



Test Summary

Resonant Fatigue Testing
4 1/2" OD, 11.60 ppf, P-110 GB HB
7" OD, 23.00 ppf, P-110 GB HB

September 14, 2009

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Rev. 2 (1/21/2011)

Introduction

This document summarizes the testing performed to qualify GB DWC Connections for ConocoPhillips who has particular interest in fatigue resistant connections for Drilling with Casing operations in their South Texas Lobo Field. GB Tubulars developed two couplings for drilling with casing. Each uses standard API BTC pin threads. The GB CD Coupling is a shortened API BTC Coupling where the pin noses meet in the center for the high torque resistance needed for rotating while drilling. The GB HB is essentially the GB CD Coupling with a sacrificial, integral, hard-faced wear sleeve on the mill side providing the robust wear protection needed during casing drilling operations. See Figure 1.

Test Procedure

The test program was developed to demonstrate satisfactory performance within the anticipated worst-case scenario defined by ConocoPhillips for their casing drilling operations. During testing, applied build rates, rotational cycles, and internal pressure levels (and hold times) exceeded anticipated maximum operating conditions to achieve additional margins of safety.

Two samples of each size were supplied and all samples were used for make/break testing. Make/Break Testing consisted of a mill make-up where the coupling is bucked onto a piece of casing followed by two field make-ups/breakouts and a final field makeup. After each breakout, pin and box threads underwent a critical visual inspection prior to the next makeup.

After completing make/break testing, one fully assembled sample of each size was used for resonant fatigue testing; the other was set aside as a spare to be used if needed. The following table lists anticipated worst-case casing drilling conditions provided by ConocoPhillips.

Casing	Rotating Hours	RPM's	Max. Rotations
4 1/2" OD, 11.60#, P-110	100	120 to 150	900,000
7" OD, 23.00#, P-110	150	120 to 150	1,350,000



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Resonant fatigue cycling was designed to simulate a 3°/100 ft. bend in the casing and was performed with 200 psi internal hydrostatic test pressure. After the initial number of cycles was achieved, the sample was hydro-tested to 2,000 psi for 1 hour. Pressure testing was performed again at the same pressure and hold time after the second round of fatigue testing.



Resonant Fatigue Test Equipment

Test Results

The GB HB Connections on both casing sizes demonstrated good repeatability during make/break testing. The threads were in excellent condition even on the final breakout after fatigue and pressure testing. All parts were re-used "as-is" after each breakout without any field dressing (because observed threadform disturbance was minor). Successful positive test results are more remarkable given the fact



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that all threads were re-used without field dressing. Based on observations at the time of testing, it is unlikely that the parts would have required dressing prior to re-use in the field.



Coupling Threads after Breakout



Pin Threads after Breakout

No structural damage occurred during fatigue testing. As shown in the table below, the number of cycles applied to the test samples considerably exceeded those anticipated under the anticipated maximum operating conditions; 79% on the 4 1/2" OD sample and 28% on the 7" OD sample.

Casing	Rotating Hours	RPM's	Target Max. Rotations	Actual Fatigue Cycling #1	Actual Total Fatigue Cycling #2
4 1/2" OD, 11.60#, P-110	100	120 to 150	900,000	1,413,871	1,613,216
7" OD, 23.00#, P-110	150	120 to 150	1,350,000	1,449,520	1,728,186

No leaks occurred during hydrostatic pressure testing to 33% above normal field pressure tests holding twice as long as the field test hold times.



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Figure 1

