



OTC 18730

## Development of an Expandable Liner-Hanger System to Improve Reliability of Liner Installations

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This paper was prepared for presentation at the 2007 Offshore Technology Conference held in Houston, Texas, U.S.A., 30 April–3 May 2007.

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### Abstract

Liner hangers and liner-top packers are commonly used in the oil field in various liner applications. Unfortunately, in the traditional systems that employ “cone and slip” technology, the failure rate of the liner top packers as well as the failure of system installation has been great, impacting the ultimate cost and efficiency of the well completion. In conventional systems, mechanical equipment with multiple slips are run and set. The disadvantages of these systems include multiple leak paths, reduced radial clearance, and exposed hydraulic ports, all of which increase their potential for failures. Reasons for unsuccessful liner installations can be attributed to a number of conditions, such as:

1. the liner cannot be run to depth
2. the liner hanger/packer pre-sets
3. the setting tool fails
4. the setting ball cannot reach the setting tool.

This paper will discuss an expandable liner system that was developed to address the shortcomings of the traditional systems. The expandable liner hanger provides a clean outer diameter to reduce preset risk and allow drilling or reaming the liner in with reduced risk of damage or hanging up. Hydraulically operated liner-hanger systems typically rely on a setting ball to plug the tubing to allow pressure activation of the liner hanger. Problems can arise if the ball is unable reach the seat due to debris or hole deviation. The new liner system combines expandable solid liner technology with an improved hydraulic setting tool that eliminates the setting ball as the primary setting method.

The following discussion will include details concerning development of the design, operating procedures, and benefits of the expandable liner hanger as well as how the versatility and adaptability of the system improves its reliability. Several case histories to verify the efficiency of the new system will be discussed.

### Introduction

Liner hangers and liner-top packers are commonly used in oilfield completions where liners are run in the well. The conventional liner-hanger system employs “cone and slip” technology. Failure of the liner-top packers as well as failure of system installation significantly impacts the ultimate cost and efficiency of the well completion.<sup>1</sup> Many of these liner hangers are run on hydraulically operated setting tools. The typical operation requires dropping a setting ball and waiting for the ball to seat in the setting tool so that pressure can be applied. If the liner top fails, time-consuming remedial operations increase costs for equipment and services, and operational efficiency is further impacted by the delay in well completion and revenue generation.

An expandable liner-hanger system that addresses some of the problems with the conventional liner-hanger systems has been developed. The system incorporates an expandable liner-hanger body with an integral packer, a tieback polished-bore receptacle, a setting-sleeve assembly, a crossover sub to connect the assembly to the liner, and a setting tool developed to eliminate the setting ball as the primary setting method. Elastomeric elements are bonded onto the hanger body. As the hanger body is expanded, the elastomeric elements are compressed in the annular space. This virtually eliminates the liner top/casing annulus and delivers liner-top pressure integrity as well as bi-directional axial load capacity. The hydraulic setting tool uses a flapper-type closure mechanism to plug the tubing and to allow pressure to be applied to the setting tool to expand the hanger body. As the hanger body is expanded, the elastomeric elements are compressed into the annular space. This virtually eliminates the liner top/casing annulus and delivers liner-top pressure integrity as well as impressive axial load capacity.<sup>2</sup> **Fig. 1** shows a cross section of the expandable liner hanger set inside 9-5/8-in. casing.

The new setting tool eliminates the wait time required for the ball to seat and provides a robust system for applications requiring drilling or reaming the liner to bottom. By eliminating the setting ball from the system, the liner hanger can be deployed in highly deviated vertical as well as horizontal wells.

### Conventional Liner-Hanger Systems

In conventional liner systems, “cone and slip” technology is used. A liner is run on the bottom of the liner hanger or liner-hanger packer assembly, and in many cases, is run on a hydraulically activated setting tool. Typically, a ball is