Downhole Test Tool Experience in HPHT and Hostile Environments

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Testing Services DST Product Champion
Why are HP, HT, and Sour Environments Different?

- Metallurgy
  - Yield strength
  - Corrosion resistance
    - Sulfide-stress cracking (SSC)
    - Stress-corrosion cracking (SCC)

- Elastomers
  - Low- and high-temperature sealing
  - Explosive decompression
  - Chemical resistance
  - Dynamic or static

- Electronics and batteries
  - Stability
  - Longevity

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- NBR, HNBR
- FKM (Viton®, Fluorel®)
- FEPM (Aflas®)
- FFKM (Chemraz®, Kalrez®)
Hostile Regions

<table>
<thead>
<tr>
<th>H₂S, %</th>
<th>CO₂, %</th>
<th>Pressure, psi</th>
<th>Temperature, degF</th>
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Approach to Hostile Environments
A Complex Problem Made Manageable With the Right Process

Technical Center Analysis

Knowledge Database

Close Out

Postjob QA/QC

Equipment Preparation

Prejob QA/QC

Monitoring

Execution

Customer, Well

H₂S, CO₂, bottomhole pressure and temperature, water chemistry stimulation

Job Planner

Domain expertise
Tech center support
Job simulation
Service delivery plans

Design and Planning

Test Program

Material Selection

Equipment Selection

Equipment Planning

Prejob QA/QC Preparation

Monitoring
Hostile Well Test Operation

Objective
Perform two downhole test runs, testing and sampling two zones per run, without pulling out the string.

Design parameters
Downhole conditions included 5,500-psi pressure, 290-degF temperature, 25% H₂S, and 10% CO₂ for 30 days.

Solution
Use customized downhole test string that included ultraHPHT DST tools with special seals for sour service and inline fluid reservoir sampling tools.

Well configuration
Permanent packer, safety valve, and wellhead in place.

Procedures
- Run downhole test string with seal assembly.
- Perforate through tubing with wireline in first zone.
- Stimulate with coil tubing (acid job).
- Test and sample.
- Run coil tubing and cement-plug first zone.
- Repeat the process for second zone.
- Pull out of hole.
- Follow the same method for second DST with new string.

Component exposed to 290 degF, 5,500 psi, 25% H₂S, and 10% CO₂ for 720 h
Testing in Hostile Environments with High-Performance Downhole Reservoir Testing System

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<th>Well</th>
<th>Bottomhole pressure, psi</th>
<th>Bottomhole temperature, degF</th>
<th>H₂S, %</th>
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- Dual valve
- Quartz gauges
- Inline independent reservoir fluid sampling
- High-integrity reservoir test isolation system
- 27/8-in guns with explosive automatic gun release
- Deep-penetrating perforating shaped charges
Experienced Outcome in Hostile Testing

Design Considerations

- **Primary concern**—cracking
  - Addressed by following NACE recommendations
- **Secondary concern**—general corrosion and pitting
  - Mitigated by using corrosion-resistant alloys (CRAs)
- **Sealing concern**
  - Elastomer selection based on fluid compatibility

Best Practices

- Job design, planning, preparation, and monitoring
- Project-management approach
- Equipment traceability of equipment
- Tools redress and inspection at the base
- Test design optimization
- Minimization of well intervention as no cables are required
Key to Success

- **Metallurgy**
  - Systematic approach
  - Return of experience
  - Extensive testing and qualifications

- **Elastomers**
  - Fit for purpose sealing technology
  - Return of experience
  - Extensive testing and qualifications

- **Electronic and batteries**
  - Development of new battery technology
  - Multichip module electronics
    - Highly integrated electronics
    - Reliable performance in high temperatures