

# Well Construction Versatility

## **Reducing costs and mitigating risk for cemented-back completions using stage tool technology**

A high cost incurred by operators for construction of horizontal wells involves using multiple drill bit and casing sizes to reach the horizontal section. With larger diameter wellbores, these costs are further increased.

The Packers Plus line of SF Cementor® stage collars provides an option to reduce these costs by cementing back the well. Using a stage collar to cement the vertical and build section of a horizontal wellbore in a monobore application saves on the cost of running an intermediate casing string. In addition to monobore well design, the stage collars can be combined with liner hanger packers, providing an economic solution to cement specific sections in the wellbore above the target depth that are undesirable or problematic.

A secondary closure sleeve without any inside diameter restrictions ensures the SF Cementor can be closed after cementing operations and that all stages in the wellbore can be stimulated as designed.

## STAGE TOOL APPLICATIONS

Stage tools in North America are commonly used in monobore wells to cement back the vertical and build section of the wellbore, not requiring a liner hanger. The technology has since adapted and proven to work with liner hangers to selectively isolate specific sections or trouble zones in the wellbore.

### Monobore Well Design

In a monobore well design, a single diameter hole is typically drilled from surface casing to total depth. Monobore wells can be used in both open hole and cemented applications. Using a stage collar to cement the vertical and build section of a wellbore, an open hole completion can be run as a monobore from the horizontal back to surface. This eliminates the requirement for the intermediate casing and also the trip needed to remove the running string and install the fracture string for stimulation. A single diameter hole also means that larger production casing sizes can be afforded for higher production volumes, and consequently, fewer wells may be needed to develop a field<sup>1</sup>. Furthermore, larger diameter wellbores facilitates re-entry opportunities for re-stimulation or stimulation of bypassed zones.

#### Monobore Savings

A leading operator in the Niobrara has almost entirely switched their wells to a monobore well design, estimating cost reductions between \$50,000 and \$100,000 per well. A full day on average is saved in drilling time and the savings are even more significant with longer laterals<sup>1</sup>.



<sup>1</sup> Larson, D. "Monobore Drilling: Drilling companies continue to shave costs with efficient well designs"; Energy Pipeline; December 2016; Vol 3 Issue 16

## Off-Bottom Cementing

Cemented-back completions are applicable in areas where there is sufficient wellbore stability to maintain integrity while the horizontal is being drilled<sup>2</sup>. The formation must also be compatible with the drilling mud system in place; higher or lower formation pressure compared to the hydrostatic pressure of the mud column can result in fluid kick-back or loss, respectively. This can be a deterrent during cementing operations. Another consideration for a cemented-back monobore well design involves deeper, higher pressure formations that are more susceptible to lost circulation while drilling and cementing. In these situations, cementing back only the required section above the target depth can mitigate the operational risk associated with lost circulation.

## STAGE TOOLS OVERVIEW

Plug-type stage tools were one of the first kinds of stage cementing tools that were developed for the oil and gas industry. They function by dropping a plug or dart followed by hydraulic pressure to open the tool for cementing operations, and a second wiper plug to close the tool for stimulation operations.

## Sleeve Closure After Cementing

If a stage tool fails to close, an expandable casing patch is required to close the sleeve. Casing patches can restrict the inside diameter of the completion liner. For cemented-back monobore ball-activated completions, this means that planned stages at the heel could be missed due to restriction of ball sizes, equating to lost production volumes.

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<sup>2</sup> Kimmit, K. "Developing a Stage Tool for Cemented Back Monobore Completions with Open Hole Multi-Stage Systems in the Montney"; 2011; IPTC-15267-MS  
<http://dx.doi.org/10.2523/IPTC-15267-MS>

## Functionality of Fracture Sleeves

For ball-activated completion systems, it is critical that large amounts of debris not be allowed to pass through the stage tool onto ball seats, as it may prevent fracture sleeves downhole from opening or closing properly. Plug-type stage tools require that actuating plugs be drilled out to ensure that other tools can pass through without restriction. The process of drilling out produces debris that can cause problems in downhole operations if not dealt with properly.

## Packers Plus Cementing Stage Collars

The Packers Plus line of SF Cementor® stage collars have enabled operators to successfully install and complete monobore wells by mitigating the risk of lost stages resulting from a failure to close the tool after cementing operations. A built-in secondary closure sleeve without any inside diameter restriction enables the stage tool to be closed using a shifting tool in the instance that the primary sleeve closure mechanism fails to function. The secondary closure sleeve operates independently of the primary sleeve.



**SF Cementor**

**Hydraulically opened,  
mechanically closed**



**SF Cementor D**

**Hydraulically opened,  
closed with actuation ball or  
specialized wiper plug**

Packers Plus offers two stage tools: the SF Cementor and SF Cementor D. The SF Cementor stage collar is mechanically closed by lowering the casing and applying compression without the use of a wiper dart or plug—this reduces debris issues during post-cement cleanout operations and also means that a cement head is not required.

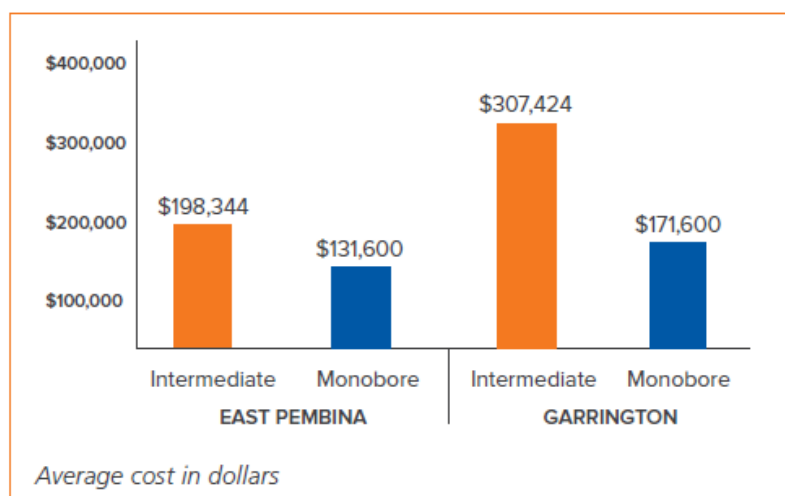
The SF Cementor D stage collar features the same functionality as the standard SF Cementor, with the exception that a specialized wiper plug is used to close the tool, similar to conventional stage tool design. This version of the stage tool provides the capability to work in conjunction with a liner hanger packer and cement only a specific section of the wellbore above the target depth.

## CASE STUDIES

### Time and Cost Savings of Monobore Well Design

An operator working in the Cardium formation in Canada was continually investigating ways to reduce costs and increase operational efficiency in their monobore wells and decided to use the SF Cementor stage collar.

Initial wells were designed such that intermediate casing could be installed in case of wellbore stability concerns. After the operator became accustomed to procedures for drilling monobore wells, the diameter of the vertical and build section was condensed to further reduce costs. More than 220 wells were completed using the SF Cementor with 100% success.



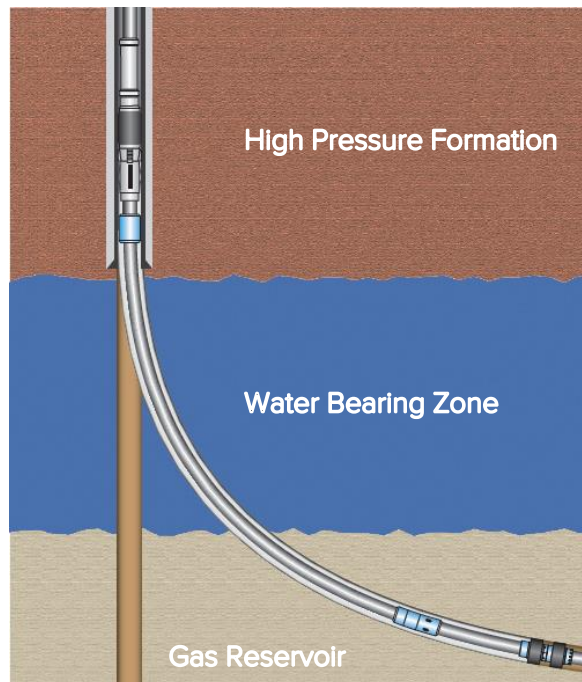
By adopting monobore well construction in the East Pembina and Garrington fields of the Cardium, the operator was able to reduce costs by 34% and 44%, respectively, over previous operations using intermediate casing. A reduction in drilling and operations hours of 38% and 59% was also observed.

## Unique Application to Cement a Water Bearing Zone

An operator targeting a carbonate formation in the Middle East used the SF Cementor D stage collar for a unique application to cement back a water bearing build section of a sidetracked open hole horizontal wellbore. The stage collar was used in conjunction with the Packers Plus StackFRAC® HD system and a liner hanger packer to stimulate the horizontal.

The SF Cementor D stage collar was redesigned for the application to accommodate the liner hanger packer, being closed with a drill pipe dart launched from surface and a liner wiper plug housed in a bushing sub below the liner hanger packer. The installation, system setting, cementing, milling and cleanout operations were successfully completed, ensuring the shallower water bearing zone did not commingle with the hydrocarbon produced to surface after treating the reservoir.

With the SF Cementor D, the operator was also able to mitigate concerns about the stage tool not closing after cementing operations were complete. The combination of the stage collar and liner hanger packer lowered completion costs and improved stimulation effectiveness for the operator by reducing the amount of casing required.



Water bearing zone cemented with SF Cementor D stage collar

## CONCLUSION

Using stage collars in a monobore wellbore completion offers the advantage of cost reductions by eliminating the requirement of the intermediate casing while also reducing the time spent during drilling and completions operations.

Whereas the failure mode of conventional stage tools can likely result in lost stages at the heel section of a ball-activated completion system, the SF Cementor line of stage tools mitigates this risk with an independent and built-in secondary closure mechanism that does not have an inside diameter restriction. Less risk means there are potential savings that would otherwise be spent on remedial operations, and also means that the production and economic potential of the planned completion program can be realized.

The success and versatility of the stage tool has enabled it to be customized to specific applications involving liner hanger packers, providing an economic option to cement undesirable or problematic zones above the target depth of the wellbore.

## FURTHER RESOURCES

Packers Plus is a completion technology company dedicated to providing high quality solutions that work the first time. To this end, Packers Plus offers systems for a variety of applications, including cemented liner, open hole, and high pressure and high temperature applications.

Packers Plus' knowledgeable and experienced specialists have been dedicated to providing customized solutions for clients around the world over 15 years.

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