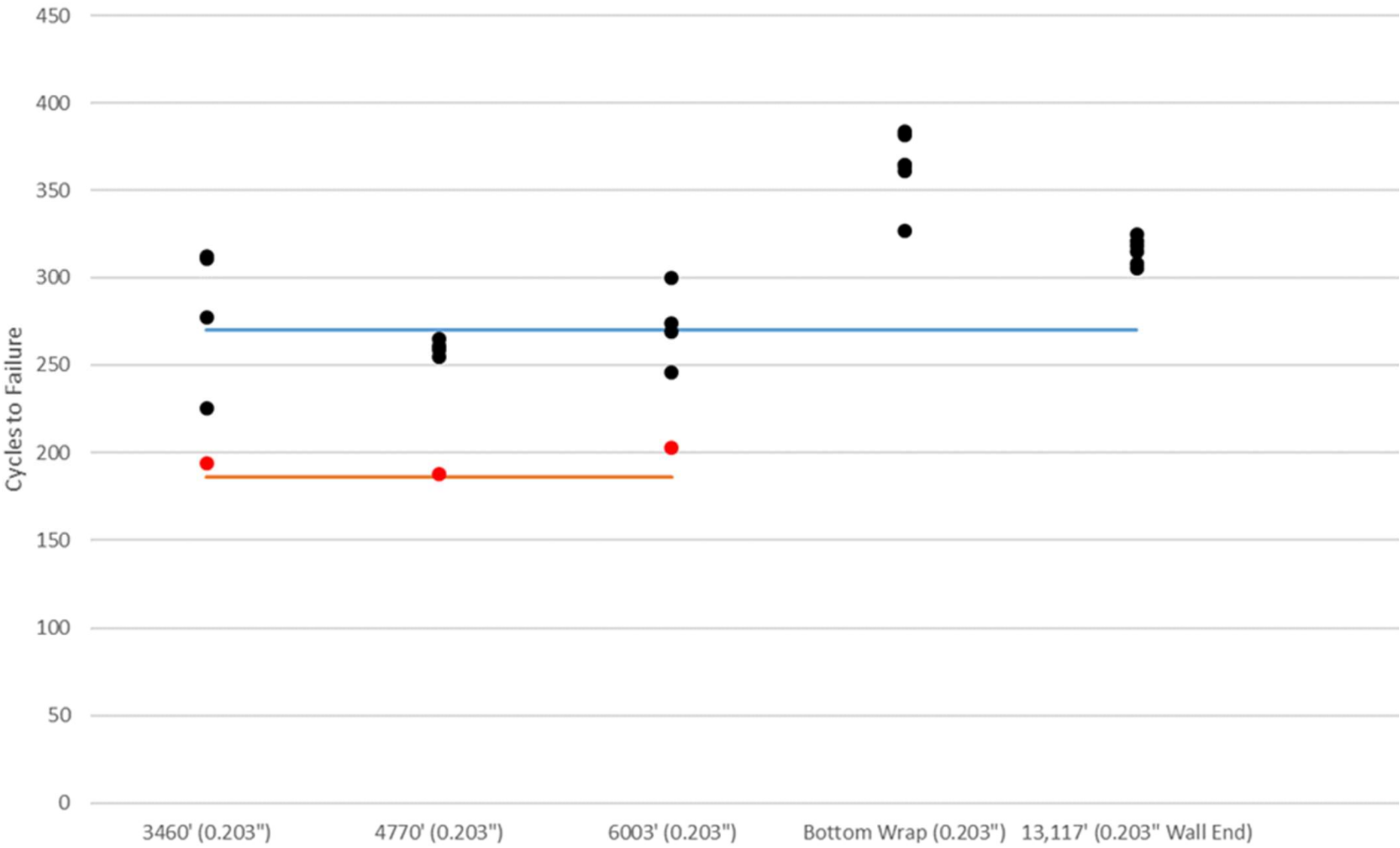
SN	Grade	OD (in.)	Wall (in.)	Storage
44410-8000	QT-900	2.375	0.188 - 0.203	27 mo
44118-0000	QT-1300	2.625	0.156 - 0.203	23 mo
43396-8010	QT-1100	1.250	0.125 - 0.156	23 mo
44379-0000	QT-16Cr	2.375	0.175	23 mo
43824-8010	QT-1000	2.000	0.125 - 0.175	33 mo
44648-0000	QT-900	1.500	0.156 - 0.203	24 mo

# As-Received

SN 444108000, Manufactured: 06/25/2015



SN 444108000, QT-900, 2.375", 0.175"-0.203", Manufactured: 06/25/2015





# Representative Views of SN 444108000

Post-Low Cycle Fatigue Testing



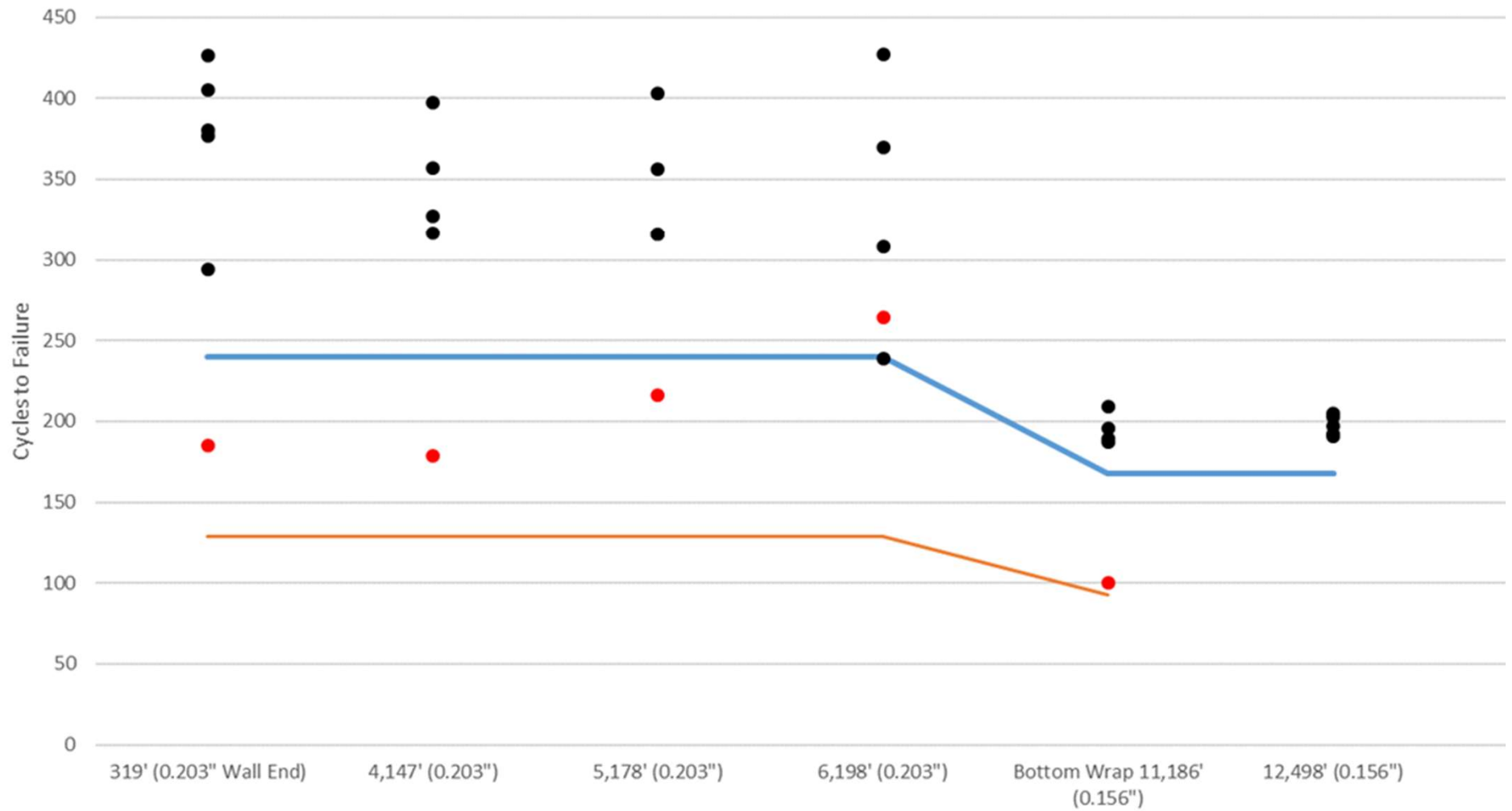


# As-Received

SN 441180000, Manufactured: 10/30/2015



SN 441180000, QT-1300, 2.625", 0.134"-0.175", Manufactured: 10/30/2015



# Conclusions

- Five Keys
  - OD: Coat
  - OD: Cover
  - ID: Purge with inert gas
  - ID: Inhibit (biocide as well by market)
  - ID: Cap
- Evaluation of strings stored this way is very positive
- More work to come, will be a paper/presentation at SPE/ICoTA in March



# Quality Tubing

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Production Solutions