

06

Openhole Isolation Systems



Introduction

Halliburton Openhole Isolation Systems include two product families — our ZoneGuard® openhole isolation packers and Swellpacker® isolation systems. While primarily used for the isolation of wellbores completed with openhole producing sections, our tools are also well-suited for cased-hole applications and qualify to perform at the same specifications in either scenario. Halliburton openhole isolation systems are designed to meet or exceed the most stringent requirements, with industry-recognized performance and reliability.

Much has changed in the oil and gas industry since the commercial introduction of the Swellpacker system in 2001 and the ZoneGuard openhole packer in 2012. Swellpacker systems have gained wide acceptance in an increasing variety of applications, while openhole packer systems are most commonly used for annular isolation both on and offshore.

The growing complexity of well completion designs, harsher wellbore environments, and advances in technology have increased demand for more diverse openhole isolation products that provide better performance and reliability to meet the needs of the modern oil field. To achieve this objective, Halliburton implements rigorous testing and cutting-edge qualification procedures.

HALLIBURTON

Completion Tools

Openhole Isolation Packers

ZoneGuard® FP Packer

The ZoneGuard® FP (Frac Pack) packer is designed to provide effective, economical annular isolation in openhole wellbore sections, while remaining versatile enough for cased-hole isolation applications. It is primarily used in wellbores that require multizone isolation for stimulating, fracturing, or general production operations.

The ZoneGuard FP packer is run as an integral part of the production casing or tubing string and is set with hydraulic pressure by setting a plug beneath the tool. The packer uses a uniquely designed element package with backup system to deliver consistent sealing performance in a defined range of openhole and cased-hole sizes. Additionally, the compact design is ideal for wellbores with short radius build angles or high dogleg severity well conditions. The design also provides additional value for wells in which a significant number of packers need to be run, such as unconventional shale plays, to isolate dozens of individual zones.

Applications

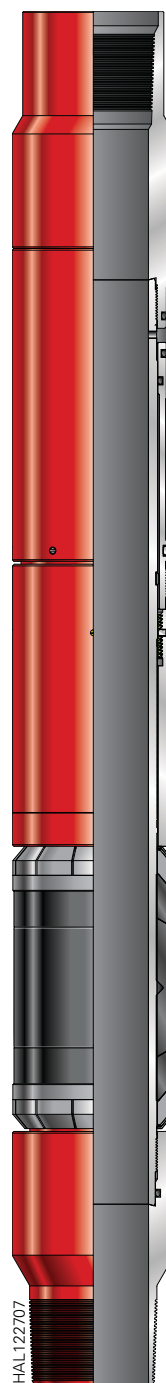
- » Unconventional and mature assets
- » Open or cased-hole applications in vertical or horizontal wells
- » Multistage fracturing or acidizing
- » Production management
- » Wellbore segmentation
- » Remedial stimulation

Features

- » Instant hydraulic setting
- » Compact, concise design
- » Small running OD
- » Multi-piece element package with unique backup
- » Adjustable setting shear value
- » Internal locking system

Benefits

- » Effective and economical design suited for multizone fracturing treatments
- » Compact size for trouble-free deployment in horizontal or directional wells
- » Effective selective production management in horizontal wellbores
- » Reliably control inflow or injection within selected sections of the wellbore



ZoneGuard® FP
Packer

ZoneGuard® FP Packer

Tool Connection	Maximum Metal OD	Minimum ID	Minimum Borehole	Maximum Borehole	Length	Temperature Rating	Maximum Pressure Rating (in Minimum Bore ID)
in.	in.	in.	in.	in.	in.	°F	psi
4 1/2 13.5 lb API-LC	5.755	3.895	5.875	6.5	48.71	325	10,000
4 1/2 Blank	5.755	3.895	5.875	6.5	50.95	325	10,000
5 1/2 23.0 lb API-LC	7.25	4.65	7.75	8	52.15	325	10,000
5 1/2 Blank	7.25	4.65	7.75	8	53.28	325	10,000
5 1/2 23.0 lb API-LC	8	4.67	8.5	8.75	47.6	325	10,000
5 1/2 Blank	8	4.67	8.5	8.75	51.7	325	10,000

ZoneGuard® SR Packer

The Halliburton ZoneGuard® SR (Short Radius) openhole packer is a versatile solution that helps enable effective annular zonal isolation in a wide range of oilfield applications. The packer includes many enhanced features, such as an innovative anti-preset mechanism, upgraded element package with robust backup system, and ample setting range. These features help ensure reliable deployment to target depth and unsurpassed sealing performance in a variety of wellbore conditions. The ZoneGuard SR packer is ideal for situations in which tight radius well conditions exist, effective isolation is imperative, and deployment risks need to be removed.

The ZoneGuard SR packer is run as an integral part of the production casing or tubing string. It is set with hydraulic pressure either by setting a plug beneath the tool, or when plugging the completion string is not possible, by running an isolation straddle tool across the packer. Additionally, the innovative anti-preset mechanism helps prevent premature setting of the packer during running operations. Once on depth and set, an internal locking mechanism helps ensure the elements remain energized against the wellbore. The ZoneGuard SR packer can be used for zonal isolation in production control, selective stimulation, fracturing, and a wide array of other applications.

Applications

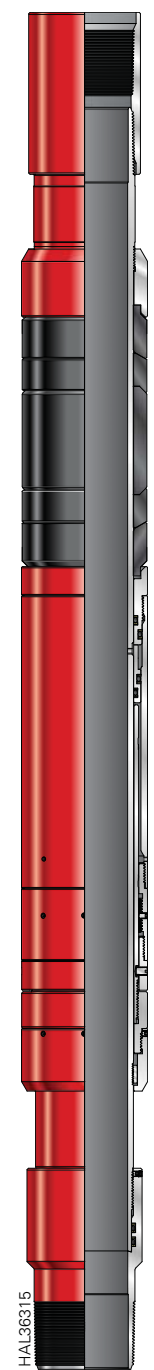
- » Deepwater, unconventional, and mature assets
- » Horizontal, deviated, or vertical completions
- » Open or cased-hole isolation
- » Stimulation, such as fracturing and acidizing
- » Sand control
- » Stage cementing
- » Water and gas shutoff
- » Selective production
- » Wellbore segmentation

Features

- » Anti-preset feature
- » Upgraded element package with robust backup system
- » Adjustable setting shear value
- » Internal locking system
- » Multiple hydraulic-setting methods
- » Differential pressure ratings up to 15,000 psi
- » Temperature ratings up to 400°F
- » Standard or sour service availability

Benefits

- » Hydraulically set for instantaneous zonal isolation
- » Effective isolation for fracturing, production management, sand control, cementing, and various other applications
- » Innovative anti-preset mechanism reduces deployment risks



ZoneGuard® SR
Packer

ZoneGuard® SR Packer (Standard Pressure Systems)

Tool Connection	Maximum Metal OD	Minimum ID	Minimum Borehole	Maximum Borehole	Length	Temperature Rating	Maximum Pressure Rating (at Minimum Borehole ID)
	in.	in.	in.	in.	in.	°F	psi
4 1/2 in. Blank	5.65	3.850	5 7/8	6 1/4	70.48	325	10,000
4 1/2 in. 13.5 lb API-LC	5.65	3.850	5 7/8	6 1/4	60.04	325	10,000
4 1/2 in. 15.1 lb API-LC	5.81	3.724	5 7/8	6 1/4	60.61	325	10,000
4 1/2 in. 13.5 lb API-LC	5.9	3.850	6 1/4	6 1/2	60.01	325	10,000
5 1/2 in. 23.0 lb API-LC	7.25	4.670	7 1/2	7 7/8	80.24	325	10,000
5 1/2 in. 23.0 lb API-BC	7.25	4.670	7 1/2	7 7/8	80.24	325	10,000
5 1/2 in. Blank	7.25	4.670	7 1/2	7 7/8	80.24	325	10,000
5 1/2 in. 23.0 lb API-LC	8.00	4.670	8 1/2	9 3/4	80.36	325	10,000
5 1/2 in. 23.0 lb API-BC	8.00	4.670	8 1/2	9 3/4	80.36	325	10,000
5 1/2 in. Blank	8.00	4.670	8 1/2	9 3/4	80.36	325	10,000
6 5/8 in. 32.0 lb VAMTOP®	8.25	4.890	8 1/2	9 3/4	84.25	325	10,000

VAM TOP® is a registered trademark of Vallourec Oil and Gas France.

ZoneGuard® SR Packer (High-Pressure Systems)

Tool Connection	Maximum Metal OD	Minimum ID	Minimum Borehole	Maximum Borehole	Length	Temperature Rating	Maximum Pressure Rating (at Minimum Borehole ID)
	in.	in.	in.	in.	in.	°F	psi
4 1/2 in. 23.0 lb API-LC	5.81	3.72	6	6 1/4	58.06	325	15,000
5 1/2 in. 23.0 lb API-LC	7.50	4.59	7 3/4	7 7/8	74.77	325	15,000
5 1/2 in. 23.0 lb API-LC	8.25	4.650	8 1/2	8 3/4	72.88	325	15,000

ZoneGuard® SR Bypass Packer

The Halliburton ZoneGuard® SR (Short Radius) Bypass openhole packer is designed to provide effective annular zonal isolation in a wide range of oilfield applications with the added ability to allow up to six cable feed-through lines. The ZoneGuard SR Bypass packer includes the same enhanced features as the ZoneGuard SR packer, such as an innovative anti-preset mechanism, upgraded element package with robust backup system, and ample setting range. These features help ensure reliable deployment to target depth and unsurpassed sealing performance in various wellbore conditions. The ZoneGuard SR Bypass packer is ideal for situations in which tight radius well conditions exist, effective isolation is imperative, deployment risks need to be eliminated, and reservoir monitoring and production management is desired.

The ZoneGuard SR Bypass packer is run as an integral part of the production casing or tubing string. The packer is set with hydraulic pressure either by setting a plug beneath the tool, or when plugging the completion string is not possible, by running an isolation straddle tool across the packer. Additionally, the packer's innovative anti-preset mechanism helps prevent premature setting of the packer during running operations. Once on depth and set, an internal locking mechanism helps ensure the elements remain energized against the wellbore. The packer design can accommodate up to six 1/4-in. feed-through lines for monitoring of multiple wellbore sections, thus enhancing formation knowledge and reservoir production management.

Applications

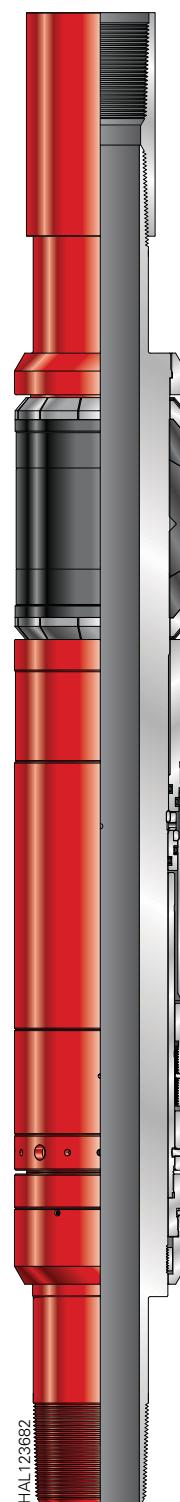
- » Deepwater, unconventional, and mature assets
- » Horizontal, deviated, or vertical completions
- » Open or cased-hole isolation
- » Stimulation monitoring
- » Sand control
- » Intelligent completions
- » Production management

Features

- » Innovative design suited for a variety of well conditions
- » Bypass for up to six 1/4-in. feed-through lines
- » Anti-preset feature
- » Upgraded element package with robust backup system
- » Adjustable setting shear value
- » Internal locking system
- » Multiple hydraulic-setting methods
- » Pressure ratings up to 10,000 psi
- » Temperature ratings up to 325°F

Benefits

- » Hydraulically set for instantaneous zonal isolation
- » Bypass feature allows for reservoir monitoring and production management
- » Six feed-through lines help enable the use of control lines, fiber optics, or gauges



ZoneGuard® SR
Bypass Packer

ZoneGuard® SR Bypass Packer

Tool Connection	Maximum Metal OD	Minimum ID	Minimum Borehole	Maximum Borehole	Length	Temperature Rating	Maximum Pressure Rating (at Minimum Borehole ID)
	in.	in.	in.	in.	in.	°F	psi
3 1/2 9.2 lb VAMTOP®	5.75	2.962	5 7/8	6 1/4	56.97	325	10,000
5 1/2 23.0 lb VAMTOP	8.25	4.65	8 1/2	9 3/4	71.72	325	10,000

VAM TOP® is a registered trademark of Vallourec Oil and Gas France.

ZoneGuard® HE Packer

The Halliburton ZoneGuard® HE (High-Expansion) packer is designed for situations in which a high-expansion sealing element is required and when large variations in hole gauge diameter are anticipated. The packer uses a multidurometer, multi-element package with a unique backup and deployment system to deliver industry-leading sealing performance in a large range of open or cased-hole diameters in the most challenging wellbore environments. The packer is well-suited for zonal isolation in multiple applications, such as sand control, production management, stimulation, and stage cementing.

The ZoneGuard HE packer is run as part of the completion string and can be set either hydrostatically or hydraulically, depending on the well conditions. The hydrostatic-set ZoneGuard HE packer requires a shifting tool to shift an internal sleeve that allows the hydrostatic pressure to enter the setting chamber and set the packer. The hydraulic-set ZoneGuard HE packer can be set by plugging the tubing below the packer or with an isolation straddle tool to provide hydraulic pressure to the setting chamber. The hydraulic ZoneGuard HE packer can also contain a hydrostatic-assist feature, which helps maintain positive pressure on the packer at all times.

Applications

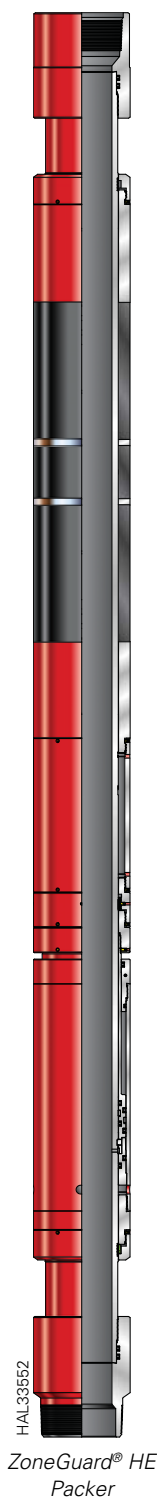
- » Deepwater, unconventional, and mature assets
- » Open or cased-hole applications (horizontal or vertical)
- » Production management
- » Sand control
- » Stimulation
- » Stage cementing
- » Water and gas shutoff

Features

- » Hydrostatic-assist feature for positive pressure on element
- » High-expansion element package
- » Anti-preset mechanism
- » Small running OD
- » Adjustable setting shear value
- » Internal locking system

Benefits

- » Provides selective production management in horizontal wellbores
- » Reliably controls inflow or injection within selected sections of the wellbore
- » Wide range of openhole isolation capabilities with one packer design
- » Optional setting procedure: either hydraulic, hydrostatic, or hydrostatic-assist



ZoneGuard® HE Packer

Tool Connection	Maximum Metal OD	Minimum ID	Minimum Borehole	Maximum Borehole	Length	Temperature Rating	Maximum Pressure Rating (at Minimum Borehole ID)	Setting Process
	in.	in.	in.	in.	in.	°F	psi	
4 1/2 12.60 lb VAMTOP®	5.630	3.490	6	8 1/4	130.70	325	5,000	Hydraulic
4 1/2 12.75 lb API-EU	5.630	3.490	6	8 1/4	169.08	325	5,000	Hydrostatic
5 1/2 17.0 lb NEW VAM®	8.000	4.670	8 1/2	11 1/2	142.33	325	5,000	Hydraulic
5 1/2 17.0 lb API-LC	8.000	4.870	8 1/2	11 1/2	170.85	325	5,000	Hydrostatic
6 5/8 32 lb VAMTOP	8.000	4.890	8 1/2	11 1/2	140.88	325	5,000	Hydraulic

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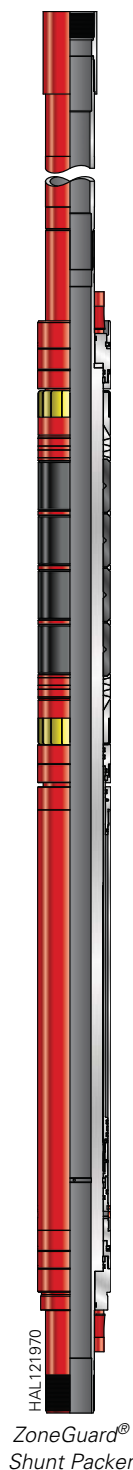
ZoneGuard® Shunt Packer

The Halliburton ZoneGuard® Shunt packer builds on the ZoneGuard packer platform with the addition of unique feed-through features that enable alternate path, multizone gravel packing of the reservoir. This helps enhance slurry placement along the entire target interval. The ZoneGuard Shunt packer contains our industry-leading, high-expansion sealing element designed for use in the most challenging environments in which large variations in hole gauge diameter are anticipated. The packer uses a multidurometer, multi-element package with a unique backup and deployment system to deliver industry-leading sealing performance in a large range of open or cased-hole diameters. The packer is ideally suited to provide zonal isolation in conjunction with the Halliburton ZonePac™ system for multizone sand control, production management, stimulation, and reservoir compartmentalization.

The ZoneGuard Shunt packer is run as part of the completion string and can be set either hydrostatically or hydraulically, depending on well conditions. The hydrostatic-set mechanism of the ZoneGuard Shunt packer requires a shifting tool to shift an internal sleeve that allows the hydrostatic pressure to enter the setting chamber and set the packer. The hydraulic-set ZoneGuard packer can be set by plugging the tubing below the packer or with an isolation straddle tool to provide hydraulic pressure to the setting chamber. The hydraulic ZoneGuard packer also includes a hydrostatic-assist feature, which helps maintain positive pressure on the packer at all times.

Applications

- » Deepwater and mature assets
- » Open or cased-hole applications (horizontal or vertical)
- » Alternate path, gravel packing
- » Sand control
- » Production management
- » Stimulation
- » Reservoir compartmentalization



Features

- » Hydraulically set by plugged tubing or isolation straddle
- » Hydrostatically set with use of a shifting tool
- » Hydrostatic-assist feature for positive pressure on the element
- » Unique alternate path feed-throughs
- » High-expansion element package
- » Anti-preset mechanism
- » Small running OD
- » Adjustable setting shear value
- » Internal locking system

Benefits

- » Large tolerance to openhole diameter variations
- » More effective slurry placement by means of alternate path gravel packing
- » Reliably control inflow or injection within selected wellbore sections

Swellpacker® System Technologies

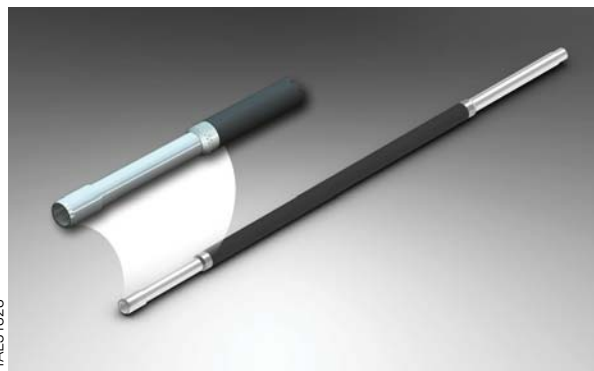
Swellpacker® Isolation System

The Halliburton Swellpacker® isolation system is an innovative technology that offers simple, safe, and reliable downhole isolation. The Swellpacker system is based on the swelling properties of rubber in hydrocarbons, water, or both. A Swellpacker system can swell up to 200%, sealing the annulus around the pipe to achieve effective zonal isolation. Once deployed, the rubber retains its flexibility, allowing the Swellpacker isolation system to adapt to shifts in the formation over time, thus retaining the seal integrity. Additionally, the Swellpacker system's self-healing properties make this a reliable and risk-mitigating technology for all zonal isolation applications. Each Swellpacker system is bonded to a basepipe and can be delivered with any element length, only limited by the basepipe length. Because the rubber is bonded to the basepipe, it is extremely robust and can hold significant differential pressures and can be rotated or reciprocated while running in hole. After the element is bonded, the rubber element also retains its flexibility, enhancing run-in-hole effectiveness.

The Swellpacker system can be used in cased or openhole environments. In some openhole applications, operators might be able to avoid cementing and perforating altogether, reducing the costs associated with these operations. By reducing well construction costs, saving rig time, and isolating producing zones, the Swellpacker system helps enable previously unachievable levels of oilfield performance.

Applications

- » Open and cased-hole isolation
- » Stimulation placement
- » Open and cased-hole straddles
- » Intelligent completion systems
- » Permanent monitoring and chemical injection
- » Water control
- » Multilaterals
- » Compartmentalization for screen/inflow control device completions
- » Gravel pack isolation
- » Well construction



*Swellpacker®
Isolation System*

Features

- » Can be manufactured on any oilfield tubular, coiled tubing, or other pipe
- » Suitable for cased and open holes
- » Robust construction
- » No moving parts
- » Self-healing, interventionless technology
- » Can be run in most all fluid environments
- » Multiple polymers available to provide oil-swelling, water-swelling, and hybrid-swelling solutions
- » Engineered swelling delay system
- » Can swell in as little as 2% activation fluid

Benefits

- » No specialist required for installation
- » Maintains casing integrity
- » Ideal for irregular borehole geometry
- » Alternative solution to cementing and perforating in certain applications
- » Able to complement cement to resolve well integrity issues
- » Provides an additional isolation barrier
- » Helps reduce operational risks
- » Isolates producing zones more effectively
- » Helps reduce well costs and rig time

Swellpacker® Isolation Systems

Operating Condition	Oil Swelling (OS)	Water Swelling (WS)	Hybrid Swelling (HS)	Comments
Run-in-hole fluid: oil-based mud (OBM)	Design to suit applications	All fluid systems	Design to suit applications	Contact Halliburton for engineered delay system
Run-in-hole fluid: water-based mud (WBM)	All fluid systems	Design to suit applications	Design to suit applications	Contact Halliburton for engineered delay system
Temperature range	30 to 390°F (0 to 200°C)	30 to 390°F (0 to 200°C)	OS: 30 to 390°F (0 to 200°C) WS: 250 to 390°F (120 to 200°C)	—
Reservoir fluid: liquid hydrocarbon	Wide range of crude oil tested; swelling rate is a function of fluid viscosity	Does not swell in hydrocarbons	Wide range of crude oil tested; swelling rate is a function of fluid viscosity	Contact Halliburton for design and simulations
Reservoir fluid: oil with high water cut	Swells in traces of hydrocarbon fluid	All fluid systems; swelling depends on temperature and salinity	Swells in traces of hydrocarbon fluid; WS depends on temperature and salinity	Contact Halliburton for design and simulations
Reservoir fluid: water	Does not swell	Wide range of fresh and saline water tested	Wide range of fresh and saline water tested	Salinity and temperature affect swell time
Reservoir fluid: gas condensate	Swells in traces of hydrocarbon fluid	Requires contact with water-based fluid for permanent seal	Swells in traces of hydrocarbon fluid	Contact Halliburton for design and simulations
Differential pressure capability	Up to 15,000 psi (1032 bar)	Up to 10,000 psi (690 bar)	Up to 10,000 psi (690 bar)	Contact Halliburton for application-specific pressure ratings
Time to set	Varies based on designs and well conditions Can be engineered for swelling times from hours to weeks			Contact Halliburton for application-specific simulations
Chemical resistance	Common oilfield chemicals			Contact Halliburton for application-specific questions
Element length	Application and basepipe dependent			Contact Halliburton for length requirement
Basepipe tensile/burst/collapse/metallurgy	Customer supplied or Halliburton purchased to match specifications			Can be built on any oilfield tubulars

Swellpacker® Slip-On Isolation System

The Swellpacker® Slip-On isolation system provides effective zonal isolation with slip-on convenience. This modular design can slide onto any non-upset casing or tubing string. Therefore, these packers do not require basepipe supplied upfront during the manufacturing process and can be easily installed at the rig site. This enables storing and stocking of the tools, simplifies logistics, and reduces costs significantly. This pioneering slip-on packer also features a full-length internal seal. This helps ensure the Swellpacker Slip-On system provides an effective seal to the borehole ID and against the pipe, unlike other slip-on designs that rely on o-rings that can be easily cut when installed on the basepipe.

Like bonded-to-pipe Swellpacker systems, once deployed, the rubber element retains its flexibility, allowing the Swellpacker Slip-On system to adapt to formation shifts over time to maintain seal integrity. Its self-healing properties make it a truly innovative technology for all zonal isolation applications, whether in cased or openhole environments. In some openhole applications, operators might be able to avoid cementing and perforating altogether, thus reducing the costs associated with these operations.

Applications

- » Open and cased-hole isolation
- » Stimulation placement
- » Open and cased-hole straddles
- » Water control
- » Multilaterals
- » Standalone screen sand control
- » Compartmentalization for screen/inflow control device completions
- » Gravel packer isolation
- » Well construction

Features

- » Suitable for cased and open holes
- » Install on any non-upset basepipe
- » Robust construction
- » No moving parts
- » Self-healing, interventionless technology
- » Can be run in most all fluid environments
- » Multiple polymers available: oil-swelling, water-swelling, and hybrid-swelling solutions
- » Engineered swelling delay system
- » Can swell in as little as 2% activation fluid



Swellpacker® Slip-On Isolation System



Swellpacker® Slip-On Isolation System After Installation on Basepipe

Benefits

- » No specialist required for installation
- » Maintains casing integrity
- » Simplified logistics
- » Allows last-minute adjustments to placement
- » Ideal for irregular borehole geometry
- » Protects sand screens from plugging
- » Alternative solution to cementing and perforating
- » Helps reduce operational risks
- » Isolates producing zones more effectively
- » Helps reduce well costs and rig time

Swellpacker® Slip-On Isolation System

Operating Condition	Oil Swelling (OS)	Water Swelling (WS)	Hybrid Swelling (HS)
Run-in-hole fluid: oil-based mud (OBM)	Design to suit applications	Does not swell in hydrocarbons	Design to suit applications
Run-in-hole fluid: water-based mud (WBM)	All fluid systems	Design to suit applications	Design to suit applications
Temperature range	32 to 392°F (0 to 200°C)	32 to 392°F (0 to 200°C)	OS: 32 to 392°F (0 to 200°C) WS: 266 to 392°F (130 to 200°C)
Reservoir fluid: liquid hydrocarbon	Wide range of crude oil tested; swelling rate is a function of fluid viscosity	Does not swell in hydrocarbons	Wide range of crude oil tested; swelling rate is a function of fluid viscosity
Reservoir fluid: oil with high water cut	Swells in traces of hydrocarbon fluid	All fluid systems; swelling depends on temperature and salinity	Swells in traces of hydrocarbon fluid; WS depends on temperature and salinity
Reservoir fluid: water	Does not swell	Wide range of fresh and saline water tested	Wide range of fresh and saline water tested
Reservoir fluid: gas condensate	Swells in traces of hydrocarbon fluid	Requires contact with water-based fluid for permanent seal	Swells in traces of hydrocarbon fluid
Differential pressure capability	Up to 3,500 psi (per 1-m element)	Up to 3,500 psi (per 1-m element)	Up to 3,500 psi (per 1-m element)
Time to set	Varies based on designs and well conditions Can be engineered for swelling delays of 1 to 20 days		
Chemical resistance	Common oilfield chemicals		
Element length	Standard lengths of 0.3, 0.5, 1, or 1.5 m Stacked lengths of 1, 2, or 3 m		

Salinity and temperature affect swell time for WS and HS.

Contact Halliburton for design simulations (pressure rating, time) and custom lengths.

Swellpacker® Cable System

Winner of multiple industry awards for its spliceless feed-through capabilities, the Swellpacker® Cable system simplifies and reduces risks during completion system installations that require the use of control lines, flatpacks, injection lines, fiber-optic cables, or other surface-controlled devices. Each line can be installed in 20 minutes compared to hours with conventional feed-through packer systems. This provides operators with significant costs savings by reducing rig time. The spliceless connections enabled by the Swellpacker Cable system help eliminate the need for cable splices, control line cuts, and cable stripping, which can increase the risks of signal degradation or loss caused by performing these processes at each packer. As a result, installation reliability is increased with every connection. The Swellpacker cable system can easily accommodate up to six different lines of varying geometries, providing superior flexibility in the downhole systems that can be deployed.

Like other Swellpacker systems, the Swellpacker Cable system is based on the swelling properties of rubber in hydrocarbons, water, or both. A Swellpacker Cable system can swell up to 200%, sealing the annulus around the pipe to achieve effective zonal isolation as well as swelling to seal against any control or flatpack installed with the packer elastomer. Each flatpack or control line is installed on the rig floor using a specifically designed installation tool that requires no additional rig time. Once deployed, the rubber retains its flexibility, allowing the Swellpacker Cable isolation system to adapt to shifts in the formation over time, thus retaining the seal integrity. Additionally, its self-healing properties make this a reliable and risk-mitigating technology for all zonal isolation applications. Each Swellpacker Cable system is bonded to a basepipe and can be delivered with any element length depending on the basepipe length. Because the rubber is bonded to the basepipe, it is extremely robust and can hold significant differential pressures even with the flatpacks and control lines run through the packer element. After the element is bonded, the rubber element also retains flexibility, enhancing run-in-hole effectiveness.

The Swellpacker Cable system can be used in cased or openhole environments. In some openhole applications, operators might be able to avoid cementing and perforating altogether, thus reducing the costs associated with these operations. By reducing well construction costs, saving rig time, and isolating producing zones, the Swellpacker Cable system helps enable previously unachievable levels of oilfield performance.



HAL32625

*Swellpacker®
Cable System*

Applications

- » Open and cased-hole isolation
- » Stimulation placement and measurement
- » Distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) monitoring
- » Intelligent completion systems
- » Chemical injection
- » Compartmentalization for screen/inflow control device completions
- » Gravel pack isolation

Features

- » Manufactured on any oilfield tubular
- » Robust construction
- » No moving parts
- » Spliceless cable feed-through option
- » Self-healing, interventionless technology
- » Can be run in most fluid environments
- » Multiple polymers available: oil-swelling, water-swelling, and hybrid-swelling solutions
- » Engineered swelling delay system
- » Can swell in as little as 2% activation fluid

Benefits

- » No splices, cuts, or stripping necessary
- » Reduced risks of signal degradation or loss
- » Faster installation helps reduce rig time
- » Helps reduce operational risks
- » Perfect seal for irregular borehole geometry
- » Isolates producing zones more effectively for enhanced monitoring of well conditions
- » Up to six feed-through lines possible

Swellpacker® Cable Systems Tools

Operating Condition	Oil Swelling (OS)	Water Swelling (WS)	Hybrid Swelling (HS)	Comments
Run-in-hole fluid: oil-based mud (OBM)	Design to suit applications	All fluid systems	Design to suit applications	Contact Halliburton for engineered delay system
Run-in-hole fluid: water-based mud (WBM)	All fluid systems	Design to suit applications	Design to suit applications	Contact Halliburton for engineered delay system
Temperature range	30 to 390°F (0 to 200°C)	30 to 390°F (0 to 200°C)	OS: 30 to 390°F (0 to 200°C) WS: 265 to 390°F (129 to 200°C)	—
Reservoir fluid: liquid hydrocarbon	Wide range of crude oil tested; swelling rate is a function of fluid viscosity	Does not swell in hydrocarbons	Wide range of crude oil tested; swelling rate is a function of fluid viscosity	Contact Halliburton for design and simulations
Reservoir fluid: oil with high water cut	Swells in traces of hydrocarbon fluid	All fluid systems; swelling depends on temperature and salinity	Swells in traces of hydrocarbon fluid; WS depends on temperature and salinity	Contact Halliburton for design and simulations
Reservoir fluid: water	Does not swell	Wide range of fresh and saline water tested	Wide range of fresh and saline water tested	Salinity and temperature affect swell time
Reservoir fluid: gas condensate	Swells in traces of hydrocarbon fluid	Requires contact with water-based fluid for permanent seal	Swells in traces of hydrocarbon fluid	Contact Halliburton for design and simulations
Differential pressure capability	Up to 15,000 psi (1032 bar)	Up to 10,000 psi (690 bar)	Up to 10,000 psi (690 bar)	Contact Halliburton for application-specific pressure ratings
Time to set	Varies based on designs and well conditions Can be engineered for swelling delays of 1 to 20 days			Contact Halliburton for application-specific simulations
Chemical resistance	Common oilfield chemicals			Contact Halliburton for application-specific questions
Element length	Application and basepipe dependent			Contact Halliburton for length requirement
Basepipe tensile/burst/collapse/metallurgy	Customer supplied or Halliburton purchased to match specifications			Can be built on any oilfield tubulars

Swellpacker® System Technology Customizations

Swellable Elastomers

Halliburton offers three different types of swellable elastomers to customize a Swellpacker® system to the requirements of the particular application. These three types of elastomers are oil-swelling (OS), water-swelling (WS), and hybrid-swelling (HS). Halliburton OS elastomers expand by the diffusion of a liquid hydrocarbon into the elastomer. OS elastomers provide excellent resistance to any oilfield chemical or fluid, whether it is introduced into or produced from the wellbore. As the name implies, the Halliburton WS elastomer swells in the presence of a water-based fluid. These elastomers are most popular for control of unwanted water production or reservoir management. The HS elastomer option is ideal for situations in which the fluid that can activate the packer is unknown at the time of design. Halliburton HS elastomers swell in the presence of either water or oil to help achieve a competent annular seal.

Swelling Delay Systems

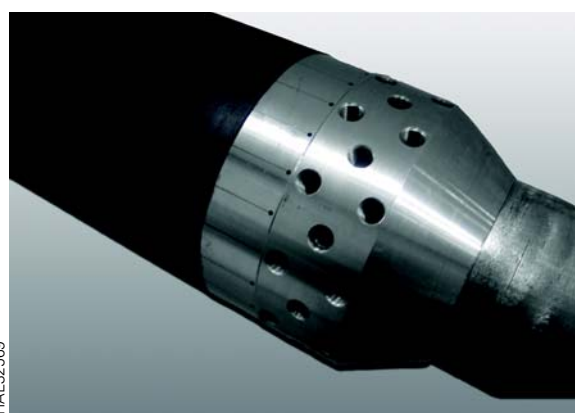
To help minimize the effect of oil or water contained within the well fluid on the packer while it is run in hole, Halliburton engineered several systems that can delay the swelling process. These delay systems help enable control of the elastomer swelling process, thus helping ensure the setting time can be tailored according to the customer's needs. This mitigates premature setting risks while optimizing the Swellpacker system operating envelope. The swelling delay systems include the use of polymers with built-in slower swelling properties and/or a variety of applied diffusion barriers, which help inhibit fluid intake. Because of meticulous systems testing and qualification, customizing a design with either of these options, or using them in combination, allows Halliburton to create a well-specific engineered product.

Standard End Ring Design

End rings are placed at either end of the selected swellable elastomer and assist in increasing the packer differential pressure capability and guiding the packer when run in hole. The Halliburton standard end ring design includes a tapered leading edge and is flush with the packer element to provide protection. Depending on the application and requirements, the end ring can be made from a variety of materials and anchored using set screws, a crimping process, or welding.

K2 Extrusion Limiting End Ring Design

The Halliburton K2 extrusion limiting end ring is an enhanced design over the standard end ring. The K2 end ring offers additional packer element protection while running in hole and helps eliminate the extrusion gap once the packer is set. The unique K2 end ring design offers further benefits through the end rings ability to shorten tool length while maintaining differential pressure. It also increases the absolute differential pressure performance of the tools, with testing performed to 15,000 psi across the packer.



HAL32569

K2
End Ring

SwellSim® Software

The SwellSim® software program is a Halliburton proprietary performance simulator used to select the most suitable Swellpacker® system design to overcome the challenges of each wellbore. SwellSim software helps Halliburton representatives provide engineered, customized packer design recommendations based on specific customer requirements and well conditions. This helps ensure delivery of the industry's most reliable swellable packer solutions. Because the simulator is based on actual test data, it provides the utmost confidence the selected product will meet customer expectations.

The SwellSim software program was developed through extensive testing on the expansion properties of the Halliburton swellable elastomer and delay systems. Using the customer's well conditions and requirements helps the software program predict the downhole performance of each customized Swellpacker system design. This provides the user the ability to observe the impact of well conditions on a variety of designs (bonded-to-pipe, slip-on, cable bypass, etc.) and polymer types (oil, water, and hybrid-swelling) in the proposed well environment. Packer design collaboration often occurs in real time as Halliburton representatives illustrate changes in variables using the SwellSim software until the packer is optimized to meet the challenges of the application.

Benefits

- » Provides engineered packer performance recommendations
- » Predicts time to first seal
- » Illustrates time to operational and maximum differential pressure
- » Shows the effect of hole size variation
- » Provides run-in-hole time
- » Enables suggestion of delay systems
- » Helps identify potential failure modes
- » Reduces downhole risks
- » Decreases non-productive time

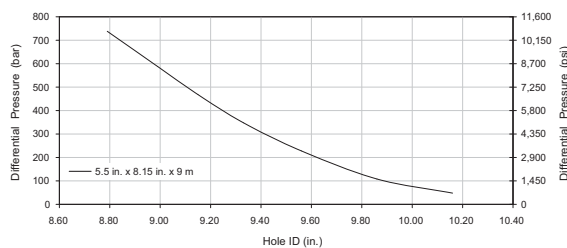
SwellSim Software Legend

- » Expansion ratio: volume increase of packer element
- » Time to first seal: when packer OD engages openhole or casing ID
- » Time to operational differential pressure: when packer reaches customer-specified differential pressure
- » Time to maximum differential pressure: when packer reaches maximum differential pressure capability

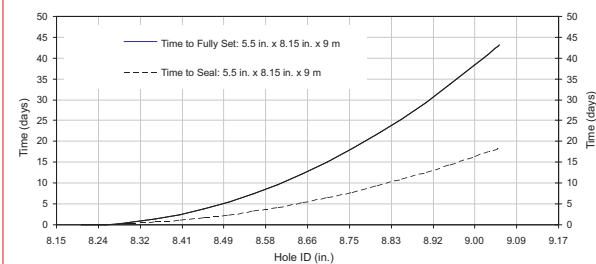
SwellSim Software Output

The simulator automatically generates a differential pressure profile and a swell profile (time to seal and time to fully set vs. hole size) curve. The following examples show the curves extracted from the simulator.

DIFFERENTIAL PRESSURE PROFILE



SWELL PROFILE



Swellpacker® System Technology Applications

Swellpacker® systems, services, and special expertise can help optimize the completion design in a variety of applications, regardless of the conditions.

Multistage Fracturing

Perhaps the most common application for Swellpacker system technologies is providing zonal isolation for multistage, hydraulic-fracturing operations. Using Swellpacker bonded-to-pipe or Swellpacker Slip-On systems provide operators with new options for completing unconventional multizone wellbores and facilitate highly accurate fracture placement with little-to-no intervention. These systems allow operators to selectively access, isolate, and stimulate multiple payzones in a single wellbore using a variety of methods, such as plug and perforating, fracturing sleeve technologies, or coiled-tubing fracturing. Regardless of the selected method, the effectiveness of the Halliburton Swellpacker system in providing simple, reliable isolation helps lead to increased production results and reduced overall well completion costs.

Production Management

Swellpacker system technologies can significantly contribute to isolation in standalone screen completions to reduce fines migration and better compartmentalize the wellbore for enhanced production results. Using Swellpacker systems with screens can also help prolong screen life and decrease plugging risks. Furthermore, in reservoirs prone to sand production, Swellpacker systems help enable increased productivity and reduced well construction costs because these systems can be installed easily without specialized operating personnel. During completions that use inflow control devices, Swellpacker Slip-On systems are often used to create shorter compartments for improved reservoir management.

Permanent Monitoring

Incorporating permanent monitoring gauges or fiber-optic cables provides data that operators can use to optimize production results and improve wellbore placement, reservoir drainage, or stimulation designs. The Swellpacker Cable system helps enable the use of economical permanent monitoring technologies by helping decrease rig time and helping eliminate risks associated with conventional feed-through packers. This allows operators to understand fracturing operations, wellbore production, or downhole conditions without the worry of data loss or signal degradation.

Well Construction

Depleted or overpressured reservoirs can hinder the ability to achieve optimal zonal isolation using conventional methods. Complicated wellbore geometry has pushed the limits of technology in perfecting annular pressure confinement and isolation of multiple zones. Depleted reservoirs necessitate well designs with more casing setting points to isolate depleted reservoirs before drilling ahead to higher-pressure areas. More casing setting points dictate smaller annular volumes between the casing and the open hole or casing and casing. These smaller annular volumes create further difficulties for current methods to provide sufficient zonal isolation or prevent sustained casing pressure. More casing setting points can also dictate larger annular volumes in under-reamed openhole sections.

Halliburton swellable technology systems provide solutions to existing technologies to create safe and competent wellbores.

Top of Cement

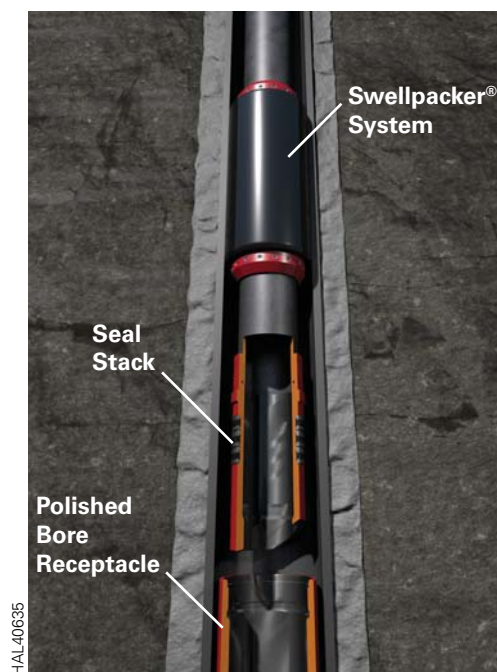
Swellpacker® isolation systems used above the top of cement (TOC) help prevent pressure migration to surface (sustained casing pressure) from lower reservoirs, without regard to the competency of the original cement operation. Swellpacker TOC systems help prevent sustained casing pressure should the well cement debond from the casing during the life of the well, which could create channels for pressure to migrate from the formation. Swellpacker TOC systems work independently of other operations, regardless of conditions, as long as fuel is present. The packers are normally placed in any upper casing string to provide a positive seal. The system can also be adapted to include a one-way check valve in the element itself, which allows the system to hold pressure from below (reservoir), while allowing any pressure buildup above the Swellpacker system to be relieved below the casing shoe.

Liner Tiebacks

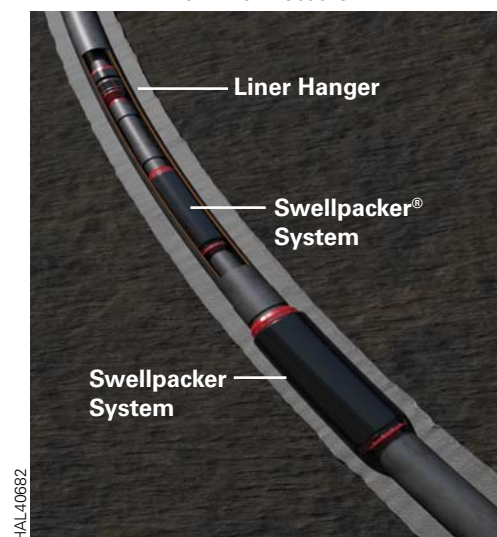
Using Swellpacker systems on the liner tiebacks eliminates the need for cement to anchor the tieback string. Swellpacker systems are installed above the seal assembly and the tieback string is run in hole to the tieback receptacle. The seal assembly is pressure tested and then raised; thereby, fuel for the swellable element is circulated to the proper location (if fuel is not already in place). The seal assembly is lowered back into the tieback receptacle, and the Swellpacker system is allowed to swell. The Swellpacker system provides pressure-holding capability and creates a significant anchoring force for the liner tieback string. There is no cement, float equipment, or cement plugs to drill. Many of the risks are reduced, and days of operations are eliminated.

Below Liner Hangers

Swellpacker systems on liner casing, below a mechanical liner hanger inside the parent casing, create assurance of a positive seal to isolate the openhole section from the surface. Liner hanger Swellpacker systems can be designed to swell either before the mechanical liner hanger is set or after the mechanical liner hanger packoff is energized. Liner-top squeeze operations can be eliminated, saving substantial time and costs. Liner hanger Swellpacker systems can be used with or without cement.



*Swellpacker® Isolation System
on Liner Tiebacks*



*Swellpacker® Isolation System
Below Liner Hangers*

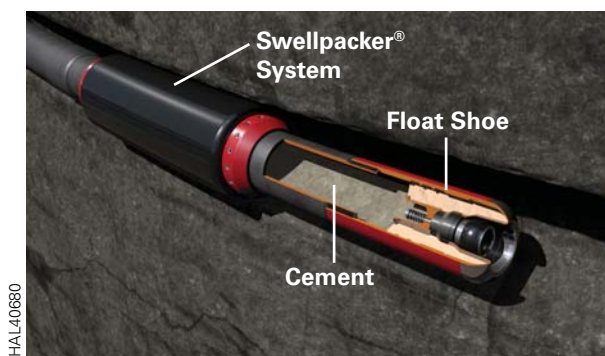
Production Zones with Cement

Swellpacker® systems in production zones with cement complement the cement slurry by providing total zonal isolation. During cementing, various circumstances can affect cement operation efficiency. Insufficient centralization, poor mud cleanout, lack of rotation and reciprocation, and reduced velocity during cementation can negatively impact cement operation quality. Swellpacker systems, when combined with primary cementing operations, can provide comprehensive long-term zonal isolation, thus enhancing the productive life of the well and minimizing the potential of a costly workover operation.

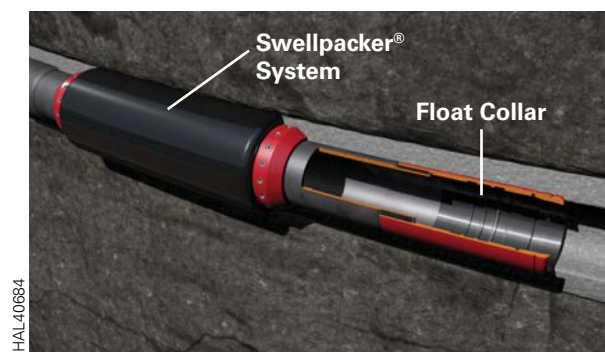
Swellpacker systems in production zones with cement have the added benefit of providing a reactive downhole means to address the microannulus that occurs when set cement debonds from the casing. The systems remain dormant while encased in the cement sheath. Once the microannulus opens and liquids or gas attempt to flow through the microannulus, the packer swells to close the flow path. The swellable rubber conforms to almost any irregular geometry in the casing or cement.

Isolation at Shoe Joints

Swellpacker systems used on shoe joints create a competent pressure seal on the shoe joint and allow for a Formation Integrity Test (FIT), regardless of the tail cement condition. These systems are designed to swell by means of the base fluid used in the drilling fluid, which is generally water or oil. If competent tail cementation is achieved, the Swellpacker system shoe joint does not activate. If there is insufficient mud cleanout in the shoe joint area, the contaminated fluid is the fuel for the packer. The shoe joint Swellpacker system will swell and allow for a competent FIT while facilitating drilling ahead. Shoe joint Swellpacker systems are normally placed on the shoe track while the casing is run.



*Swellpacker® System
in Production Zones with Cement*



*Swellpacker® System
at Shoe Joints*

Scab Liners

Swellpacker systems on scab liners are a logical selection when scab liners are used. Scab liners are placed in the well to simply provide a casing conduit from the lower liner to the upper tieback casing string. Cementing a scab liner in place is time-consuming and high risk. Using Swellpacker systems on scab liners helps reduce the risks of performing a competent cementing operation in relatively small annuli.

Anchoring of Casing Strings

Another application for Halliburton Swellpacker® system technology is providing an anchoring point for the casing or tubing string inside a wellbore. This application of swellable technology has been used in various ways, such as combating tubing movement forces during stimulation treatments, all the way to repairing wells that were planned for abandonment. Based on testing conducted at the Openhole Isolation Systems Center of Excellence, Swellpacker systems can provide a significant amount of anchoring force, thus helping ensure the entire casing or tubing string can be successfully held in place. Using sophisticated simulators, Halliburton engineers can estimate the amount of anchoring force necessary and then design a Swellpacker system to match the needs of the application.

Isolation at Perforations

A common challenge in the oilfield is the isolation of perforations that were either shot off-depth or created unwanted wellbore production. As an alternative to the expandable patch technology or straddle systems, Swellpacker systems can be used to address this challenge. A Swellpacker system can be deployed using wireline, coiled tubing, or jointed pipe to the target set of perforations. It can either be set in place using a hanger tool or allowed to swell and isolate the perforations before releasing off of the Swellpacker system using a disconnect tool.

