

# Accelerating Efficiency

## 8 Benefits of Cemented Ball-Activated Sleeves

The price of oil bears a major impact on completion strategy. In high priced environments, the focus is moving frac crews – lots of crews – quickly from well to well. In low priced environments, the focus shifts to lowering costs. In either case, the choice of technology influences the time and cost to complete a well.

For cemented liner completions, the choice boils down to three basic methodologies: plug-and-perf, coiled tubing-activated sliding sleeves, or ball-activated sliding sleeves. Each has its advantages. However, ball-activated sleeve completions offer many operational efficiencies, allowing operators to:

1. Get a frac crew scheduled sooner
2. Minimize fluid usage, management, and cost
3. Reduce operational risk
4. Lower breakdown pressures
5. Minimize non-productive time
6. Improve fracture complexity
7. Reduce or eliminate millouts for extended laterals
8. Achieve better production with effective treatment

These benefits combine to provide both improved operational efficiency and a lower total completion cost. Whether the price of oil is low or high, operators should be aware of these factors.

## BENEFITS OF CEMENTED BALL-ACTIVATED SLEEVES

### 1. Get a frac crew scheduled sooner

When the number of wells being drilled outpaces the number of frac crews available, some operators can be left waiting weeks or months to obtain a frac crew or add wells to their DUC (drilled but uncompleted) stockpile.

However, it is common for crews to be available for 1 or 2 days between jobs, which is enough time to finish a typical ball-activated completion.

### 2. Minimize fluid usage, management, and cost

The logistics of gathering, transporting, and staging water is a significant, expensive, and critical part of completion logistics, particularly in remote areas and where resources are scarce or restricted. Whether the water must be transported in or reused from another well, the higher the volume, the higher the costs, which may include:

- Storage
- Transportation
- Heating
- Accessibility
- Disposal
- Flowback time

Plug-and-perf operations generally require more fluid than other completion methods. After proppant stimulation, each stage is flushed with a spacer, to rid the lateral of proppant, plus additional fluid to pump the bridge plug to position.

Ball-activated completion spacer volumes are much smaller and can carry the ball to the seat to isolate the next stage. Depending on well depth and casing size, ball-activated completions often use 8–10 times less water.

*An operator in the Bakken recently had 5 wells drilled, 4 of which were installed with coiled tubing sleeves, and one with a ball-activated sleeves.*

*While waiting several weeks for a crew to get scheduled for the coil fracs, the 20-stage ball-activated sleeve system was completed in 20 hours.*

### 3. Reduce operational risk

Ball-activated systems are entirely hydraulic and operated from surface, requiring none of the physical intervention needed for either coiled tubing or plug-and-perf.

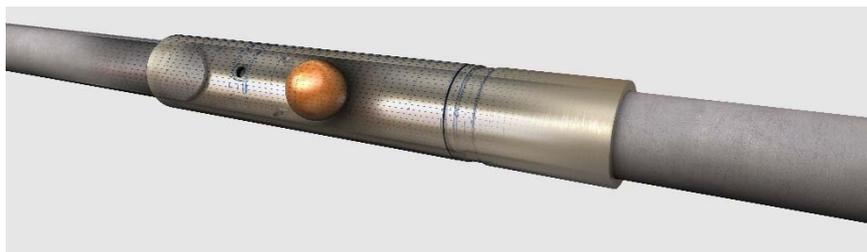
A major benefit of an interventionless method is that it greatly lowers operational risk. The tools are hydraulically activated with balls, eliminating concerns associated with tripping in and out of the wellbore.

Safety risks are also reduced, since personnel are not needed to handle charges or open and close valves in the red zone.

### 4. Lower breakdown pressures

As a result of formation damage created in the near wellbore region from plug-and-perf charges and jets, breakdown pressures are high. This can be magnified by increased tortuosity if perforation clusters do not align with the formation stresses. The fracture must reroute a path from the perforation to align with the formation stress profile.

Plug-and-perf requires higher pressure than for ball or coil activated sleeve systems. There is no formation damage created through sleeve activation, so once the cement sheath is broken, the fracture initiates along the plane of least resistance, resulting in lower breakdown pressures and conductive fractures.



TREX QuickPORT IV Limited Entry Sleeve

## 5. Minimize non-productive time

Zipper frac completions on well pads have evolved to reduce the non-productive time between plug-and-perf stages.

This technique allows two or more wells on a pad to be completed simultaneously by alternating stimulation and wireline runs between wells after each treated stage. In these cases the zipper progression schedule can determine the fracture initiation, placement, and complexity during the treatment process. Thus, how these factors are affected by the order and number of wells to be zippered must be understood and optimized before commencing operations.

Compared to waiting several hours between stages in a single well completion, the switch from one well to another takes around 30 minutes. Although reduced, the time between stages can add up to significant hours for high-stage completions. While a ball-activated sleeve completion is pumped continuously with no non-productive time between stages, a 20-stage, 2-well zipper frac might add an extra 10 or more hours.

*An operator working in the Montney formation ran a number of cemented hybrid systems with 70-75 stages. The lower 10-16 stages were completed using a hydraulic toe sleeve and ball-activated sleeves, and the remaining stages were completed using coil tubing sleeves.*

*The operator reduced operational risk and time for the lower stages and stimulate at higher rates, while benefiting from their proficiency with coiled tubing.*

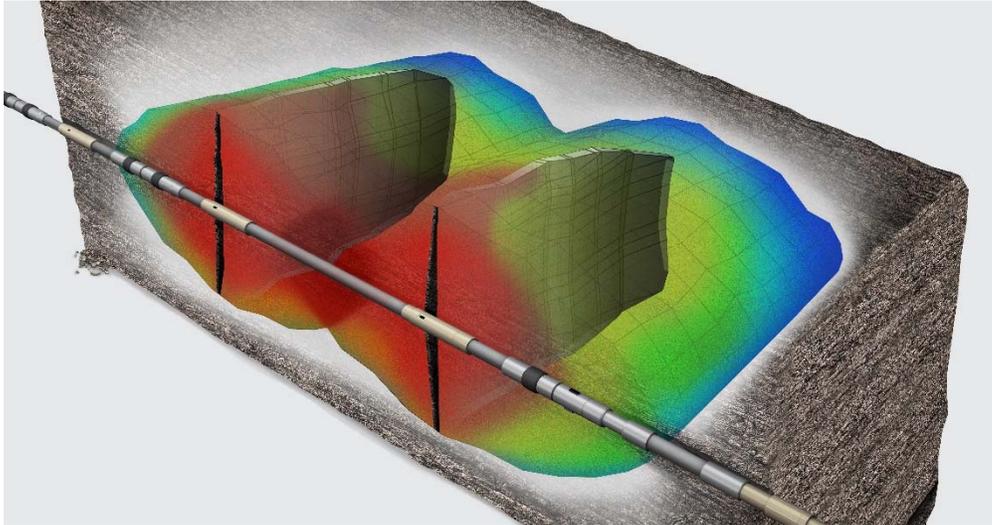
## 6. Improve fracture complexity

During plug-and-perf stimulation, the added pressure along a fracture induces a stress shadow that extends beyond the fracture. This energy dissipates into the surrounding rock as the fracture closes and stress relaxation begins, once the pumping has stopped.

Recent geomechanical hydraulic fracturing studies<sup>1</sup> show evidence that continuous pumping completions lead to increased fracture complexity and fracture extension. This is a result of no downtime between stages to allow stress and pressure to dissipate throughout the reservoir.

<sup>1</sup> Bunger, A., Lu, G.; Time-Dependent Initiation of Multiple Hydraulic Fractures in a Formation with Varying Stresses and Strength. Society of Petroleum Engineers; 2014  
Ghassemi, A.; Impact of Fracture Interactions, Rock Anisotropy and Heterogeneity on Hydraulic Fracturing: Some Insights from Numerical Simulations; American Rock Mechanics Association; 2016

These studies suggest that stress shadows associated with each fracture leads to added fracture complexity, greater fracture surface area, and improved drainage efficiency.



Conceptual effect of stress shadow and stress interactions in the rock surrounding two hydraulic fractures.

## 7. Reduce or eliminate millouts for extended laterals

Running ball-activated sleeves with degradable actuation balls in the lower stages of a well can reduce or eliminate the need for millout. This is particularly useful in extended reach lateral wells, where the time and cost of millouts increase exponentially with depth.

Ball-activated sleeves at the toe of a well can be combined in a hybrid completion system with coiled tubing sleeves or plug-and-perf operations in the upper stages of the well. In the case of plug-and-perf, only bridge plugs require milling out, saving the cost of milling out the entire system.

## 8. Achieve better production with effective treatment

The combination of numerous perforation holes with hundreds of thousands of pounds of slurry results in perforation erosion and uneven treatment distribution throughout a stage. This uncontrolled geometry typically results in only one dominant fracture within the cluster grouping, with little fluid or activation diverted to the other clusters. Although these fractures may be far-reaching, they lack complexity, resulting in small stimulated rock volume totals and bypassed pay.

Ball-activated sleeves are designed with flow ports or nozzles with anti-erosion materials and coatings that reduce entry point erosion and provide even fluid distribution throughout the stage length. This treats the lateral more effectively, leading to a greater and more connected fracture network for each fracture with the ultimate goal of higher production.



TREX Diffusor Single Point Entry Sleeve

## CONCLUSION

Among the various cemented completion methods, operators can lower cost and improve operational efficiency using ball-activated sleeve systems.

Operators can gain these benefits using the Packers Plus TREX™ line of cemented systems and tools—for example, with Diffusor® sleeves for single point entry and QuickPORT™ IV for limited entry.

	<b>Ball-Activated Sleeves</b>	<b>Coiled Tubing Sleeves</b>	<b>Plug-and-Perf</b>
Quick Frac Crew Turnaround	✓	N	N
Reduce Operational Risk	✓	N	N
Improved Fracture Complexity	✓	✓	N
Lower Breakdown Pressures	✓	✓	N
Quick Turnaround Between Stages	✓	✓	N
Lower Fluid Costs	✓	✓	N
Reduced Millout Time	✓	N/A	N
Even Distribution for Limited Entry	✓	N/A	N

Packers Plus TREX Cemented Completion Solutions have been designed for a wide range of applications and include a suite of tools for every portion of the wellbore, including the PrimeSET™ liner hanger, Hydraulic Toe Sleeve, Single Test Toe Sleeve, and Lightning Composite Plugs.

Explore more solutions, case studies, and news at [packersplus.com](http://packersplus.com).