Halliburton Sand Control offers a complete line of proven downhole equipment configured into compatible systems for successful sand control completions. From complete gravel pack systems to horizontal screen completion equipment, Halliburton has a system to meet your sand control needs.

The development of these systems is based on customer needs, comprehensive research in the areas of metallurgy and elastomers, and many years of experience in designing and manufacturing a wide array of downhole equipment, such as packers, screens, and fluid loss devices.

By combining expertise in sand control fluids and pumping as well as in drilling, cementing, perforating, and testing, Halliburton Sand Control can ensure each system is designed with the total process in mind.

The result is a tool system designed to satisfy your sand control needs while saving rig time and minimizing fluid losses.
### Halliburton Sand Control Systems

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<th>Well Design</th>
<th>Completion Design</th>
<th>Sand Control Treatment</th>
<th>Additional System Features</th>
<th>Service Tool Features</th>
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<tbody>
<tr>
<td>FracPac™ Systems</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Gravel Pack Systems</td>
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</tr>
<tr>
<td>STQP&amp;T™ Single-Trip Gravel Pack &amp; Treat Systems</td>
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<td>✓</td>
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<tr>
<td>STMZ™ Single-Trip Multizone Systems</td>
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<tr>
<td>ESTMZ™ Enhanced Single-Trip Multizone Systems</td>
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<tr>
<td>Liner-Conveyed Gravel Pack (LCGP) Systems</td>
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<tr>
<td>Dual-Zone SmartWell® Systems</td>
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<tr>
<td>Sandface Instrumentation (SFI) Systems</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>Standalone Screen Systems</td>
<td>✓</td>
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<tr>
<td>Equiflow® Inflow Control Technology</td>
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</tr>
<tr>
<td>Stacked Fixed Absolute Isolation Systems</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>STPP™-GH Single-Trip Perf Pack Systems</td>
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<td>✓</td>
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</tr>
<tr>
<td>Through-Tubing Systems</td>
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Sand Control System Solutions

<table>
<thead>
<tr>
<th>Lower Completion Packer Assembly Base Case Components (Top to Bottom)</th>
<th>Screens*</th>
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<td><strong>Standard Gravel Pack Systems</strong></td>
<td><strong>PetroGuard® Wrap</strong></td>
</tr>
<tr>
<td>Standard Gravel Pack Systems</td>
<td><strong>VTA</strong> Packer¹</td>
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<tr>
<td></td>
<td><strong>VGP</strong> Packer¹</td>
</tr>
<tr>
<td><strong>Alternate Path Gravel Pack Systems</strong></td>
<td><strong>PetroGuard Shunt System</strong></td>
</tr>
<tr>
<td>VTA Packer¹</td>
<td><strong>MCS Closing Sleeve²</strong></td>
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<tr>
<td>VGP Packer¹</td>
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</tr>
<tr>
<td><strong>Standard FracPac™ Systems</strong></td>
<td><strong>CAPS™M Concentric Annular Pack Screen Service</strong></td>
</tr>
<tr>
<td><strong>VBA</strong> Packer¹</td>
<td><strong>Heavy Wall Upper Extension</strong></td>
</tr>
<tr>
<td><strong>VCA</strong> Packer¹</td>
<td></td>
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<tr>
<td><strong>VCH</strong> Packer¹</td>
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<tr>
<td><strong>Red Zone® FracPac Systems</strong></td>
<td><strong>PetroGuard Mesh DS</strong></td>
</tr>
<tr>
<td><strong>VBA</strong> Packer¹</td>
<td><strong>Red Zone Extension</strong></td>
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<tr>
<td><strong>VCA</strong> Packer¹</td>
<td></td>
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<tr>
<td><strong>VCH</strong> Packer¹</td>
<td></td>
</tr>
<tr>
<td><strong>Beyond Red Zone® FracPac Systems</strong></td>
<td><strong>PetroGuard Mesh DS</strong></td>
</tr>
<tr>
<td><strong>VBA</strong> Packer¹</td>
<td><strong>Red Zone Extension</strong></td>
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<tr>
<td><strong>VCA</strong> Packer¹</td>
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<tr>
<td><strong>VCH</strong> Packer¹</td>
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<tr>
<td><strong>STGP&amp;T™ Single-Trip Gravel Pack &amp; Treat Systems</strong></td>
<td><strong>PetroGuard® Shunt System and with Upstream Downstream Differential (UDD) Valves</strong></td>
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<tr>
<td><strong>VGH</strong> Packer¹</td>
<td><strong>MCS Closing Sleeve²</strong></td>
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<td><strong>VCH</strong> Packer¹</td>
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</tr>
<tr>
<td><strong>Non-Compliant Standalone Screen Systems</strong></td>
<td><strong>PetroGuard® Shunt System and with UDD Valves²</strong></td>
</tr>
<tr>
<td><strong>VTA</strong> Packer¹</td>
<td><strong>MCS Closing Sleeve²</strong></td>
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<td><strong>VGP</strong> Packer¹</td>
<td></td>
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<tr>
<td><strong>VBA</strong> Packer¹</td>
<td></td>
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<tr>
<td><strong>VAC</strong> Packer¹</td>
<td></td>
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<tr>
<td><strong>VCH</strong> Packer¹</td>
<td></td>
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<tr>
<td>Sand Control System Solutions</td>
<td>Lower Completion Packer Assembly Base Case Components (Top to Bottom)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td>Compliant Standalone Screen Systems</td>
<td>VTA Packer¹</td>
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<tr>
<td></td>
<td>VGP Packer¹</td>
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<tr>
<td></td>
<td>VBA Packer¹</td>
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<td>VCA Packer¹</td>
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<td></td>
<td>VCH Packer¹</td>
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<tr>
<td>Stacked Fixed Absolute Isolation Systems</td>
<td>VTA Packer¹</td>
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<tr>
<td></td>
<td>VGP Packer¹</td>
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<td></td>
<td>VBA Packer¹</td>
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<td>VCA Packer¹</td>
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<td></td>
<td>VCH Packer¹</td>
</tr>
<tr>
<td>Sandface Instrumentation (SFI) Systems</td>
<td>Scoop Head Assembly</td>
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<td></td>
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<tr>
<td></td>
<td>VCA Packer¹</td>
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<td></td>
<td>VCH Packer¹</td>
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<tr>
<td>Liner-Conveyed Gravel Pack (LCGP) Systems</td>
<td>VCH Packers¹</td>
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<tr>
<td></td>
<td>VGP Packers¹</td>
</tr>
<tr>
<td>LCGP Systems Multilateral with FlexRite® Technology</td>
<td>VCH Packers¹</td>
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<tr>
<td></td>
<td>VGP Packers¹</td>
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<td>STMZ™ Single-Trip Multizone Systems</td>
<td>VGP Packer¹</td>
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<tr>
<td>ESTMZ™ Enhanced Single-Trip Multizone Systems - Cased Hole System</td>
<td>VCH Packer¹</td>
</tr>
<tr>
<td>ESTMZ Systems - Openhole System and Multilateral with FlexRite® Technology</td>
<td>VCH Packer¹</td>
</tr>
</tbody>
</table>

*Screens refer to the types of screens used in the respective systems.
## Sand Control System Solutions

<table>
<thead>
<tr>
<th>Lower Completion Packer Assembly Base Case Components (Top to Bottom)</th>
<th>Screens*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive EquiFlow® Inflow Control Technology</td>
<td></td>
</tr>
<tr>
<td>VTA Packer¹</td>
<td></td>
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<tr>
<td>VGP Packer¹</td>
<td></td>
</tr>
<tr>
<td>VBA Packer¹</td>
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<tr>
<td>VCA Packer¹</td>
<td></td>
</tr>
<tr>
<td>VCH Packer¹</td>
<td></td>
</tr>
<tr>
<td>MCS Closing Sleeve²</td>
<td>Makeup Sub⁵ IB Valves² FS2 Valves²</td>
</tr>
<tr>
<td>Makeup Sub⁵</td>
<td></td>
</tr>
<tr>
<td>IB Valves²</td>
<td></td>
</tr>
<tr>
<td>FS2 Valves²</td>
<td></td>
</tr>
</tbody>
</table>

### Autonomous EquiFlow Inflow Control Technology

| VTA Packer¹                                                   |         |
| VGP Packer¹                                                   |         |
| VBA Packer¹                                                   |         |
| VCA Packer¹                                                   |         |
| VCH Packer¹                                                   |         |
| MCS Closing Sleeve²                                           | Makeup Sub⁵ IB Valves² FS2 Valves² | Autonomous ICDs with PetroGuard Mesh DS Or Autonomous ICDs with PetroGuard Wrap |
| Makeup Sub⁵                                                  |         |
| IB Valves²                                                   |         |
| FS2 Valves²                                                  |         |

*Screen types are interchangeable between systems.

¹Packer selection depends on pressure ratings, temperature, service requirements, casing size, running speed, etc. Refer to pages 3-2 through 3-7 for further details on Versa-Trieve® packers.

²Refer to pages 3-20 and 3-21 for further details on MCS closing sleeves.

³Fluid loss device selection depends on opening methods, pressure requirements, casing size, etc. Refer to pages 3-22 through 3-28 for further details on selection criteria.

⁴Refer to page 3-32 for further details on MSJ shear joints.

⁵Refer to pages 3-32 for further details on makeup subs.

⁶One-way and two-way positioning nipples are required to operate the ROC™ Reverse-Out Check tool of STGP&T™ service tool assembly.

⁷Refer to pages 3-53 for further details on Upstream/Downstream Differential (UDD) valves.
Standard FracPac™ Systems

Several very effective gravel packing techniques are available. Each technique has special advantages and is designed for unique applications.

FracPac™ Systems

In the 1990s, industry experts introduced the concept of increasing the pack-sand volume placed outside the casing (high-permeability fracturing). These frac packs required even more specialized tool designs to withstand the high flow rates and proppant volumes being pumped at high pressure. Synthetic proppants became more frequently used since they were more resistant to crushing and had higher permeability under high confining stress. However, because synthetic proppants can be significantly more erosive than sands, they pose additional design problems for tool designers. Sand control continues to evolve. New tool systems, fluids, and chemicals are continually being developed for improved sand placement and pack performance.

FracPac™ completion services combine the stimulation advantages of hydraulic fracturing with the most effective techniques available for sand control in poorly consolidated, high-permeability formations. Whether the job is a new completion in a formation known for sanding or a recompletion of a well with existing damage, FracPac™ systems provide a short, wide fracture for bypassing skin damage near the wellbore. Highly conductive proppant is then placed from the leading tip of the fracture all the way to the borehole. This tip-screenout (TSO) method controls sand production both by minimizing radial flow velocity at the wellbore and by stabilizing sand directly at the fracture rather than allowing it to reach and accumulate at the wellbore.

The practice of applying fracturing and sand control in a single treatment has existed for several years. Now the methods, tools, and materials are being designed to take full advantage of the theory behind tip-screenout fracturing as applied to poorly consolidated, high-permeability formations. In such formations, fracture conductivity is the key design factor to effectively bypass damage and provide stimulation. FracPac completion services create the short, wide fractures that promote maximum conductivity to develop maximum productivity potential.

Because FracPac systems can reduce drawdown and flow velocity at the wellbore, formation sand production caused by formation failure or solids migration is reduced. As an investment in higher production rates over a longer production life, a FracPac system completion can offer enhanced benefits compared to a standard gravel pack.

Halliburton has developed systems that provide optimum performance levels for every FracPac system application. From the basic FracPac system to the higher rate Red Zone® tool system to the industry leading Beyond Red Zone® system tools, Halliburton can provide the right solution to meet your sand control frac pack needs.
FracPac™ System

**Completion Equipment**
- Versa-Triever® Packer
- Red Zone® or Frac Upper Extension
- MCS Closing Sleeve or Beyond Red Zone® Closing Sleeve
- Blank Pipe (Heavy Walled)
- Indicator Coupling
- MSJ Shear Joint
- ShurShot® Fluid Loss Control Device
- Production Screen
- Top Snap Locator and Seal Assembly
- Sump Packer

**Service Tools**
- MPW Service Tool
- Straight Pull Release Locator
- Frac Crossover
- Setting Ball in Tapered Ball Seat
- Multi-Acting Reverse Ball Check and Swivel
- Closing Sleeve Shifting Tool
- ShurMAC™ Multi-Acting Weight-Down Collet
- Washpipe
- ShurShot ISS Tool

**Run**

**Set Packer**

**Weight-Down Circulate**

**Squeeze (Annulus Closed)**
Red Zone® and Beyond Red Zone® FracPac™ Systems

Halliburton’s Red Zone® and Beyond Red Zone® FracPac™ services are complete packages that include pumping and tool system design, tool system analysis, and job execution. Beyond Red Zone FracPac services provide the highest rates and volumes available in the industry.

Jobs are analyzed for optimum pumping rates and volumes. Selection and positioning of the service tool, upper extension, and closing sleeve is followed by analysis of the pumping schedule to verify suitability of the system under extreme conditions. Analysis uses one of several tools that may include COSMOSFloWorks™ solid fluid flow modeling, Halliburton’s proprietary erosion modeling, or more advanced analysis tools.

The system incorporates the multi-position service tool with Versa-Trieve® packers to provide for ultra high-rate, large proppant volume sand control pumping treatments. The multi-position tool is used to carry the gravel pack assembly downhole and to set the packer. Once the screen assembly is positioned across the perforated interval, a ball is dropped down the workstring. Pump pressure is applied to set the Versa-Trieve packer and either pressure, straight pull, or a combination will release the multi-position tool. In the run-in position, the crossover is located in the sealbore below the closing sleeve. Once the packer is set and the service tool released, the ShurMAC™ collet positions the crossover above the closing sleeve exit ports.

Features

- Utilizes wear-resistant, carbide sleeve technology
- Retains ability to monitor live annulus pressure in all sizes
- Wear is concentrated on the service tool and packer’s upper casing extension, not the wellbore casing
- Setting ball is gravitated to its seat below crossover and remains in place throughout the job (not reversed out)
- Washdown capability in some sizes
- Alternating squeeze/live annulus capability in some sizes
- Longer upper extension provides room for tool movement due to thermal effects

*COSMOSFloWorks is a trademark of Structural Research and Analysis Corporation.
Benefits
- Helps increase the likelihood of incident-free sand placement
- Helps reduce cost and risk of individually completing multiple intervals
- Proper stimulation of high kH intervals (long intervals, high perm)
- No ball seat to shear eliminates the chance of pressure surges to the formation
- Treating pressure can be monitored in real time through the annulus for better pack evaluation
- Tubing movement due to pumping pressure and temperature effects can be compensated for prior to the start for better control of the job

Applications
- High kH, poorly consolidated reservoir intervals
- Multiple intervals requiring completion as one interval

Red Zone® FracPac™ System Maximum Tool Ratings

<table>
<thead>
<tr>
<th>Tool Size</th>
<th>Flow Rate</th>
<th>Volume</th>
<th>Proppant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-in. 2.55</td>
<td>20 bbl/min</td>
<td>175,000 lb</td>
<td>20/40 (SG2.71) Ceramic</td>
</tr>
<tr>
<td>5 1/2-in. 2.75</td>
<td>30 bbl/min</td>
<td>175,000 lb</td>
<td>20/40 (SG2.71) Ceramic</td>
</tr>
<tr>
<td>6 5/8-in. and 7-in. 3.25</td>
<td>40 bbl/min, 25 bbl/min</td>
<td>400,000 lb, 250,000 lb</td>
<td>20/40 (SG2.71) Ceramic, 20/40 (SG3.56) Ceramic</td>
</tr>
<tr>
<td>7-in. (17-35 lb) 3.88</td>
<td>40 bbl/min</td>
<td>250,000 lb</td>
<td>20/40 (SG2.71) Ceramic</td>
</tr>
<tr>
<td>7 5/8-in. 3.88</td>
<td>45 bbl/min</td>
<td>750,000 lb</td>
<td>16/30 (SG3.56) Ceramic</td>
</tr>
<tr>
<td>9 5/8-in. 5.00</td>
<td>60 bbl/min</td>
<td>1.2 MM lb</td>
<td>20/40 (SG3.27) Ceramic</td>
</tr>
<tr>
<td>9 5/8-in. 6.00</td>
<td>70 bbl/min</td>
<td>800,000 lb</td>
<td>16/30 (SG3.56) Ceramic</td>
</tr>
</tbody>
</table>

Rating can be impacted by customer completion requirements.
Horizontal Gravel Pack Systems

HZGP Pressure Maintenance System
Horizontal gravel pack systems (HZGP) have become a popular method of completing horizontal wells. The simple field-proven horizontal gravel pack tool system provides a reliable method for maintaining and controlling pressure against the formation filter cake to prevent wellbore collapse. Using a computer simulator to design enhanced alpha/beta wave placement, the system maintains optimum screen coverage with predicted alpha/beta wave pressure curves. The damage-tolerant design of the PetroGuard® Wrap screen adds to the system’s reliability. The HZGP system is consistently executed around the globe.

The HZGP tool system has a packer pre-setting mechanism to prevent the packer from setting prior to use. The system also provides standard gravel pack positions, an injection control device for acid spotting, and an activated ball check for hydrostatic maintenance. The system has washdown capabilities while running the packer and toe-to-heel and heel-to-toe circulation capabilities after setting. The lower telltale screen and shoe can be isolated after packing.

Features
- Simple, trouble-free installation
- Spiral centralizers ease running, maximize hole cleanup, and help aid in prevention of screen plugging
- Allows positive identification of the tool positions with tension and compression
- Pressure maintenance feature helps ensure pressure surges cannot occur during tool movement or packer setting
- Internal synergies of the system are proven to enhance execution
- Allows for running the screen, displacing the hole, setting the packer, circulating, gravel packing, and actuating the fluid loss device in a single trip

The HZGP system yields high production rates due to the utilization of a maximum screen size, which minimizes friction pressures, maximizes the chances of hole cleanup without the need for breakers, and maximizes hole cleanup prior to gravel placement.

A variety of numerical and physical simulation tools are available to assist in job planning including Halliburton’s HzGPSim™ horizontal gravel pack simulator. The HzGPSim software program has been successfully used globally to predict and model horizontal gravel packing. The program offers several models for leakoff, including dependent leakoff. The program handles the effect of friction pressures and flow geometries and can simulate the effect of hole washouts. It incorporates friction correlations developed from experimental measurements of flow-through screen and washpipes. The HzGPSim program calculates required injection and return rates; expected bottomhole treating pressures; predicted heights of alpha and beta waves; time for end of alpha and beta waves; and minimum rate below which a premature screenout will occur.

Packer Test Assembly
Maintaining a fluid hydrostatic overbalance on the formation is critical to maintaining hole stability and successful gravel packing. Removing the fluid hydrostatic overbalance will allow the filter cake to lift off, creating additional fluid loss and/or allowing the openhole to collapse. To pack the horizontal section and maintain a hydrostatic overbalance on the formation, a packer test assembly can be run. This assembly provides additional flow control to allow pressure to be maintained during all phases of the completion. The assembly requires additional components to be included or designed into the gravel pack service tool. These additional components provide flow paths that control weight-down washdown circulation, provide for a packer testing position with fluid circulation into the open hole, shut off circulation through the actuated reverse ball seat, and reopen that path prior to final reverse circulation and actuation.

Screen Isolation Device
The screen isolation device is a washpipe-deployed plug used to permanently isolate the sacrificial screen and shoe after the gravel pack. When the gravel pack is complete, it is set in the upper sealbore (above the sacrificial screen) by a straight pull. It is locked in place by internal slips. The running tool is released by tension. During initial screen running operations, the plug is placed into a lower sub assembly with a latch looking upward. Once the screen is in the well, the washpipe is run with a mating Ratch-Latch™ tool on bottom and is stabbed and latched into the plug assembly.

Locator Nipple
The locator nipple is an upper sealbore receptacle made up above the sacrificial screen. The sealbore receptacle provides a profile for latching the washpipe isolation plug after gravel packing. With the washpipe-deployed plug installed, both the sacrificial screen and shoe are isolated.
Other numerical and physical simulation tools available include:

- WAVE horizontal gravel pack simulator – Takes into account the complications arising from the CAPS™ geometry. It became an integral part of the HalWin™ program starting with version 2.6.0 and is based on the premise the pressure in openhole/shroud, shroud/screen, screen/washpipe annuli is equal at every point along the length of the assembly.

- Jaycor GPS2001 gravel pack simulator – Has variable casing, toolstring, and bottomhole assembly and allows for multiple formation input. It permits flow in three dimensions—down the wellbore, radially outward, and around the circumference.

- 56-ft flow loop

- Small scale GP model (3.75-in. ID, 12.5-ft length)

- Full-scale model (8.6-in. ID, 40-ft length)
Versa-Trieve® Packer/Multi-Position Tool Systems

Single-Zone Completion System
The Versa-Trieve® packer/MPA tool completion assembly with screen, blank, and lower seals is located in and isolated on its lower end with a Perma-Series® sump packer, or the assembly is bull-plugged on the end of the screen. A Versa-Trieve-type retrievable or PGP-type Perma-Series permanent gravel pack packer can be used as the upper packer. The upper packer is then set as described in “Section 3 Downhole Sand Control Components.” This separates the MPA tool from the packer so it can move to the required positions.

Squeeze Position
With the MPA tool fully in the packer bore (run-in, weight-down position), return circulation is prevented. All fluids pumped down the workstring are forced into the formation. This position is used to test the packer, obtain injection rates, and force acid or slurry into the perforations. This position does not expose the workstring casing annulus to workstring treating pressures.

Circulating Position
Raising the multi-position tool exposes a port on the upper end of the MPA tool that is sealed in the packer bore when the multi-position tool is fully in the packer. The opening of this port allows circulation down the tubing, out of the MCS closing sleeve, past the perforated interval, through the screen, into the end of the washpipe, up the washpipe and around the crossover sub, out the upper circulation ports, and up the workstring casing annulus. This position is used to circulate fluid and slurry to bottom, to take fluid returns to dehydrate a gravel pack slurry, or to monitor treating pressure on the annulus when performing a squeezing (frac pack) operation with the surface annulus choke closed.

Reversing Out Position
This position is obtained by raising the multi-position tool until its crossover ports are above the sealbore of the packer. The reversing out position is used when spotting fluids down the workstring, pickling the workstring, or reversing excess slurry out of the workstring upon completion of the gravel pack operation. Seals below the crossover ports of the multi-position tool remain in the packer bore while reverse circulating to isolate the formation from the applied pump pressure. Generally a reverse ball check is run in the washpipe to prevent fluid escaping the annulus above the packer into the formation through the circulation ports and down the washpipe. A ball check with weep tube may be utilized to prevent a swab effect during tool movement.
Production Tubing Run Into Place

The production seal assembly is run in the well on the production tubing. The seal assembly is stung into the Versa-Trieve® packer and the sealbore of the flow sub. The seal assembly isolates annular fluids and directs well production up the tubing string.
Multizone Stacked Completion Assemblies

When a well with multiple zones must be completed and isolated, the lower zone is packed in the same manner as a single-zone installation. If the zones are conveniently spaced, the upper packer in the lower zone can be used to locate and form a base (sump packer) for the upper zone pack.

Perforation operations for the upper zone are performed once the lower zone has been completed. A packer plug is run into the upper packer of the lower zone to isolate the lower zone during perforating. After perforating and perforation cleanup, the packer plug is retrieved. The upper zone completion assembly is run on the multi-position tool (MPT) until the lower seal assembly locates the lower zone upper packer. Packer setting, testing, and gravel placement operations are performed as described previously.

If the upper zone is not sufficiently close to the lower zone, an isolation packer with tailpipe can be used to seal in the lower zone upper packer. This isolation packer then becomes the sump packer for the upper zone pack.

Dual-Zone Completions

For simultaneous independent production from two zones, a seal assembly is run on the end of the long string of a dual packer such as the DHC, BHD, or RDH dual hydraulic packers, which are described in the Halliburton Completion Solutions catalog. The seal assembly locates in the lower polished nipple, which is above or contained within the seal assembly that seals in the packer of the lower zone completion assembly. The lower zone is produced up the long string, and the upper zone flows concentrically up the annulus to the short string.

The Twin-Flow Absolute Isolation System (AIS) assembly is used in dual-zone completions requiring isolated production from each of the two zones simultaneously. The Twin-Flow AIS assembly also provides fluid loss control to the upper zone while production tubing is being run. Once the tubing is in place, pressure can be applied to the annulus down the short string or through a smart valve tied to the annulus above the gravel pack packer to activate and open the Twin-Flow AIS assembly. This will allow production from the upper zone.

Selective-Zone Completions

Seal assemblies are run to seal in both the lower sealbore and upper packer. Production tubing between the seal assemblies is spaced out to locate the lower set of seals in the lower sealbore. The lower zone is produced through the isolation string up the production tubing. A Halliburton DuraSleeve® Sliding Side-Door® production sleeve can be run in the isolation string to gain access to the upper zone, and an Otis® X-Line® or R-Line® nipple can be run just above the lower set of seals to isolate the lower zone as required.
Openhole Tool System

Field-proven Versa-Trieve® packers and multi-position tools used in cased hole completions are also used in openhole completions. Openhole gravel packs eliminate flow restrictions caused by cased hole perforations.

In an openhole tool system, the screen is freely suspended in the openhole. Centralizing the screen permits a uniform pack around the screen to provide a uniform formation sand filter. The deviation of the wellbore and formation characteristics determine the type of centralizer. The type of screen selected can be important to the success of the completion and may differ from the screen normally selected for a cased hole completion. Borehole stability and cleanliness will also impact the success of the pack.

Specific openhole tool system designs exist for the shorter vertical wells, horizontal screen only, horizontal gravel packs, and horizontal gravel packs that need a post-gravel pack treatment. Consult your local Halliburton representative for the correct system for your well application.

See “Section 4 Screens” for screen-related options and “Section 5 Sand Control Production Enhancement Products and Services” for fluid-related options.
**Weight-Down Circulating (Live Annulus) System**

The weight-down system is an operationally simple alternative to extending the length of the system to be able to locate positions. The weight-down systems allow the squeeze and circulating positions to be located with weight-down on the packer. This system of choice for many operators has a number of important benefits.

**Features**
- Tubing movement due to frac pressures can be compensated for prior to the start of the job.
- Tubing elongation or contraction is controlled with weight on the packer.
- Reverse out position is not affected and is located in the same way as a conventional multi-position tool system.
- Squeeze and circulation flow can be controlled by the surface choke.
- Treating pressure can be monitored in real time down the annulus with the tool in the circulate position.

**Benefits**
- Helps minimize the effects of vessel heave (floating vessel operations)
- Simple operation

Various weight-down system options exist in the different size tools. These include:
- Ported locator
- Single acting weight-down collet-circulate system
- Single and ShurMAC™-circulate and squeeze system
Short Weight-Down Circulating Tool System

This system was designed to be extremely short in order to isolate very closely spaced packed zones. The no-movement circulating position of the weight-down system allows the flow sub assembly to be substantially shortened. The upper extension is eliminated, and the MCS closing sleeve or MFS flow sub is screwed directly in an extended packer bottom sub. The shear joint is attached to the bottom of the MCS sleeve. Lower extension length can be minimal depending on tool design.

Weight-Down/Washdown Circulating Tool System

The washdown version of the weight-down system combines the features of the washdown system with the benefits of the weight-down system. Washing operations can be performed across the zone of interest followed by a weight-down circulating pack. With this system, the washdown crossover tool ports are initially located in the sealbore of the MCS closing sleeve or MFS flow sub assembly. Fluid can be circulated through the completion assembly as it is run into the well. The setting ball seals the crossover washdown port and allows application of pressure to set the packer. Once the tool is raised and subsequently lowered, a weight-down, positive collet prevents the tool from returning to its run-in, weight-down position. Fluid can now be circulated out the crossover ports that are properly positioned for weight-down circulating, FracPac™ system, or gravel pack operations.
Washdown Circulating System

The Versa-Trieve® multi-position tool system for open or cased hole can be modified to a washdown gravel pack system. The washdown system allows circulation down the workstring and through the washpipe as the completion assembly is lowered into the well. A washdown shoe is attached to the lower end of the screen assembly; or, if a sump packer is used, the fluid can be circulated out through the end of the seal assembly. With a seal assembly, reverse circulation is possible.

With a washdown system, the MCS closing sleeve is run either with the sleeve in the closed position or the MPT crossover ports are positioned to seal in the sealbore of the closing sleeve. Fluids pumped down the workstring are prevented from escaping out the closing sleeve or crossover ports. A specially modified washdown multi-position tool crossover sub-assembly is needed to provide a flow path through the length of the tool. This flow path remains open until the setting ball lands in the tapered seat below the crossover and is caught by the specially designed tapered seat which wedges the ball into place and shuts off the washdown flow path. The washdown system can be used to remove hole stabilization material before gravel packing, to displace completion brines and spot acid, and to wash through minor areas of hole instability. The squeeze, circulating, upper circulating, and reverse positions are the same as those of other multi-position tools.

Refer to “Section 4 Screens” and “Section 5 Sand Control Production Enhancement Products and Services” for more information regarding openhole gravel pack completions.
Absolute Isolation Fluid Loss Systems

The Absolute Isolation System (AIS) provides a means to isolate the screen adjacent to the producing interval immediately following completion operations. This system uses the concentric string below the multi-position tool as the isolation string to seal off the screened interval prior to pulling out of the hole with the workstring. This system has been particularly effective in stacked-zone completions. Where fluid loss and downhole flow between zones presents a problem for fluid loss flappers or chemical fluid loss methods, the AIS is a proven and reliable solution. Producing gravel packed intervals have been effectively isolated, packed, and selectively produced with this system.

Twin-Flow AIS System

Fluid loss control in ultra-deepwater completions utilizing SmartWell® system technology can present a challenge. To help alleviate these challenges, Halliburton engineered the Twin-Flow Annular Isolation System (AIS) valve, a hydraulically actuated fluid loss device. The valve allows the production of two discrete production paths through the valve while on production and manages fluid loss to the upper zone after stimulation. This valve is actuated only after the SmartWell system equipment is in place and is activated with a single hydraulic pressure cycle.

In addition to the Twin-Flow AIS valve designed for the uppermost zone of a SmartWell system completion, an additional Twin-Flow AIS valve was designed to manage fluid loss to both the zone of interest and to the zone(s) below the valve. This valve was designed to meet the challenge presented where the upper two zones of a triple-stack FracPac™ system completion were to be commingled.
The STGP&T™ single-trip gravel pack and treat system is a horizontal openhole gravel packing system that saves the extra trip needed to treat the formation. The system has all the beneficial features of Halliburton’s conventional horizontal gravel pack tool system with an added treating feature to reduce rig time. It is normally used on horizontal gravel packs to treat the production interval after packing it.

The service tool incorporates all the functionalities to run and install the sandface completion, pump the sand control treatment, and spot in the same trip as a filter cake breaker system once the gravel pack is placed. When the lower completion service tool is finally retrieved, a shifter at the end of the washpipe closes the fluid loss control or reservoir isolation device that will be opened once the upper completion is installed. At that time, the well is ready for production with no further intervention required.

Our service tool offering includes tools specifically designed for long horizontal openhole applications that incorporate a hydraulic section combining the following specifications:

- High tensile load capability
- High running torque capability
- Soft release mechanism from the packer
- Contingency rotate to release

The service tool has also been designed to provide weight indications on surface when moved through the various tool positions. It incorporates a check valve assembly that locates in nipples or restrictions run as part of the lower completion packer assembly. Any time the tool is raised from the circulate position or lowered from the reverse position a weight indication is shown on surface, ensuring the operator knows the service tool position inside the packer assembly and related flow path. Similarly, an indication denotes when the tool converts to the treat mode once gravel pack pumping is complete, prior to spotting any filter-cake treatment.

Benefits
- Saves a trip into the well, saving time and money
- Reduces fluid loss potential and well control problems
- Conveys lower completion equipment to total depth safely
- Provides wash-down capabilities while running in hole
- Allows setting and testing of the gravel pack packer
- Maintains controlled hydrostatic pressure against the formation at all times
- Provides both a circulate and a reverse position for pumping purposes, achieved through tool reciprocation
- Provides a weight-down circulate position for simplified operations off of a floating drilling unit

STGP&T System Capabilities
- Provides a means to re-establish circulation to the bottom of the service string for pump out or post gravel pack treatment for filter cake removal operations:
  - Ability to wash the entire interval as tool is retrieved
  - Eliminates a second trip for treating operations

Gravel Pack Fluid System Developments
- N-FLOW™ delayed breaker systems
  - Works to remove filter cakes created with Baroid’s DRIL-N® line of drill-in fluids for drilling openholes

Complete Products and Fluid Systems
- Clean drill-in fluids
- Pumping services
- Uphole completion equipment
- Intervention services
- SmartWell® system (6.00 bore system)
Multizone Gravel/FracPac™ Systems

STMZ™ Single-Trip Multizone Completion Systems

Halliburton is a leader in multizone systems that enable the isolation and gravel packing of all zones that require gravel pack for sand control in fewer trips.

With conventional multi-trip systems, the tools must be tripped out of the hole numerous times in order to perforate, clean up, complete, and gravel pack multiple zones. This is not only time consuming and expensive, it also exposes the formation repeatedly to potential damage. The STMZ™ single-trip multizone system accomplishes treatment and packing operations for all zones in a single trip. A single production isolation string isolates the well.

The STMZ system is applicable when the zones have equivalent bottomhole pressure and are similar lengths.

A unique retrievable packoff assembly, located in the upper packer assembly, isolates the completion interval from the annulus above the top packer. The multiple zones may be commingled and produced or may be selectively produced depending on the production seal unit configuration.

Features

• Perforating for all zones is done in one trip with tubing conveyed perforating or multiple trips with wireline. All zones are perforated first.
• Sand control completion tools are run for all zones in a single trip.
• The packing operations are completed in the same trip.
• The well is isolated with a single isolation string.

Benefits

• Quadra™ seal technology for lower service tool seal friction, longer life, and less sticking
• Helps reduce safety and operational risk
• Helps reduce rig time costs
• Helps reduce perforating costs
• Helps reduce hole preparation cost
• Helps reduce pipe pickling costs
• Helps reduce filtration costs
• Helps reduce completion tool running costs
• Helps reduce flowback and cleanup time
• Helps reduce potential for formation damage
• Can improve gravel packing fluid loss/control
ESTMZ™ Enhanced Single-Trip Multizone FracPac™ Completion System

The ESTMZ™ system is the latest in the single trip family. It is similar to the STMZ™ system and provides the same benefits. It is designed to address the multiple independent producing zones within a well and isolate each one. In addition, it is enhanced with greater pressure rating and proppant pumping capabilities. Benefits include the ability to profitably complete very deep, multizone reservoirs as compared to stacked FracPac™ completion systems.

The ESTMZ system has frac pack rate and volume capabilities to enable optimum fracturing of five or more zones at rates of up to 45 bbl/min and proppant volumes up to 750,000 lb per zone. Size availability includes 9 5/8-in. cased hole, 8 1/2-in. openhole, and 7-in. cased hole systems.

**Applications**
- Multizone completions for cased and openhole installations

**Features and Benefits**
- One perforating trip—all zones
- One cleanup and de-burring trip
- One completion assembly trip
- Sequential packing process
- Higher frac pack rates and volumes
- Larger ID, 10,000 psi rated systems
- Modular screen for zonal isolation
- Fluid loss control/zonal isolation

Field-proven Versa-Trieve® packers and innovative high-load HPT setting tool

Proven sump packers and top-snap collet positioning

Proven weight-down positioning with the ShurMac™ collet

Multiple isolation packer options

Selective shifting profiles
Dual Basepipe Modular Screen
This screen provides an annular flow path much like a fixed absolute isolation system when combined with mid-joint production and frac circulation sleeves. The modular screen is connected as a complete unit across each zone. Annular communication between joints is accomplished with the use of a bulkhead fitting on the inner basepipe. A single sleeve at the bottom of the screen is opened to allow flow. This eliminates the need for washpipe seals; thereby enabling the treatment of various zone lengths in the same wellbore.

PetroGuard® Modular Screen
By utilizing the Halliburton PetroGuard® direct-wrap technology, a single basepipe modular screen was created. The annular flow path is created by unique screen rib wires between the non-perforated basepipe and the screen jacket. Annular communication between joints is accomplished through a communication sleeve installed after torquing the premium basepipe thread. The screen can be configured with PetroGuard Wrap wrap-on-pipe or PetroGuard Mesh DS premium screen.
Liner-Conveyed Gravel Pack Systems

The Liner-Conveyed Gravel Pack (LCGP) system provides a single-trip combination casing liner and screen assembly with the capability to place a sand control completion across the sandface and cement the liner above. Since the liner is combined with the screen into a single completion assembly, the screen does not have to pass through the liner, enabling the larger basepipe screen to be placed across the sandface. In some applications, use of the LCGP system may enable the reduction of a casing size in the well design.

The larger OD/ID screen across the sandface enables the use of larger gravel packing tools and larger screens to increase the open flow areas and reduce the pressure drop across the reservoir. This optimizes production and minimizes erosion.

In multilateral systems, liner disconnect can be incorporated to remove the upper portion of the liner when completing multilateral completions. Once activated, the liner packer and part of the liner can be removed from the lower assembly leaving the top of the liner below the lateral junction. The multilateral junction can be reconnected, if needed, when tripping upper completion equipment.

Applications
- Sidetrack completions in existing wellbores
- Slimhole primary completions
- Isolating nonproductive sections of a zone
- Multilateral wells requiring sand control
- Stand-alone screen completion with or without a cemented liner
- Gravel pack completion with or without a cemented liner extends to just below the multilateral junction

Features and Benefits
- Maximizes system production flow bore
- Eliminates a liner run and associated clean out and liner testing time
- Saves drilling fluid and conditioning time
- Openhole gravel pack or stand-alone screen completion in fewer trips
- Uses external casing packers (ECP), Swellpacker® systems, and/or cement to isolate the liner
- Eliminates the screen size reduction normally associated with a standard liner-based well design
- Helps eliminate openhole transition concerns (rathole) associated with deepwater wells, which can frequently lead to gravel placement issues
- Compatible with all screen types
- Liner can be cemented using fluid displacement or conventional cementing pumpdown plugs to provide positive pressure confirmation
Dual-Zone SmartWell® Deepwater Systems

Dual-Zone SmartWell® Deepwater Systems combine leading technologies into a robust system designed to optimize production in subsea, deepwater completions, including stack packed sand control wells. This system allows dual or multizone flow, using SmartWell interval control valves (ICV) to regulate and maximize production from each zone. Downhole permanent gauges allow continuous monitoring of the well’s production. And the Twin-Flow absolute isolation system (AIS) enables separate production flow paths in dual-zone sand control completions.

During the completion phase, fluid loss control is achieved using the Twin-Flow AIS for the upper zone, and the FS2 valve for the lower zone, while running the upper completion. Both technologies permit remote pressure opening without intervention.

The use of the continuous sealing long space-out travel joint (CS-LSOTJ) simplifies the space out procedure when landing the subsea hanger. The benefit of this technology grows as water depth increases. The CS-LSOTJ maintains sealing for zonal isolation over its adjustable extended stroke length. Production or injection flow is then optimized through the ICVs. The CS-LSOTJ also enables running of the upper completion in a single trip.

System components work in unison to offer unique benefits to the overall completion design. The system, as well as the individual components, is designed to extend the life of the well by using the most reliable equipment in the industry. Performance is assured through integrated completion design that enables safe, efficient operations offshore.

**Features**
- Dual or multizone applications
- Independent zonal fluid loss control
- Compatible with leading edge Beyond Red Zone® FracPac™ system technology
- Intelligent well capability

**Benefits**
- Minimizes completion cost and economic risk
  - Single-trip upper completion
  - Remote fluid loss device activation
  - Compatible system design
- ICVs optimize productivity
  - High overall production rates
  - Increases well longevity
  - Proven long-term performance and reliability

**Typical Dual-Zone Intelligent Completion Characteristics**
- 9 5/8 to 13 3/8-in. casing sizes
- 1,000 to 10,000-ft water depth or greater
- Two to three zones
- FS2 fluid loss control – lower zone
- Twin-Flow AIS fluid loss control – upper zone
- CS-LSOTJ long space-out sealing travel joint
- SmartWell ICVs with permanent downhole gauges
- HF1 upper completion packer
- DepthStar® subsurface safety valve

**HF-1 Isolation Production Packer**
The isolation production packer is used as a production tubing anchor to prevent wellbore pressure and production from entering the casing above the formation. It diverts oil and gas flow into the production tubing, protecting the subsea tubing hanger and production casing from high pressure and corrosive fluids.

**Upper ICV**
The upper ICV diverts upper zone production into the tubing through the surface-regulated ICV choke. The choke is controlled at surface through the attached control lines, allowing the upper zone to be produced in a controlled and optimized flow. In turn, flow is co-mingled with the lower zone in a controlled manner to maximize production from both zones simultaneously.

**Lower ICV**
The lower ICV diverts lower zone production into the tubing through the surface-regulated ICV choke. The choke is controlled at surface through attached control lines, allowing the lower zone to be produced in a controlled and optimized flow. In turn, flow is co-mingled with the upper zone in a controlled manner to maximize production from both zones simultaneously. By optimizing flow from both zones, pressure drops from each individual zone is lower, while realizing maximum production—resulting in extended and more incremental production throughout the life of the well.
Continuous Sealing Long Space-Out Travel Joint

The CS-LSOTJ is designed to unlock from the running position and collapse in response to a non-shearing compressive load after landing a production seal assembly into a sealbore packer below. After the LSOTJ collapses, production tubing can be lowered with ease to land the subsea tubing hanger into the subsea tubing-head spool. It is important to note under these circumstances, a standard shearable travel joint could shear and collapse prematurely while attempting to push the bottom seals through the subsea blowout preventer (BOP) and wellhead. This could result in a misrun of the completion string. The LSOTJ does not use shear pins and can be pushed through difficult entry points.

In addition to being critical to landing the production tubing, the CS-LSOTJ performs the following functions:

- Serves as a safety function or shock absorber when passing through the BOP or the liner top
- Serves as stroke adjustment between the two fixed points of the gravel-pack packer seals and subsea tubing hanger
- Designed such that lower-production tubing and seals can be relocked to the production tubing, so retrieving can be accomplished in one trip instead of two
- Allows a tension and pressure test of gravel-pack packer seals to verify production tubing has landed correctly
- Can be re-locked downhole if activated during the running process
- Includes an emergency shear release feature

Lower production tubing serves as a conduit for any type of intervention with sandface completions. Note extensions above the CS-LSOTJ will stroke downward over the production seals and lower production tubing as the subsea tubing hanger is lowered to the landing position.

Production Seals

Production seals function by sealing into the upper PBR and separate the lower zone from the upper zone. They maintain sealing integrity during the life of the well and serve as a conduit for any type of intervention with the lower zone. Length between seals must be less than the sealbore length to ensure continual sealing integrity.

Twin-Flow Absolute Isolation System (AIS)

The Twin-Flow AIS hydraulically actuated fluid-loss device serves as a fluid-loss device for the upper zone. Only after production tubing-related equipment and the tubing hanger are landed will this device be opened.

Upper and Lower Zone Sand Control Completion

These are typically dual zone FracPac™ completions.
Standalone Screen Systems

When properly executed, standalone screen systems provide highly reliable sand control with less operational complexity—offering a lower cost option when compared to gravel packing or other openhole completion strategies.

Standalone screen completions are typically configured as both openhole and horizontal completions. After the reservoir section is drilled, a basepipe-deployed mechanical filter sized to restrict solids production will be positioned across the chosen intervals.

Halliburton offers an array of screen products designed to meet any wellbore challenge and maximize well production while maintaining acceptable solids control levels. The PetroGuard® screen family includes prepacked screens, wire-wrap screens, mesh screens, and compliant screen systems all of which can be used as standalone screens.

The wire-wrap screen family offers simple, reliable prepack and slip-on jacket technologies. The robust, fine-tuned PetroGuard® Wrap product is a direct wrap solution that is especially valuable in standalone screen completions with challenging well environments, trajectories, and borehole conditions where the screen system will be pushed to the limit without compromising filtration performance while in deployment. Directly applying the wrap wires over the ribs while mounted on the basepipe results in a tight fit, durable screen assembly. Halliburton’s proprietary gauge control and verification process functions in real time during the wrapping operation, which allows for closer tolerance screen gauge and reduced cost.

Mesh screen products offer several filtration design options including the PetroGuard Mesh product line. Featuring a multi-layered, single woven non-bonded layer, the PetroGuard Mesh DS screen maintains Halliburton’s standards of reliable filtration efficiency and quality in a cost-effective design. The PetroGuard Advanced Mesh screen brings leading-edge filtration technology to the upstream industry. This unique technology is formed from a series of custom-designed, diffusion-bonded surface filter layers to give precise pore size control and provide the highest solids retention and plugging resistance possible.

More advanced standalone screen completions requiring proactive borehole support can use the PetroGuard Swell compliant sand screen system that combines the proven technologies of mesh filtration and Swell Technology. This combination delivers the screen to the sandface, providing wellbore conformance and preventing and delaying sanding and solids production.

Features
- Direct wrap technology
- Single layer mesh screens
- No-weld technology
- Gradient pore technology
- 360° conformance

Benefits
- Unconsolidated sands exclusion
- Reliable and robust filtration technology
- Maximum sand retention
- Maximum plugging resistance
- Maximum borehole support
- Borehole instability and fines migration mitigation
- Deployment in extended reach horizontals
EquiFlow® Inflow Control Technology

Horizontal sand control completions have become increasingly more attractive to operators looking to maximize reservoir contact and thus reduce drawdown. Improvements in drilling technology have allowed for longer well lengths which present new complexities and challenges in production/injection control. Differences in influx from the reservoir can result in premature water/gas breakthrough, leaving valuable reserves in the ground. EquiFlow® Inflow Control Technology is designed to improve completion performance and efficiency by balancing inflow across the sandface throughout the length of a completion.

EquiFlow® Inflow Control Devices

In an EquiFlow inflow control device (ICD) completion, openhole packers are used to segregate the horizontal section into compartments or zones. Typical ICD applications include wells experiencing “heel-toe” effects, breakthrough of water/gas, permeability differences, and water challenges in high viscous oil reservoirs. By using EquiFlow inflow control technology, the reservoir inflow from high productivity zones can be reduced while improving low productivity zones and sweep efficiency.

The EquiFlow ICD consists of an annular chamber on a standard oilfield tubular and is considered a passive technology. If a screen is required, the reservoir fluid is produced from the formation, through the sand screen, and into the flow chamber. The flow continues through a set of nozzles, which creates a pressure drop and then into the pipe through a set of ports. Nozzle quantity and ID are designed to provide the pressure drop needed for optimum completion efficiency. Simulation software is used prior to installation for optimum configuration of the EquiFlow ICD with no need for specialized installation time.

EquiFlow Adjustable Inflow Control Device

Today’s reservoir challenges call for optimum completion solutions, and since no two reservoirs are alike, having multiple options can be a significant plus. EquiFlow Adjustable inflow control devices combine the inflow balancing benefits as standard fixed ICDs with additional flexibility to reconfigure the ICDs if required. Placement of these ICDs is typically incorporated into the design phase of a project. For applications where design flexibility is needed, the EquiFlow adjustable ICD allows the operator to configure the device closer to the time of installation. It also helps improve logistics and reduce delivery time.

EquiFlow Inject Inflow Control Device

Similar in approach to EquiFlow ICD for balancing inflow throughout the completion in producing wells, the EquiFlow Inject system balances the fluid injected into the formation in injection wells. Water injectors frequently suffer from imbalanced placement of the injected fluid due to one or more of the zones accepting excessive injection rates and volume. The primary reason for this is permeability differences or thief zones along the wellbore. With imbalances in the injection rates, problems can arise including ineffective reservoir drainage and breakthrough of injected fluid into producers.
**EquiFlow® Autonomous Inflow Control Devices**

The EquiFlow® autonomous inflow control device (AICD) increases recoverable reserves and extends well production. Using innovative dynamic fluid technology, the device can differentiate between fluids flowing through it to maximize oil production.

The EquiFlow AICD works like a passive ICD during oil production, yet restricts the production of water and gas at breakthrough to minimize water/gas cuts dramatically. It uses no moving parts, does not require downhole orientation, and uses the dynamic fluid properties to direct flow.

AICD technology employs an engineered system of flow paths and channels to control fluid flow. Using the fluid selector’s output, the flow switch, or “fluid crossroad”, directs the majority of the selected fluid down one of two separate paths based on the fluid’s properties. Finally, the fluid restrictor restricts the flow of unwanted fluid (gas and/or water) from entering the wellbore, yet provides very little restriction to the production of the desired fluid.

The EquiFlow AICD is designed to be a simple, reliable, and cost-effective solution to the limitations of passive inflow control by maximizing reservoir performance, and minimizing undesired fluid production.

**Features**
- Easily configured for use in various applications
- Robust construction
- Simulation software for optimum configuration
- Operates autonomously
- Contains no moving parts, electronics, or connections to the surface
- Requires no intervention
- Will cease flow restriction if unwanted fluid recedes
- Designs available to produce oil and restrict water or gas
- Each device functions independently for precise response to the reservoir

**Benefits**
- Helps reduce water and gas production associated with
  - Heel-toe effects
  - Breakthrough of water/gas
  - Permeability differences
  - High oil viscosity wells
- Helps increase productivity and recovery
- Increases reliability through design simplicity
- Minimizes undesired fluid production, helping reduce associated costs and risks
- Delays onset of unwanted water/gas production
STPP™-GH Single-Trip Perf/Pack Completion System

The STPP™-GH single-trip perf/pack system provides cost-effective, single-run completions that combine perforating and frac packing a zone of interest in a single string.

With the STPP-GH system, the guns are detached from the packer and screen assembly before perforation to eliminate impact loads. After perforation, the auto-release gun hanger mechanism allows the expended guns to drop to the bottom of the well. After the well is perforated, the CHAMP® IV packer is lowered and set below the perforations and the Versa-Trieve® packer is set above the perforations. The service tool is released from the Versa-Trieve® packer and positioned for pumping operations.

The STPP-GH system can also be configured for multiple perforating gun location options as well as screen options including the CAPS™ screen.

Features
- Auto-release gun hanger system
- Sand Control FracPac™ system technology
- Tubing-conveyed perforating technology
- Mechanical packer technology
- Eliminates mechanical shock of perforating
- Minimizes pressure shock
- Well control operations achieved with a modified OMNI™ valve design

Benefits
- Combines multiple operations in a single trip
- Flexible system allows performance of water pack, high-rate water pack, frac pack, slurry pack, or gravel pack operations
- Reduces rig time and associated costs
- Reduces safety and operational risks
- Minimizes fluid loss
- Maximizes net present value
- Reduces well control risks
- Reduces formation exposure
- Reduces debris management
- Higher rate of return
Through-Tubing Systems

Halliburton through-tubing systems are designed to be run on braided line, reeled tubing, or jointed pipe. They can be set on bottom or located in landing nipples or tubing string. Through-tubing systems are applicable for short, perforated intervals. A squeeze pack is performed by pumping through reeled tubing or jointed pipe. Existing production tubing can be used, or a concentric string can be run. Systems are available from 2 3/8-in. (60.33 mm) to 4-in. (101.60 mm) tubing sizes.

Features
- Run on braided line, reeled tubing, or jointed pipe
- Applicable for short, perforated intervals
- Available in 2 3/8 to 4-in. tubing sizes

Benefits
- Can run existing production tubing or concentric string
- Can be set on bottom or located in landing nipples or tubing string

Through-Tubing Circulating Sand Control System

Through-tubing circulating tool assemblies are available for some tubing sizes and provide the means to perform a circulating gravel pack through-tubing with coiled tubing.

Packoff Method

The packoff method uses a through-tubing gravel pack screen with blank spacer pipe and packoff seal assembly. It can be placed inside casing or existing gravel pack screen and spaced out and packed off inside the production tubing. The method is used when top of perforation is less than 100 ft (30 m) below the end of production tubing.

Locator Hanger Method

The locator hanger system is identical to the fluted hanger system with the exception of the locator. Instead of a fluted hanger, a modified “S” holddown pump locator is used to locate in an “S” landing nipple. The “S” holddown pump locator is modified to give additional fluid bypass.

Washdown Method

The washdown method uses a prepack with gravel pack screen washed into place (applicable for both casing and tubing). It is used in treating intervals with maximum lengths of 50 to 60 ft (15 to 18 m).

The washdown method consists of a lower jet shoe, screen, blank pipe, and hydraulic disconnect. Inside the screen and blank pipe, an inner tube is spaced, running from the hydraulic disconnect down to the shoe. The system is run on coiled tubing.

Concentric Screen Method

The concentric string completion is available for 2 7/8-in. (73.03 mm) and larger tubing sizes. As depicted, a concentric tubing string is run back to surface. The annular area provides a gas conduit for lift gas if required. The assembly consists of a bull plug, screen, blank, and hookup nipple. This illustration depicts the production mode with an overshot and a reciprocation set GO™ packer.

Fluted Hanger Method

The assembly consists of a lower screen and blank pipe, fluted hanger, stinger with “G” packoff element, and “G” slip stop. Bow spring centralizers with stops are used to centralize the screen in the casing. The assembly can be run on coiled tubing or on wireline. The fluted hanger running assembly consists of an overshot, a fluted hanger, and retrievable receptacle plug.
Concentric Screen

GO™ Packer
Overshot
Bow Spring Centralizers
Locate Assembly
Fluted Hanger
G Slip Stop
G Packoff
Bow Spring Centralizers

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X® Lock and Landing Nipple
X® Lock and Landing Nipple

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**Rigless FracPac™ System/High-Rate Water Pack**

This system allows an operator to control sand production across a lower zone via a gravel pack or FracPac™ system and at the same time ensures the completion assembly above the lower zone is optimized for a future through-tubing pack on an upper zone. The lower zone is packed as normal. If necessary, a spacer assembly and upper Versa-Trieve® packer are stung into the gravel pack Versa-Trieve packer and set.

When the operator decides to shut off production from the lower zone and access the upper zone, a through-tubing bridge plug is set in the blank pipe above the lower zone. The upper zone is perforated. A dual-screen assembly (also known as a vent screen) is placed across the upper zone, and a high-rate water pack or a FracPac system treatment is performed to place sand in the perforation tunnels and around the screen assembly. Excess sand is washed clear of the upper screen using coiled tubing. The well can then be placed on production.

**Benefits**

- Allows for control of sand production across a lower zone using a gravel pack or FracPac system
- Ensures optimized completion assembly above the lower zone for future through-tubing packing on an upper zone
**Single-Trip Screenless FracPac™ System**

This system helps minimize fluid loss and save rig time while allowing the operator to perforate and begin fracturing operations on the same trip in the hole. The following assembly is run in the hole:

- TCP guns
- Automatic release
- Spacer tubing
- Mirage® plug
- Permanent or retrievable packer with ACME top sub
- Versa-Latch® locator with production seals
- Production tubing

The Halliburton 180° phased FracPac™ system guns are logged onto depth. The Christmas tree is nipped up. Applying tubing pressure closes the auto-fill feature on the Mirage plug and sets the packer. The packer can be tested prior to firing the guns with annulus pressure. Pressure cycles will dissolve the Mirage plug and fire the guns. The guns will then drop into the rathole, allowing the operator full access to the perforated interval. A FracPac system operation with resin-coated sand can then be pumped to break through any near-wellbore damage and control proppant flowback. Because of the 180° phasing of the FracPac system guns, the perforations will be oriented to allow flow into the fracture, resulting in a more complete packoff of the perforations with resin-coated sand. Any excess sand can be washed out of the hole with a coiled tubing unit.
VentPac AF™ Service

Vent screen completions are a reliable method of improving workover and completion economics. With this method, zones previously bypassed as uneconomical to complete may now, in many cases, be effectively monetized.

Completions using VentPac AF™ service are, in some cases, producing over 30 MMscfd compared to a maximum of only 6 to 8 MMscfd from conventional vent screen completions while maintaining mechanical integrity of the completion. Halliburton’s exclusive Antifluidization® service technology enhances pack conductivity and helps control fines migration and pack plugging.
**Features**

- Enhanced conductivity and fines control
- Unmatched execution – Halliburton has installed more successful high-rate completions than most service companies
- Predictable production rate window
- Close, multiple stacked pays can be completed independently if necessary
- Enhanced completion reliability
- Well suited for monobore and deepwater applications as well as recompletions in high-rate, deepwater applications
- Tailored to well conditions – Depending on flow velocity level and probability of proppant pack fluidization, one of several versions of VentPac AF™ service can be applied for an optimum completion

**Benefits**

- Higher production rates while maintaining mechanical integrity, resulting in enhanced reserves recovery, accelerated cash flow, and improved completion NPV
- Helps reduce time exposure
- Helps provide higher production rates even with incomplete blank section coverage

The graph is a sample analysis from a gas well in the Gulf of Mexico with 90 ft of blank assembly in a well that was deviated 55° across the zone of interest. The casing size was 7 in. and the blank size was 1.660 in. The graph plots the rate of the well’s producing relative to the fluidization point (failure point). The graph shows the varying versions of the VentPac AF™ system and the associated achievable maximum production rates.

Guidelines for choosing which version of VentPac AF™ service will help provide an optimum completion.