CASE STUDY 2023

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MAXIMUS OIGA PRIVATE LIMITED
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Maximus OIGA Resolving Thermal Expansion-Induced Premature Setting in 7" HPHT with SPECTRAMAX PBP

Executive Summary

Maximus OIGA delivered flawless zonal isolation for E&P company's high-pressure, high-temperature (HPHT) wells using its 7" SpectraMax Permanent Bridge Plug. Facing chronic premature failures in outsourced plugs that caused $0.5M in losses, Maximus OIGA material science rigor and rapid response resolved critical field issues—eliminating downhole failures and cutting abandonment costs by 32%. Across 6 deployments at 8,500 ft (335°F/8500 psi), the solution achieved zero NPT and perfect pressure integrity, establishing a new benchmark for reliability in extreme environments

Background & Challenges

Product: HPHT 7" Permanent Bridge Plug

Challenge: Product Failure in High-Pressure High-Temperature (HPHT) Conditions

1. The Crisis: Recurring Failures on the Rig Background:

Customer Provider had outsourced manufacturing of permanent bridge plugs to one of our competitors for cost-efficient localization. The plugs were deployed in an offshore well (8,500 ft MD, 320°F BHST, 8000 psi pressure) for zonal isolation during abandonment. After few consecutive failures, the Completion Manager, escalated issues:

- **Premature Setting:** Plug activated during run-in-hole (RIH) at 6,000 ft, stalling operations.
- **Improper Shear-Out:** Shear pins failed inconsistently (partial release or no release), preventing tool activation.
- **Element Leakage:** Elastomer failed to seal, causing 2,000-psi pressure bleed during testing.

The incidents caused 48 hours of non-productive time (NPT), $115K in recovery costs, and delayed well abandonment.

2. The Investigative Analysis: Engineering Analysis of Failed Samples

Actions Taken:

Our team collected a failed plug from the rig and conducted a multi-phase analysis study**:**

- **Dimensional Inspection:** Laser scanning(out-sourced) revealed 0.2–0.5% radial swelling in the setting sleeve.
- **Material Testing:**
  - *CTE Mismatch*: The setting sleeve (Grey CI Class-20) exhibited thermal expansion at 200°F+ (CTE: 10.3 µm/m°C vs. rated range 10.8-11.2 µm/m°C), triggering premature setting.
  - Shear Pin Defects: Perform Shear test on brass screw for checking shear strength as per IS 5242(1979) standards (Shear Value: 30,000 lbs ±1000 lbs vs. spec 55,000 lbs ±1000 lbs).
- **Elastomer Analysis:** The HNBR sealing element hardened and cracked at 200°F+ (Shore A Hardness: 95), failing to energize.

Root Causes:

Failure Mode	Root Cause	Impact
Premature Setting	Thermal expansion of low-CTE-rated steel	58% RIH failures
Shear Pin Failure	Poor metallurgy and inconsistent QC	35% activation defects
Sealing Leakage	Elastomer degradation at HPHT	100% test failures

3. The Solution: Engineering a HPHT-Optimized Bridge Plug

SPECTRAMAX PBP design:

We proposed our 7" permanent bridge plug, modified for the well's conditions:

- **Material Upgrades:**
  - Setting Sleeve: Grey Cast Iron Class 40 (CTE: 10.9 µm/m°C) for thermal stability to 400°F.

- Shear Pins: Precision-machined H13 Tool Steel (Shear Value: 55,000 lbs ±1000 lbs).
- Sealing Element: Viton (HPHT-rated for 350°F/10,000 psi; retains 80 Shore A Hardness).

❖ **HPHT Validation Testing (Simulating Well Conditions):**

Test Parameter	Condition	Result
Temperature Cycle	77°F → 350°F → 77°F (5 cycles)	Zero expansion-induced setting
Shear Test	55,000 lbs ±1000 lbs	Consistent pin release
Pressure Integrity	10,000 psi @ 320°F for 4 hrs	0-psi drop; elastomer-maintained seal

4. The Result: Flawless Deployment and Field Execution:

❖ 20 SPECTRAMAX PBP deployed on the rig within 4 weeks of failure analysis.

❖ Key Metrics**:**

- RIH at 150 ft/min to 12,500 ft MD with zero premature setting.
- Shear pins released at 54,000 lbs (avg.), activating slips and element.
- Pressure test: Held 5,000 psi for 15 min (0 leakage) and 10,500 psi for another 30 min (0 leakage)

Client Feedback:

"Spectramax PBP performance was night-and-day. We abandoned three zones in 48 hours with zero NPT. The HPHT validation gave us total confidence."
– Completion Rig Manager

Outcome:

❖ Saved our client $1.2M in recovery costs and rig time.

❖ Localized manufacturing retained with our QC oversight (defect rate: <1% post-fix).

5. Lessons Learned

- ❖ Localization ≠ Compromise: Outsourced parts must adhere to global metallurgical/HPHT standards.
- ❖ Environment-Specific Validation: HPHT plugs require testing beyond API 11D1 (e.g., Dilatometry, Spectroscopy, Thermal cycling etc.).
- ❖ Collaborative Resolution: Joint failure analysis with rig teams accelerates root-cause identification.

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