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Connection Performance Evaluation for Casing-Drilling Application

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Abstract

With the evolution of casing drilling technology, connections are subjected to increasingly stringent well conditions. These conditions include higher pressures, higher temperatures, and higher mechanical loads for longer drilling periods. As a result, the performance of the connector under these conditions is of increasing concern. Most recent casing connection evaluation test programs are based on ISO 13679[1] requirements. However, API RP7[2] is the dominant testing program for drill stem applications. Drilling with casing applications combine drilling and casing concerns. As a result, a new test program is required to adequately characterize connection performance when used in casing drilling applications[3].

As part of the test program, the static and dynamic connector capacities are individually evaluated to benchmark the design. Based on these results, additional testing is conducted to determine the connector static capacity after dynamic loading for an expected drilling period at an expected maximum build rate. This testing demonstrates the connector performance under drilling with casing application conditions.

This testing program may be utilized to better define connector performance limits when used in drilling with casing applications leading to increased operational safety and lower overall risks. A better understanding of how connection tolerances impact connection performance under combinations of static and dynamic loading conditions will aid in connector selection for drilling with casing applications and may allow the technology to be used in broader applications.

The paper includes results, observations, and conclusions from a subject test per the testing program. The subject test is currently being conducted on a 9-5/8" 53.50ppf P-110 drilling with casing connector.

Introduction

The objective of this project is to evaluate the connection performance for casing drilling application. Tests were conducted in four phases, each with distinctive goals.

Phase I: Design Selection
Phase II: Fatigue to Failure Test
Phase III: Static Capacity Test
Phase IV: Post-fatigue ISO Series B Test

The objective of Phase I test was to find the best connection and thread compound combination. Three samples with different thread compounds were tested. DWC/C and DWC/C-SR connections were fatigue tested with the same loading condition. All samples were threaded to nominal tolerances and subsequent capped-end pressure test determined the best design for Phase II test.

Phase II was to generate the SN curve for DWC/C-SR connection. Three ISO configurations, with three samples in each group, were tested at different stress levels. Connections were fatigued to failure with different stress range. Fatigue performance with respect to sample configuration was investigated. ISO 2 configuration is the worst-case for fatigue.

Phase III was the static capacity verification test. Three ISO configurations, identical as tested in Phase II, were tested with ISO Series B service load envelope (SLE). The configuration with the best pressure containability was chosen for Phase IV test.

Phase IV included the post-fatigue ISO Series B test. The specimens were fatigued to pre-determined cycles at a certain stress level, followed by an ISO Series B testing. The testing format was modified based on ISO 13679 requirement. The internal pressure media for the two-quadrant ISO Series B test was gas.

Statement of Theory and Definitions

The theory behind this testing program is to simulate the actual working condition of a casing drilling connection. The connection will experience fatigue and high torsional load during the drilling process. After the casing string is set in place, the connection will experience tension/compression loads under high pressure and high temperature conditions. The testing program is designed to evaluate connection performance in both cases. The loading sequence was also considered to replicate the working condition of the casing string.