SPE 110920

New Level of Expandable Connector Qualification Helps Minimize Operational Risk in Solid Expandable Liners

Lev Ring, SPE, Weatherford International; Philippe Deltombe, Vallourec Mannesmann Oil & Gas; Patrick York, SPE, Weatherford International; and Robert V. Baker, SPE, BP America, Inc.

This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

Abstract

Expandable connectors continue to be the Achilles Heal of solid expandables due to the simple nature that the connectors need to sustain their tensile, compressional and sealing integrity, before, during and after expansion. Solid expandable products such as monobore liners and monobore clads, which push expansion ratio requirements to 20% and toward 30%, require connectors with qualification needs that exceed earlier product applications.

The API and ISO qualification bodies are now addressing the need for standardization recommendation procedures for the testing and performance specifications of solid expandable system tubulars and their connecting devices.

Connector failures and inconsistent reporting methods of specifications of solid expandable systems' performance envelops have driven the industry to attempt to apply standard methods of API connector qualification. Even applying conventional testing and qualification methodology for expandable connectors cut on seamless tubulars fell short of thoroughly qualifying these connectors for use in the extreme environment of cold working connected tubulars in situ.

Therefore, a conventional, four-quadrant service load performance envelop has been adapted and developed for the new requirements. Even expansion in "fixed-fixed" conditions has been added to help ensure consistent performance in downhole service. This type of connector qualification has historically rarely been conducted, and then only on a very small range of the possible expansion ratio or for only one size and type of connector.

This paper describes the need, the methodology and the processes required to qualify connectors to this level. This extensive testing and qualification process has yielded connector performance ratings that can be verified with empirical data for every size and style connector for carbon steel as well as CRA tubular materials.

With solid expandable products being used in a wider and broader arena of applications with associated high risk and expensive consequences, it is critical to qualify each size and type of expandable connectors, clearly document these qualifications with both theoretical modeling and empirical data and be prepared to provide the end user with sufficient proof of the expandable connector's performance ratings.

This paper explains how this new methodology provides this level of proof of performance to the end users.

Introduction

The testing of expandable connectors has been sparse in the past due to the cost of a full-scale program. For instance, if the process described in this paper is followed, the cost of qualifying a single size of an expandable connector can be $500,000 U.S. or more. This high cost stems from an extensive process that includes the following:

1. Procure ~1,500 feet of expandable casing
    - 300 feet for lab tests
    - 1,000 feet for downhole test
    - 200 feet for back-up
2. Create test samples
    - Two to four, 20-foot samples for cone testing
    - ~Ten to 12, ten-foot samples with connectors for connector tests in lab
    - ~30, 40-foot samples for downhole test
3. Perform quality testing on pipe before and after expansion
    - Tensile loading on pipe without pressure
    - Internal Pressure only on pipe
    - External Pressure only on pipe
4. Perform make & break testing on lab samples
    - w/max dope
    - w/min dope
5. Perform four-quadrant testing on several lab samples
6. Perform internal pressure test under bending (dogleg severity test)
7. Perform destructive testing on samples
    - Collapse pressure
    - Burst pressure
    - Tension