

# Subsurface Safety Equipment



# Introduction

Halliburton subsurface safety systems can be used as total systems or subsystems in an overall safety installation. We offer a full line of tubing-retrievable and wireline-retrievable subsurface safety valves, including both surface-controlled and direct-controlled designs. Under API license, Halliburton can apply the API monogram to 14A subsurface safety equipment.

In addition to normal API verification, Halliburton standardized an extended performance-based prototype test program. Each test phase is specially designed to verify overall valve durability. For example, extended verification testing of sand slurry environments consists of a minimum of 120 slam closures against sand slurry as opposed to the seven closures of an API 14A Class 2 test. Understanding the importance of subsurface safety valve reliability, both to safety and maintaining well production, brings an increased emphasis to life cycle costs for wells as opposed to minimized purchase costs.

The final testimony to reliability is performance. The SP<sup>™</sup> non-elastomer safety valve provides superior reliability because it is specifically designed for extended life applications that require ultimate reliability.



**Completion Tools** 

			-	
Applications	WellStar®	NE™	SP™	DepthStar <sup>®</sup>
Medium pressure: 5,000 to 7,500 psi WP	Х	Х	Х	Х
High pressure: 8,000 to 10,000 psi WP	Х	Х	Х	Х
Ultra-high pressure: >10,000 psi WP	-	-	Х	Х
Standard temperature: up to 300°F	Х	Х	Х	Х
High temperature: >300°F	-	Х	Х	Х
Shallow setting depth: up to 1,000 ft	Х	Х	Х	Х
Medium setting depth: 4,000 ft	-	Х	Х	Х
Deep setting depth: >4,000 ft	-	-	Х	Х
Sweet corrosion: H <sub>2</sub> S and mild CO <sub>2</sub> service (9 chrome 1 moly construction)	х	х	х	х
Moderate corrosion: H <sub>2</sub> S and CO <sub>2</sub> service (13% chrome construction)	х	х	х	х
Severe corrosion: H <sub>2</sub> S and CO <sub>2</sub> service (nickel-chrome duplex)	х	х	х	х
Sandy service	Х	Х	Х	Х
API standard weight production tubing	Х	Х	Х	Х
Heavyweight production tubing	Х	Х	Х	Х
Features	WellStar	NE	SP	DepthStar
Non-equalizing (external equalization)	Х	Х	Х	Х
Integral equalizing feature	Х	Х	Х	Х
Integral secondary valve capability	Х	Х	Х	-
Permanent lockout capability	Х	Х	Х	Х
Operates independent of tubing pressure	_	_	_	Х

## Guide to Tubing-Retrievable Subsurface Safety Valves



# **Advanced Features**

This section describes the unique characteristics of Halliburton safety valves, including the contoured flapper, high-performance piston seals, integral fittings, and selfequalizing feature.

## **Contoured Flapper**

Halliburton took advantage of its broad experience with ball valves to design a reliable contoured flapper valve by adapting the spherical sealing surface used in ball valves to the flapper shape. The contoured flapper safety valve achieves true metal-to-metal (MTM) flapper sealing integrity while providing improved valve OD/ID ratios. This unique design offers a distinct advantage over typical curved flappers because it passes API Class 1 and 2 verification testing without relying on a resilient seal.

The contoured flapper incorporates the proven advantages of the spherical MTM seal of a ball-type closure while maintaining the simple operation of a flapper valve. The mating spherical seal surfaces, lapped before assembly, provide increased bearing area as well as improved flapper centralization during valve closure. The increased spherical seal width also allows contouring of the upper and lower flapper surfaces, resulting in smaller ODs and/or enlarged IDs. The flapper's dual hinges and closure mechanism provide stability and high initial closure forces to enhance valve sealing reliability. This unique technology was awarded the prestigious Special Meritorious Award for Engineering Innovation.



Contoured Flapper with Continuous Spherical Sealing Surface



## **High-Performance Piston Actuator**

To help meet the demands of today's high-pressure/hightemperature wells, Halliburton designed and qualified a high-performance piston actuator that can withstand well temperatures up to 450°F and pressures up to 20,000 psi. The high-performance piston actuator is a dynamic nonelastomer, spring-energized seal system for tubing retrievable safety valves (TRSVs). It contains upper and lower metal-to-metal (MTM) hydraulic seals (backstops), guide shoes, spring-energized, non-elastomer dynamic seals, Vee-ring non-elastomer dynamic seals, and contoured non-elastomer backup rings. Qualification testing included:

- » Pressures from 50 to 20,000 psi
- » Temperatures from 25 to 450°F
- » 500+ cycles at differing pressures and temperatures equating to more than 40 years of service
- » 30-day 15,000-psi differential pressure hold test
- » 20,000-psi control line fluid test
- » 5,000-psi nitrogen test at 450°F
- » MTM primary seals intentionally disabled to validate performance of non-elastomer dynamic seals

The high-performance piston actuator performed with no leaks observed during static and dynamic conditions.



High-Performance Piston Actuator

## Halliburton Integral Fitting

The three-piece Halliburton integral fitting (HIF) system is designed for use with 1/4-in. OD control line and used primarily with TRSVs. The female port accepting the HIF is cut directly into the TRSV hydraulic housing and offers reliability and space advantages over conventional industry fittings. The HIF consists of a male nut, front ferrule, and back ferrule.

The HIF is standardized to one common platform compatible with common control-line materials and thicknesses and will fit within the available annular space. The single HIF offering consists of an alloy 925 male nut and alloy 600 front ferrule and back ferrule. Other materials are available upon request.

The fittings were subjected to shock/vibration and external pressure testing to simulate installation and operational loads applied to the downhole control line and fittings during its operational life cycle. Shock and vibration tests were performed at varying frequencies, acceleration, amplitudes, and temperatures. Component integrity was verified by pressurizing the control lines during the tests and monitoring the system for changes in pressure and visible leaks. After each test, no leaks were observed, and the fitting remained torqued. Once shock and vibration tests were complete, an external pressure test (20,000 psi for 1 hour) was conducted on the fitting with no leaks observed.





## **Self-Equalizing Feature**

The Halliburton sideport self-equalizing feature uses a spring-loaded carbide ball lapped to a mating spherical seal located in the flapper seat of the safety valve. Location of the equalizing device in the flapper seat allows the flow tube, when activated, to radially displace the ball outward, opening an equalizing path around the flapper mechanism. A closely controlled channel between the flapper seat and the spring housing provides for a large equalizing area and prevents debris migration into the metal-to-metal sealing area. After equalization, the flow tube moves down to open the flapper and allows the flow tube to downstop against its metal seat, thereby isolating the equalizing mechanism from flow.

Erosion is a prime consideration with equalizing devices. The sideport equalizing design addresses erosion by forcing the equalizing flow through a closely controlled flow path. This flow path allows the pressure drop to be taken through the close concentric fit of the flapper seat and mating housing instead of across the equalizing valve seat itself. This close concentric fit and controlled flow path provide an enlarged flow area and enhanced equalizing times while simultaneously filtering the equalizing flow, which prevents erosion and helps ensure a long operating life.

The sideport equalizing device has also been tested extensively in sandy environments. In addition to successfully completing API Specification 14A verification testing for Class 2 (sand service), the sideport underwent endurance testing. This testing involved putting the equalizing device in the equalizing position and flowing a sand-laden fluid through the device for 7 days. Leak tests performed afterward revealed no detrimental effects from erosion, and the sealing capability of the equalizing device was not affected. The equalizing device was also tested successfully during extensive sand closure tests commonly used for North Sea applications. The safety valve was subjected to 120 slam closures in a sand-laden fluid, a 20-fold increase over the normal API Specification 14A test. Other tests performed included repeated equalizing operations and nitrogen leak verification tests in a sandy environment.

Additionally, the equalizing feature was subjected to gas slam closures followed by 50 equalizations equivalent in volume to 1,500 ft of 7-in. tubing filled with gas at well conditions (approximately 5,000-psi bottomhole pressure). Unlike in a well scenario, the gas was vented to the atmosphere during the test, which means the full pressure differential was present for the duration of each equalization (open system), applying maximum gas velocity for the entire cycle.





# **Tubing-Retrievable Safety Valves**

## WellStar<sup>®</sup> Tubing-Retrievable Safety Valve

The WellStar<sup>®</sup> tubing-retrievable safety valve (TRSV) is a general production, hydraulically operated, downhole TRSV. The rugged hydraulic actuator of the WellStar safety valve provides durability and isolates the internal workings from well fluids through its unique construction. The metal-to-metal (MTM) sealing integrity in the body joints and closure mechanism places it in a premium valve category while featuring an economical price. Proven through years of installations, the simple, compact design enhances the valve's overall reliability and provides for trouble-free operation.

## Applications

» General production completions

## Features

- » Simple, compact design
- » Complete MTM well containment in the closed position (body/seat connections and flapper)
- » MTM flapper sealing (no resilient seal required)
- » Unique hydraulic actuation (single-piece piston/ flow tube)
- » Hydraulic chamber construction isolates the majority of the internal valve components and exposes them to clean hydraulic fluid
- » Positive debris barrier at both ends of flow tube in full open position
- » Maximized piston area and spring force
- » Flow tube construction prevents well solids and debris from settling on top of the piston

## **Benefits**

- » Helps increase optimum reliability and durability
- » Helps provide superior well containment and safety
- » Helps increase valve life
- » Low friction, smooth operation
- » Critical components isolated from well environment
- » Enhanced debris isolation and tolerance
- » Minimized potential leak paths
- » Maximized forces during valve opening and closing



WellStar<sup>®</sup> Tubing-Retrievable Safety Valve

#### Ordering Information

Specify: tubing size, weight, grade, and thread; casing size and weight; temperature and pressure rating requirements; service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines/other chemicals, chloride content, etc.); setting depth; equalizing or non-equalizing; nipple bore and profile type requirements; necessity of API monogramming or other certification requirements; special material requirements, if applicable. Part Number Prefix: 78LXE, 78LXA, 78HXE, 78HXA, 78HRE, 78HRA



Tubing Size	Maxi O	mum D	Inte Packin	ernal Ig Bore	Lock Profile	Pres Rat	sure	Len	gth																		
in.	in.	mm	in.	mm		psi	bar	in.	mm																		
	3.63*	92*				5,000	344.74																				
2 3/8	3.70	94	1.875	47.63	X®, R®, RQ	5,000	344.74	47.1	1196																		
	3.97	101				10,000	689.48																				
	4.56*	116*				5,000	344.74																				
27/9	4.65	118	2 125 to 2 212	53.98 to 58.75	53.98 to 58.75	52 08 to 58 75	V P PO	5,000	344.74	51.2	1200																
2 7/0	4.74	120	2.125 10 2.515			Λ, Ν, ΝΟ	10,000	689.48	51.2	1300																	
	4.91	125				10,000	689.48																				
	5.03*	128*		65.07 to 71.45	65.07 to 71.45	65.07 to 71.45	65.07 to 71.45	65.07 to 71.45	65.07 to 71.45		5,000	344.74															
2 1/2	5.20	132	2 562 +0 2 912							65.07 to 71.45	65.07 to 71.45	65 07 to 71 45	65 07 to 71 45	65.07 to 71.45	65 07 to 71 45	V B BO	5,000	344.74	56.2	1400							
5 1/2	5.37	136	2.502 10 2.613									Λ, η, ης	10,000	689.48	50.5	1430											
	5.62	143				10,000	689.48																				
	6.62*	168*				5,000	344.74																				
4 1/2	6.73	171	3.750 to 3.813	3 95.25 to 96.85	95.25 to 96.85	X, R, RQ	5,000	344.74	63.5	1613																	
	6.97	177				7,500	516.75																				

## WellStar®Tubing-Retrievable Safety Valves

\*Slimline options



## NE<sup>™</sup> Tubing-Retrievable Safety Valve

The Halliburton NE<sup>™</sup> tubing-retrievable safety valve (TRSV) is a single rod-piston non-elastomer flapper valve designed for general production with enhanced reliability and long life. The valve includes the non-elastomer hydraulic actuator design from the highly reliable SP<sup>™</sup> line of safety valves. Along with the metal-to-metal (MTM) body joints and closure mechanism, the actuator places this valve in the premium category while keeping costs economical. The simple, compact design enhances the valve's overall reliability and provides for trouble-free operation.

## Applications

- » General production completions
- » Hostile well environments incompatible with elastomers

## Features

- » Non-elastomer dynamic piston seals
- » Simple compact design
- » 100% MTM well containment in closed position
- » Positive debris barrier at both ends of flow tube
- » No construction seals used in the lockout and communication system
- » Unique flow tube construction prevents debris from settling on top of flow tube

## **Benefits**

- » Most field-proven and reliable hydraulic actuator in the industry
- » Dynamic and static seals independently verified gas tight
- » Verified MTM flapper sealing
- » Critical components isolated from well debris during production
- » Minimized potential leak paths
- » Optimal reliability



#### **Ordering Information**

**Specify:** tubing size, weight, grade, and thread; casing size and weight; temperature and pressure rating requirements; service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines/other chemicals, chloride content, etc.); setting depth; equalizing or non-equalizing; nipple bore and profile type requirements; necessity of API monogramming or other certification requirements; special material requirements, if applicable.

Part Number Prefix: 478LXE, 478LXA, 478HXE, 478HXA, 478HRE, 478HRA



Tubing Size	Maxi O	mum D	Internal Packing Bore		Lock Profile	Pressure Rating		Length														
in.	in.	mm	in.	mm		psi	bar	in.	mm													
	3.63*	92				5,000	344.74															
2 3/8	3.70	94	1.875	1.875 <i>48</i>		5,000	344.74	47.9	1216													
	3.97	101				10,000	689.48															
	4.65	118				5,000	344.74															
2 7/8	4.91	125	2.125 to 2.313	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	54 to 59	R®, X	10,000	689.48	51.4	1305
	4.51	114				10,000	689.48															
	5.03*	128				5,000	344.74															
2 1/2	5.20	132	2.562 to	70 to 71	70 to 71	70 to 71	70 to 71	70 to 71	70 to 71	70 to 71	70 to 71	70 to 71	X, R, RQ,	5,000	344.74	- 	1425					
5 1/2	5.38	137	2.813										70 to 71	70 to 71	70 to 71	70 to 71	70 to 71	RPT <sup>®</sup>	10,000	689.48	- 56.1	1425
	5.62	143				10,000	689.48															
	5.965*	151				8,500	586.19															
4 1/2	6.62	168	3.750 to	05 42 07	05 40 07	05 4 07	X, R, RQ,	5,000	344.74	 575	1460											
4 1/2	6.73	171	3.813	55 10 57	RPT	5,000	344.74	57.5	1400													
	6.97	177				7,500	516.75															

## NE<sup>™</sup> Tubing-Retrievable Safety Valves

\*Slimline options



## SP™ Tubing-Retrievable Safety Valve

The Halliburton SP™ tubing-retrievable safety valve (TRSV) is a single rod-piston non-elastomer flapper valve designed for hostile environments and extended life applications where ultimate reliability is required. Potential leak paths within the valve are minimized with the single rod-piston design. The piston achieves a metalto-metal (MTM) seal at its uppermost and lowermost positions to seal well pressure from the control system.

The SP valves incorporate flappers using spherical radius sealing surfaces that help greatly improve seal reliability. The spherical radius design provides full MTM sealing integrity.

For applications where either the OD or ID is restrained, SP valves incorporate the award-winning Halliburton contoured flapper. OD/ID relationships are improved by the contoured flapper design, which helps provide superior MTM sealing when compared to other forms of curved flapper technology.

## Applications

» For applications requiring ultimate reliability and longevity, such as high-temperature/high-pressure, and subsea completions, or hostile well environments

#### Features

- » Non-elastomer dynamic piston seals
- » MTM static seal at upper and lower piston positions
- » MTM body joints
- » Flow tube fluted guide
- » 100% MTM flapper
- » Concentric thrust bearing
- » Wiper ring on upper flow tube
- » Cleanout ports in flow tube's upper end
- » Internal exercise profile
- » Flow tube shock absorber
- » MTM face seat at flow tube downstop
- » Setting depths to 9,000 ft (2743 m)

## **Benefits**

- » Unsurpassed reliability of hydraulic actuator; dynamic and static seals independently verified gas tight
- » Control line isolated from well fluids by MTM seal with valve in closed position
- » Hydraulic system isolated from well pressure by MTM seal with valve in open position
- » MTM thread sealing and self-locking capability
- » Fluted guide provides maximum debris protection, allowing fluids to enter and exit during valve operation
- » No wear by torsional effects of a helical spring
- » Critical components isolated from well debris with valve in open position
- » Area above flow tube free of solids buildup
- » Flow tube can be manipulated by slickline
- » Protected from high flow rate slam closures





#### Ordering Information

**Specify:** tubing size, weight, grade, and thread; casing size and weight; temperature and pressure rating requirements; service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines/other chemicals, chloride content, etc.); setting depth; equalizing or non-equalizing; nipple bore and profile type requirements; necessity of API monogramming or other certification requirements; special material requirements, if applicable. **Part Number Prefix** 67800







## SP<sup>™</sup> Tubing-Retrievable Safety Valve

Tub Si	oing ze	Max	kimum OD	In Pack	ternal ing Bore	Pressu Ratin	ıre g
in.	mm	in.	mm	in.	mm	psi	bar
2 3/8	60.33	3.62 to 3.97	91.95 to 100.84	1.875	47.63	5,000 to 10,000	345 to 690
2 7/8	73.03	5.41 to 5.49	137.41 to 139.44	2.313	58.75	7,500 to 20,000	517.5 to 1380
3 1/2	88.9	5.03 to 5.86	127.76 to 148.84	2.313 to 2.813	58.75 to 71.45	5,000 to 20,000	345 to 1380
4 1/2	114.3	7.35 to 7.57	186.69 to 192.28	3.25 to 3.813	82.55 to 96.85	5,000 to 20,000	345 to 1380
5 1/2	139.7	7.69 to 8.38	195.33 to 192.28	4.437 to 4.750	112.70 to 120.65	5,000 to 15,000	345 to 1034
6 5/8	168.3	8.75	222.25	4.875	123.83	11,500	793
7	1770	8.90 to 9.60	226.06 to 243.84	5.750 to 6.000	146.05 to 152.39	5,000 to 10,000	345 to 690
,	177.0	8.38 to 8.52	212.9 to 216.4	5.750 to 5.875	146.05 to 149.23	5,000 to 6,000	345 to 414
9 5/8	244.5	11.75 to 12.125	298.5 to 307.9	8.375 to 8.500	212.7 to 215.9	5,000 to 10,000	345 to 690

# HALLIBURTON

# DepthStar® Tubing-Retrievable Safety Valve

The DepthStar® tubing-retrievable safety valve (TRSV) is a revolutionary concept in the realm of surfacecontrolled subsurface safety valves. Unlike other TRSVs, the DepthStar valve functions completely independent of well pressure; therefore, it is able to operate at consistently low hydraulic pressures, making it an ideal solution for deepwater completions. Previously, solutions to wellbore isolation of the piston required additional seals and/or gas-charged chambers where their reliability is heavily dependent on elastomeric seals and the permanent, long-term containment of a dome charge. The DepthStar valve, through the use of a revolutionary magnetic coupler, allows for positioning the hydraulic actuator completely out of the tubing wellbore.

By repositioning the hydraulic actuator outside the tubing wellbore, the DepthStar valve becomes the world's first 100% metal-to-metal (MTM) safety valve that contains no moving seals within the tubing wellbore. This reduction in seals combined with an intrinsically simple design makes the DepthStar TRSV inherently reliable. The DepthStar TRSV operates with a low operating pressure, making it an ideal solution for deep-set applications.

## Features

- » No moving seals exposed to the tubing wellbore
- » 100% MTM sealing within the tubing wellbore
- » Less than 5,000-psi maximum valve opening capability regardless of setting depth or pressure
- » Minimized number of body connections
- » Proven MTM, non-elastomer hydraulic actuator
- » Isolated flow tube

## **Benefits**

- » No possibility of tubing to control line leakage
- » Low hydraulic operating pressure/ reduced CAPEX
- » Unconstrained valve setting depth
- » Helps increase optimum reliability and durability
- » Helps provide superior well containment and safety
- » Helps increase valve life



## DepthStar®Tubing-Retrievable Safety Valves

Tubing Size	Maximum OD	Internal Packing Bore	Pressure Rating
in.	in.	in.	psi
A 1/2	7.87	3.813	7,500 to 10,000
4 1/2	7.87	3.562	15,000
5 1/2	8.62	4.562	7,500 to 12,500

Completion Tools

HALLIBURTON

Through use of a unique magnetic coupler, the actuation piston and hydraulic operating system connected to the DepthStar<sup>®</sup> tubing-retrievable safety valve (TRSV) is isolated from the tubing wellbore. As shown in the illustration to the right, the outer and inner magnetic sleeves are separated by a well pressure-containing housing, creating a chamber for the actuating piston that is absolutely isolated from the wellbore. Use of the magnetic coupler makes it possible to completely remove all moving seals normally found in a subsurface safety valve (SSSV) from the wellbore environment.

The DepthStar valve was subjected to tests specifically related to the magnetic coupler to determine whether there would be any effect on through-tubing operations. For example, electric coils, perforator detonators, collar locators, thermal multi-decay logging tools, memory gauges, metal shavings, DPU<sup>®</sup> downhole power unit, RMT Elite™ reservoir monitor tool, firing heads, hostile gamma neutron tools, tubing-encapsulated conductor (TEC) line, and fiber-optic cables were run through the DepthStar TRSV. All tools performed normally with no affect from the magnetic coupler.

The primary benefit of the unique DepthStar TRSV design is it provides the flexibility to place the SSSV at a depth based on the requirements and goals of the completion — not on the safety valve limitations.



DepthStar<sup>®</sup> Tubing-Retrievable Safety Valve with Magnetic Coupler



# Wireline-Retrievable Safety Systems

## **FXE Flapper-Type Valves**

The FXE wireline-retrievable flapper valve, which is normally closed, is held open by hydraulic control pressure from the surface. The valve operates on a hydraulic piston principle. To open, hydraulic pressure slightly higher than the well pressure is applied to move the piston downward. This pressure unseats the secondary seat, allowing pressure to enter through equalizing ports. Then, as additional hydraulic pressure is applied to the piston, it continues downward movement, pushing the flapper open.

The flapper hinge assembly is designed such that the force on the piston is not applied directly on the hinge pin. Upon loss of hydraulic pressure in the control line, the valve's large spring serves to lift the hydrostatic head of the control fluid. The flapper spring is designed to close the valve when the piston moves up past the flapper.

## **Opening Prong Nose Seal**

The FXE valve uses the valve housing as the downstop for the opening prong. This metal-to-metal (MTM) interface is designed to prevent flow from passing between the valve housing and the opening prong. The MTM interface isolates the flapper and seat from fluid flow while the valve is open. This design creates an MTM interface with the full force exerted by the hydraulic piston, minus the spring compression force, holding the two metal faces in contact.

## **Radius of Curvature at Flow Entrance**

Halliburton conducted a study with various curvatures on the entrance to the valve. The study tested abrasive fluids flowing through different test subs and examined the resulting wear patterns. As a result, an optimum radius of curvature was determined and implemented on the valve housings of all wireline-retrievable safety valves.

#### **Ordering Information**

**Specify:** nipple bore; pressure and temperature rating requirements; setting depth; service environment (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines/other chemicals, chloride content, etc.); API monogramming or other certification requirements; special material requirements, if applicable. **Part Number Prefixes:** 22FXE: flapper closure equalizing type, 22FXN: flapper closure non-equalizing type

## Applications

» General production completions

## Features

- » Equalizing-type flapper closure
- » Solid construction flapper made from bar stock
- » Spherical radius seat on flapper improves seal reliability
- » Sealing and seating surfaces are out of the well production flow path when valve is in the open position

## **Benefits**

- » Minimal hinge pin stress during opening and closing cycles
- » Allowable working pressures up to 15,000 psi (1035 bar)
- » Allowable setting depths up to 3,000 ft (914 m)
- » Pump-through capability built into the valve design
- » Compatible with Otis® X®, R®, RQ, RPV, and
- SAFETYSET<sup>®</sup> lock mandrels and with Halliburton tubing-retrievable safety valves in depth ratings and material selections







## FXE Flapper-Type Wireline-Retrievable Safety Valves

Tul S	oing ize	Mating Hone	g Nipple Valve ed Bore ID		lve D	Wor Pres	king sure	Length*		
in.	mm	in.	mm	in.	mm	psi	psi bar		mm	
2.2/0	60.22	1.710	43.43	0.62	15.75	10,000	689.64	36.2	920	
2 3/0	00.33	1.875	47.63	0.75	19.05	10,000	689.64	36.5	927	
		2.125	53.98	0.81	20.57	15,000	1034.5	38.5	978	
2 7/8	73.03	2.188	55.58	0.81	20.57	15,000	1034.5	38.5	978	
		2.313	58.75	1.12	28.45	10,000	689.64	39.6	1006	
		2.562	65.07	1.00	25.40	15,000	1034.5	42.0	1067	
3 1/2	88.90	2.750	69.85	1.50	38.10	10,000	689.64	44.8	1138	
		2.813	71.45	1.50	38.10	10,000	689.64	44.8	1138	
4	101.60	3.313	84.15	1.75	44.45	10,000	689.64	46.5	1181	
		3.437	87.30	1.75	44.45	15,000	1034.5	46.5	1181	
4 1/2	114.30	3.688	93.68	1.87	47.50	15,000	1034.5	43.0	1093	
		3.813	96.85	2.12	53.85	10,000	689.64	42.5	1080	
5	127.00	4.125	104.78	2.38	57.15	8,000	551.71	47.5	1207	
5 1/2	139.70	4.562	115.87	2.56	65.02	8,000	551.71	52.5	1334	
		5.750	146.05	3.38	85.85	7,000	482.75	65.0	1651	
7	177.80	5.875	149.23	3.50	88.90	7,500	517.23	63.7	1618	
		5.963	151.46	3.50	88.90	7,000	482.75	70.0	1778	

\*Lengths are extended for setting depths greater than 1,000 ft.



## FRN Flapper-Type Wireline-Retrievable Safety Valves

The FRN wireline-retrievable flapper valve, which is normally closed, is held open by hydraulic control pressure from the surface. The valve operates on a hydraulic-piston principle. To open, tubing pressure slightly higher than the well pressure below the closed flapper is applied. Once well pressure is equalized across the closed flapper, hydraulic pressure is applied to the piston, which pushes the flapper open.

The flapper hinge assembly is designed so the force on the piston is not applied directly on the hinge pin. Upon loss of hydraulic pressure in the control line, the valve's large spring serves to lift the hydrostatic head of the control fluid. The flapper spring is designed to close the valve when the piston moves up past the flapper.

## **Opening Prong Nose Seal**

The FRN valve uses the valve housing as the downstop for the opening prong. This metal-to-metal (MTM) interface is designed to prevent flow from passing between the valve housing and opening prong. The MTM interface isolates the flapper and seat from fluid flow while the valve is open. This design creates an MTM interface with the full force exerted by the hydraulic piston, minus the spring compression force, holding the two metal faces in contact.

# Radius of Curvature at Flow Entrance

Halliburton conducted a study with various curvatures on the entrance to the valve. The study tested abrasive fluids flowing through different test subs and examined the resulting wear patterns. As a result, an optimum radius of curvature was determined and implemented on the valve housings of all wirelineretrievable safety valves.

#### Applications

- » New completions
- » Deep set
- » High pressure

#### Features

- » High-strength rod-piston actuation
- » Non-equalizing flapper closure
- » Solid construction flapper made from bar stock
- » Spherical radius seat on flapper improves seal reliability
- » Sealing and seating surfaces are out of flow path of well production when valve is in open position
- » Designed for easy field servicing

## **Benefits**

- » Minimal hinge-pin stress during opening and closing cycles
- » Working pressures up to 12,500 psi (862 bar)
- Allowable setting depths up to 9,000 ft (2743 m)
- » Pump-through capability built into the valve design
- » Compatible with Otis<sup>®</sup> X<sup>®</sup>, R<sup>®</sup>, RQ, RPV, and SAFETYSET<sup>®</sup> lock mandrels and with Halliburton tubing-retrievable safety valves in depth ratings and material selections
- » Ease of on-location servicing of the external packing helps reduce downtime and operating costs

Packing **Retainer Sleeve** Rod Piston Cleanout Ports Spring Radius of Curvature at Flow Entrance

FRN Flapper-Type Wireline-Retrievable Safety Valve



Tubing Size		Mating Honed	Nipple d Bore	Va II	lve D	Working Pressure		
in.	mm	in.	mm	in.	mm	psi	bar	
2 7/8	73.03	2.313	58.75	1.00	25.40	10,000	689	
		2.562	65.07	1.00	25.40	10,000	689	
3 1/2	88.90	2.750	69.85	1.35	34.29	10,000	689	
		2.813	71.45	1.35	34.29	10,000	689	
		3.562	90.47	1.35	34.29	10,000	689	
4 1/2	114.30	3.688	93.68	1.35	34.29	10,000	689	
		3.813	96.85	2.12	53.85	10,000	689	
5 1/2	139 70	4.562	115.87	2.56	65.02	10,000	689	
5 1/2	133.70	4.313	109.55	2.12	53.85	12,500	862	
6 5/8	168.28	4.875	123.83	2.56	65.02	11,500	793	

## FRN Flapper-Type Wireline-Retrievable Safety Valves



## BigBore<sup>™</sup> Wireline-Retrievable Safety Valves

Halliburton has applied the same stringent testing used on its maximum reliability tubing-retrievable safety valves (TRSV) to its BigBore™ wireline-retrievable safety valve (WLRSV). This valve offers the durability and reliability of Halliburton TRSVs through metal-to-metal (MTM) sealing of the contoured flapper, enhanced body connections, and debris isolation. The contoured flapper provides a large ID compared to other valve designs, while providing enhanced flapper sealing.

Another significant feature of this valve is its ease of on-location servicing. The construction of the upper end of the valve provides for easy access to the valve's external packing. Once the lock is removed, the packing retainer sleeve can be removed and serviced. The savings made possible by an enlarged ID, enhanced performance, and ease of service have made it an excellent choice for replacing equipment currently installed in existing completions.

## Applications

- » New completions
- » Replacement of existing WLRSVs to provide increased ID and reliability



- » MTM sealing contoured flapper closure with large ID
- » High-strength rod-piston actuation
- » Dual-sealing minimized body connections
- » Enhanced debris isolation through MTM interface of flow tube/bottom sub
- » Radius of curvature at flow entrance
- » Equalizing feature available
- » Designed for easy field servicing
- » Setting depths to 9,000 ft (2743 m)

## **Benefits**

- » MTM sealing for increased reliability
- » Helps increase durability and reliability from piston arrangement and minimized body connections
- » Increased reliability through debris isolation
- » Optimized flow entrance to decrease wear
- » Equalizing feature isolated from well solids to enhance durability
- » Ease of on-location servicing of external packing helps reduce downtime and operating costs



## BigBore<sup>™</sup> Wireline-Retrievable Safety Valves

Tu S	bing lize	Matin Hone	g Nipple ed Bore	Val IC	ve )	Wo Pre	rking ssure
in.	mm	in.	mm	in.	mm	psi	bar
4 1/2	114.30	3.813	96.85	2.36	59.9	8,000	551.58
5	127.00	4.125	104.78	2.36	59.9	8,000	551.58
5 1/2	139.70	4.562 to 4.813	115.87 to 122.25	3.00	76.2	6,000	413.69
7	177.80	5.750 to 5.963	146.05 to 149.23	4.125	104.8	7,500	517.23
9 5/8	244.47	8.325 to 8.500	211.45 to 215.9	6.00	152.4	5,000	344.74

#### Ordering Information

Specify: nipple bore; pressure and temperature rating requirements; setting depth; service environment (standard, %H2S, %CO2, amines/other chemicals, chloride content, etc.); necessity of API monogramming or other certification requirements; special material requirements, if applicable.

Part Number Prefix: 2200





## **Capillary Deliquification Safety System**

In mature fields, liquid loading of gas wells is a common problem. In the short term, this can lead to decreased production, and if not managed correctly, can ultimately reduce overall reservoir recovery. One option for managing the problem is the use of surfactants as foaming agents to artificially unload the well. The preferred method would allow automatic and continuous delivery of these surfactants.

The Halliburton capillary deliquification safety system facilitates delivery of surfactants or other chemicals and liquids to a specified point within the completion, while maintaining the purpose and functionality of a downhole safety device. The deliquification safety system can be installed in an existing completion with the appropriate safety valve landing nipple (SVLN) profile — either a dedicated SVLN or within a tubing-retrievable safety valve (TRSV) in which the control system communication is activated to operate an installed wireline-retrievable safety valve (WLRSV).

The system's injection feature operates via the WLRSV control system. When control-line pressure reaches a predetermined pressure, a regulator installed below the WLRSV opens, allowing chemical injection to occur. Use of the existing control line provides a cost-effective method of installing a semi-permanent injection system without the need to modify the wellhead.

The WLRSV is designed to shut in the well at a point below the surface and is opened with hydraulic control pressure. In this application, the applied chemical injection pressure maintains the safety valve in the open position during injection, and the valve closes when injection is stopped.

## Applications

- » Chemical injection for gas well deliquification or scale treatment purposes
- » Available for landing nipples/TRSVs with 2.75-in. and larger sealbores

#### Features

- » Field-proven WLRSV
- » Equalizing or non-equalizing-type flapper closure

#### Benefits

- » Unique design allows system installation with no requirement for wellhead modification
- » Installed using standard intervention techniques





# Surface-Controlled Subsurface Safety Accessory Equipment

This section describes some of the Halliburton nonwelded safety valve landing nipples (SVLNs), hydraulic control lines, protectors, and accessories.

## Safety Valve Landing Nipples

Halliburton SVLNs are designed to accept surfacecontrolled wireline-retrievable safety valves (WLRSVs). An internal profile is machined in these nipples to allow a lock mandrel/safety valve to be landed and locked in place. Nipples are available with connections for one or two external control lines and for standard or heavyweight tubing with corresponding honed-bore sizes.

Punch-to-communicate SVLNs are designed to accept surface-controlled WLRSVs. The punch-to-communicate SVLN does not provide communication from the control line to the nipple until the operator requires it. A communication tool must be run via a standard slickline toolstring to establish control-line communication. This feature allows for full metal-to-metal isolation of the hydraulic control-line system and full bore access to the completion string without using slickline-installed isolation sleeves to isolate and protect the hydraulic control-line system.

Halliburton Otis® XXO and RRO sliding sleeve nipples incorporate an inner sleeve that can be closed during testing and well cleanup and subsequently opened to allow control of the safety valve. The sleeve can be opened by a wireline trip before the safety valve is run, or a shifter mandrel can be run with the safety valve. The shifter mandrel opens the inner sleeve when the valve is run and closes the sleeve when the valve is retrieved.

## Applications

- » Designed to be made up and become part of the tubing to accept surface-controlled WLRSVs
- » Punch-to-communicate version typically used in hydraulic fracturing completions or as an independent, secondary subsurface safety system when used in conjunction with a tubing-retrievable safety valve

## Features

- » Large ID is compatible with tubing size and weight
- » Solid, non-welded control-line connection and protection portion of nipples
- » Control port machined into nipple wall

#### **Benefits**

- » Wireline operator controls locating, landing, and locking safety valve in a pre-selected location
- » Locking principle is designed to hold against pressure from either direction and sudden and/or repeated reversals of pressure
- » Rugged, non-welded design



Safety Valve

Punch-to-Communicate Landing Nipple Safety Valve Landing Nipple

Sliding Sleeve Landing Nipple

#### **Ordering Information**

Specify: tubing size, weight, grade, and thread; casing size and weight; service environment (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines/other chemicals, chloride content, etc.); size of nipple bore; sliding sleeve required (Y/N); special material requirements, if applicable,



Halliburton safety valve landing nipples are offered in various combinations of lock profiles and features. Standard lock profiles are indicated by the last two alpha characters of the part number prefix as follows:

- » XO Otis<sup>®</sup> X<sup>®</sup> selective lock
- » RO Otis R<sup>®</sup> selective lock
- » RQ Otis RQ bottom no-go lock
- » RP Otis RP top no-go lock
- » RT Otis RPV top no-go lock

A duplication of the first letter (XXO, RRP, etc.) indicates equal bores and single control-line access.

Other special features symbolized by letter designations include:

- » F unequal upper and lower bores, single control-line access
- » H equal, upper, middle, and lower bores, dual control-line access
- » K equal middle and lower bores smaller than upper bore, dual control-line access

All of the above combinations are shown in the following chart.

Tul S	bing ize	We	ight	Up Packir	oper 1a Bore	Lov Packin	ver a Bore				1		Part N	lumbe	r Prefix		<b>1</b>			
in.	mm	lb/ft	kg/m	in.	mm	in.	mm	711 XXO	721 XXO	711 RRO	721* RRO	711 RRP	711 RRQ	711 FRP	711 FRQ	711 HRQ	711 KRQ	711 XXN	711 FXO	711 HXO
		4.6 to 6.2	6.85 to 9.23	1.710	43.43					٠	•									
2 3/8	60.33	4.6 to 4.7	6.85 to 6.99	1.875	47.63			٠	•									•		
		6.4 to 11.65	9.52 to 17.34	1.875	47.63					•										
0.7/0	72.02	6.4 to 8.9	9.52 to 13.24	2.125	53.98					•	•									
2 7/8	73.03	6.4 to 7.9	9.52 to 11.76	2.188	55.58	-				٠	•									
		6.4 to 6.5	9.52 to 9.67	2.313	58.75			٠	•			0	0					•		
		7.7 to 16.7	11.46 to 24.85	2.313	58.75					٠		0	0							
2 1/2	00 an	10.3 to 12.95	15.33 to 19.27	2.562	65.07					٠	•									
51/2	00.30	9.2 to 10.3	13.69 to 15.33	2.750	69.85			٠	٠									•		
		9.2 to 9.3	13.69 to 13.84	2.813	71.45			٠	•			0	0					•		
4	101.60	11.6 to 13.4	17.26 to 19.94	3.125	79.38					•	•									
-	101.00	9.4 to 10.9	13.99 to 16.22	3.313	84.15			٠	•									•		
		16.9 to 19.2	25.15 to 28.57	3.437	87.30					•	•									
4 1/2	114.30	13.5 to 15.5	20.09 to 23.07	3.688	93.68					٠	•	0	0							
		10.5 to 12.75	15.63 to 18.97	3.813	96.85			٠	•			0	0			0		•		•
		18 to 20.80	26.79 to 30.95	4.000	101.60			٠		٠						0		•		•
5	127.00	15 to 18	22.32 to 26.79	4.125	104.78			٠		٠	•	О	0			0		•		•
		11.5 to 13	17.11 to 19.35	4.313	109.55					•	•	0	0			0				
		23 to 26	34.23 to 38.69	4.313	109.55					٠	•	0	0			0				
5 1/2	139 70	20 to 23	29.76 to 34.23	4.437	112.70							0	0							
0 1/2	100.70	13 to 20	19.35 to 29.76	4.562	115.87			٠		٠		0	0			0		•		•
		13 to 20	19.35 to 29.76	4.562	115.87	4.437	112.7							0	О		0			
		17 to 35	25.30 to 52.09	5.750	146.05							0	0							
		17 to 35	25.30 to 52.09	5.875	149.23					•		0	0			0				
		17 to 35	25.30 to 52.09	5.875	149.23	5.750	146.1							0	0		0			
7	177.80	23 to 32	34.23 to 47.62	5.963	151.46			•		•		0	0					•		
		23 to 32	34.23 to 47.62	5.963	151.46	5.750	146.1												•	
		26 to 29	38.69 to 43.16	6.000	152.40					•		0	0			0				
		26 to 29	38.69 to 43.16	6.000	152.40	5.963	151.5							0	0		0		•	
9 5/8	244.48	53.50	79.62	8.375	212.73	8.250	209.6							0	0		0			

## Safety Valve Landing Nipples

Standard design available.
O Standard or SAFETYSET<sup>®</sup> compatible designs available for no-go nipples. Additional sizes available upon request.

Note: Packing bore sizes apply for upper and lower bores when one size indicated.

\*Includes sliding sleeve device



# **Hydraulic Control Lines**

Halliburton provides the accessory equipment to complete any surfacecontrolled subsurface safety valve (SCSSV) installation.

Halliburton control lines are assembled on reels filled with fluid and pressure tested. Reel spools are designed so pressure can be applied at any time during running to check control-line integrity. Halliburton offers hydraulic control lines made from two different manufacturing processes that conform to ASTM specifications: (1) seamless and (2) welded and sunk.

## Seamless

Tubing is fabricated from a solid rod. The process involves forcing a mandrel or punch through the solid rod to form a tube. The continuous lengths available from this process are limited.

## Welded and Sunk

Tubing is fabricated from flat stock. The process involves rolling the stock into a cylinder and welding the seam. Once in tube form, it is drawn through a die to achieve the proper OD. This process is considerably less costly than the seamless method and yields lines available in continuous lengths with no butt-welded connections.

Optional single and dual lines with protective encapsulation are available. The encapsulated material is suitable for use in most annular fluids. Encapsulation protects lines from damage during installation and simplifies the running process. The dual-encapsulated line can be used with "balanced" SCSSVs or injection wells where multiple lines are required. As an option, a protective cable between two control lines is available. Single-encapsulated lines have no cable; however, a protective cable on either side of the control line can be ordered.

### Installation

Control lines are attached to subsurface controls with appropriate tube fitting and pressure tested before running into the wellbore. Line spools are hung in the derrick, and control line is paid out as tubing is run.

## Applications

» For SCSSVs

#### Features

- » Different lengths of control line in continuous coil
- » Stainless and alloy 825 materials offered
- » Control lines offered in various encapsulated options
- » All control lines conform to ASTM specifications
- » Lines available in other sizes on request

### Benefits

» Wide assortment for almost every need



Typical Surface-Controlled Subsurface Safety Valve Installation and Accessories



## **Control-Line Protectors**

Halliburton offers two types of control-line protectors both designed to provide maximum control-line protection. The first type of protector is a unique design that combines a steel outer shell and a resilient inner liner. The second type is all metal, which provides full over-the-coupling protection for virtually any size electrical submersible pump cable, bare tube, or encapsulated bundle configuration. The all-metal protector is also available for mid-joint applications. A variety of channels that can accommodate a combination of bare control lines and/or dualencapsulated control line is offered for each of the protectors.

Both types of protectors use a tapered pin lock to provide maximum gripping force. The tapered pin lock can be installed by hand and driven to the locked position by a pneumatic hammer or a manual hammer tool.

0	D	W. Thick	all mess	Material	Туре
in.	mm	in.	mm		
		0.049	1.24	316L	Seamless
		0.049	1.24	316L	Welded and Sunk
		0.065	1.65	316L	Seamless
1/4	6.35	0.049	1.24	Alloy 825	Seamless
		0.049	1.24	Alloy 825	Welded and Sunk
		0.065	1.65	Alloy 825	Seamless
		0.065 <i>1.65</i>		Alloy 825	Welded and Sunk

## **Control-Line Tubing**

## Ordering Information

**Control-Line Protectors** 

**Specify:** tubing size, casing size, and weight; control line size; number of control lines; if encapsulated, specify shape and dimensions.

#### Control Lines

**Specify:** size (OD, wall thickness, and length); seamless or welded and sunk; single or dual; encapsulated with or without stress cable; material (304L SS, 316L SS, AISI 1010 alloy, alloy 825).

Part Number Prefixes: 22SXX: welded and sunk, 22SSS: seamless stainless steel, 22SNS: alloy 825



## **TTRD Protection Sleeve**

The through-tubing rotary drilling (TTRD) protection sleeve is designed to protect downhole sealbores from damage as the drillpipe rotates within the tubing during a TTRD operation.

Typically, these sealbores would be located within downhole tubing-mounted safety valves, safety valve nipples, polished bore receptacles, or Christmas trees.

The TTRD sleeve is run on a dedicated running tool that is an integral part of the drillstring. The TTRD sleeve is locked and verified in place as the drillstring is run through the safety valve and is subsequently picked back up again upon retrieval of the drillstring.

## Applications

While developed specifically for use on TTRD operations, the TTRD sleeve can be used in any application where the existing well equipment and sealbores need to be protected, such as:

- » TTRD operations
- » Electric and slickline operations
- » Snubbing and coiled tubing operations

## **Features and Benefits**

- » Efficient deployment: Sleeve deployed and retrieved on the drillstring — saving multiple runs. It can also be deployed on wireline.
- » Slimline design: Large ID maximizes the bypass flow area between the sleeve and drillpipe OD. This aids deployment, and the subsequent flow of cuttings, and lowers the equivalent circulating density.
- » Positive location: Lock mechanism helps ensure the sleeve is firmly located into the correct profile during drilling operations.
- » Versatility: Latch mechanism can be manufactured to fit any lock profile with a no-go shoulder.
- » Debris tolerant: No "dead spaces" where debris can become lodged and prevent proper operation.





## Operation

The TTRD protection sleeve is made up to a dedicated running tool via a shear ring.

As the TTRD sleeve approaches the target sealbore, it locates against the no-go shoulder of the nipple. Application of set-down weight shears the shear ring located within the lock, allowing the collet support to move down and support the collet fingers.

When the fingers are fully supported, the sleeve is mechanically locked in place. An overpull can be taken at this point to verify the TTRD sleeve is located properly. Further set-down load shears a second shear ring, allowing the drillstring to continue downhole. To retrieve the sleeve, the running tool simply locates against the bottom of the sleeve during drillstring retrieval. A predetermined overpull shears the release shear ring, unsetting the mechanical lock and allowing retrieval of the sleeve with the drillstring.

Applying additional overpull will shear the backup release mechanism should the primary mechanism fail.

#### Specifications

The TTRD sleeve can be custom designed to fit any lock profile and no-go shoulder. Therefore, the specifications are dependent on the specific requirements, including nipple profile or safety valve dimensions, etc. Contact your Halliburton representative for further details.

Existing Sizes (To Fit Safety Valve Sealbores)	Overall Length
4.562	
4.625	
5.875	To guit application but at least 155 in (2027 mm)
5.937	lo suit application but at least 155-in. (5557 inin)
6.000	
8.405	

#### **TTRD Protection Sleeves**



# Storm Choke<sup>®</sup> Safety Valves

Storm Choke<sup>®</sup> safety valves are subsurface-controlled valves that are actuated by changing well conditions. They are available in velocity-type and tubing pressure-type (ambient) models.

## **Velocity-Type Safety Valves**

## Storm Choke J Safety Valves

Storm Choke J safety valves are velocity-type, wirelineretrievable valves that are normally opened, directcontrolled valves. These valves operate on a springloaded, flow bean, pressure-differential principle and are designed for high-volume wells. A through-conduit design lessens turbulence and the possibility of sanding-up after closing. A detent mechanism provides a positive snap action closure at the predetermined disaster rate of the valve. A metal-to-metal (MTM) ball and seat assembly is used for the primary closure mechanism seal.

When the valve is operating, a spring holds it off its seat until the well flow reaches a predetermined rate. When the pressure differential across the bean exceeds the spring force, as a result of a rupture in a flowline or the surface equipment, the valve is designed to close and shut the well. To reopen, the valve pressure must be fully equalized either by applying pressure in the tubing from the surface or by running a prong to allow equalization from below. When pressure is equalized, the spring will open the valve automatically.

## Applications

- » High-rate wells
- » Ideal for deep-set applications
- » Wells with no provisions for surface-controlled valves

#### Features

- » Detent mechanism
- » MTM ball and seat assembly
- » Through-conduit design

#### **Benefits**

- » Positive snap-action closure
- » Through-conduit design lessens turbulence and sand-fouling problems
- » Run and set by standard wireline methods
- » Adaptable to any Halliburton lock mandrel
- » Can be located in any Halliburton landing nipple
- » Can also be located on large bore intervention packers

Note: Direct-controlled subsurface safety valves close only under predetermined conditions. In many cases, surface-controlled safety valves are preferable.



Storm Choke® J Safety Valve



Non Si	ninal ize	Compatible Lock Mandrel	C	D	l Withou	D ıt Bean	Top Thread (Box)
in.	mm		in.	mm	in.	mm	(2011)
1 1 / 4	21.75	1.250 S	1.190	30.23	0.380	9.65	3/4-16 UNF
1 1/4	51.75	1.250 X®	1.190	30.23	0.380	9.65	7/8-20 UNF
1 1/2	29.10	1.500 S	1.410	35.81	0.680	17.27	7/8-14 UNF
1 1/2	30.10	1.500 X	1.410	35.81	0.680	17.27	1 1/8-16 UN
		1.710 R®	1.690	42.93	0.680	17.27	1 1/8-16 UN
2	50.80	1.875 X	1.750	44.45	0.750	19.05	1 3/16-14 UNS
		1.875 S	1.750	44.45	0.750	19.05	1 3/16-14 UNS
		2.125 R	1.910	48.51	0.810	20.57	1 3/8-14 UNS
2 1/2	63 50	2.180 R	2.000	50.80	0.750	19.05	1 3/4-12 UN
2 1/2	05.50	2.313 X	2.120	53.85	1.000	25.40	1 3/4-12 UN
		2.313 S	2.120	53.85	1.000	25.40	1 3/16-12 UNS
		2.562 R	2.280	57.91	1.190	30.23	2-12 SLB
3 1/2	88 90	2.562 R	2.310	58.67	1.000	25.40	2-12 SLB
5 1/2	00.00	2.750 X	2.730	69.34	1.500	38.10	2 1/4-12 SLB
		2.750 S	2.730	69.34	1.500	38.10	2-12 UN
4	101.60	3.313 X	3.120	79.25	1.500	38.10	2 3/4-12 SLB
		3.688 R	3.440	87.38	2.000	50.80	3 1/16-12 SLB
4 1/2	114.30	3.813 X	3.720	94.49	2.000	50.80	3 1/16-12 SLB
		3.813 S	3.720	94.49	2.000	50.80	2 7/8-12 UN
5	127.00	4.125 R	3.880	98.55	2.000	50.80	3 1/4-12 SLB
5 1/2	139.70	4.562 X	4.420	112.27	2.500	63.50	4-12 SLB
0.172	100.70	5.250 R	4.950	125.73	2.750	69.85	4 1/2-8 SLB
7	177.80	5.875 R	5.730	145.54	3.500	88.90	5 1/16-8 SLB

## Velocity-Type Safety Valves (Ball-Type Closure)

Ordering Information

Specify: nipple bore and lock profile, service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines), pressure and temperature requirements, closing rate or bean size, necessity of API monogramming or other certification requirements. Part Number Prefixes: 22JO, JOR, JOS, JOX: ball-closure



# **Tubing-Pressure (Ambient) Safety Valves**

## Storm Choke® H Safety Valves

Storm Choke<sup>®</sup> H safety valves are ambient-type, wirelineretrievable valves that are normally closed and precharged with a set dome pressure. When the well flowing pressure drops below the predetermined dome-pressure charge, as a result of a rupture in the flowline or surface equipment, the dome pressure and valve spring are designed to close the valve, shutting in the well.

The H valve is used in wells producing large volumes of abrasive fluids. Its large bore is not restricted by a flow bean. The valve is designed to resist pressure surges. A metal-to-metal (MTM) ball and seat is used as the primary closure mechanism.

The H valve is ideal for protecting wells with declining bottomhole pressure because this valve is tubingpressure sensitive instead of velocity sensitive. To reopen, the valve pressure must be fully equalized either by applying pressure in the tubing from the surface or by running a prong to allow equalization from below. The valve will reopen when the tubing pressure acting on the internal piston area overcomes the dome charge.

## Applications

- » Wells producing large volumes of abrasive fluids
- » Wells with declining bottomhole pressure
- » Wells with no provisions for surface-controlled valves

## Features

- » Large bore not restricted by a flow bean
- » MTM ball and seat
- » Designed to resist pressure surges

## Benefits

- » Valve closes as flowing conditions change
- » Ball closure cleans itself of debris
- » Can be used in severe environment wells
- » Installed and retrieved under pressure using wireline methods
- » Adaptable to any Halliburton lock mandrel
- » Can be located in any Halliburton landing nipple
- » Straight-through flow path
- » Can also be located on large bore intervention packers



Storm Choke® H Safety Valve



Nominal Size		Compatible Lock Mandrel	С	D	I	D	Top Thread (Box)
in.	mm		in.	mm	in.	mm	
2	50 90	1.875 S	1.750	44.45	0.750	19.05	1 3/16-14 UNS
2	50.00	1.875 X <sup>®</sup>	1.750	44.45	0.750	19.05	1 3/8-14 UNS
2 1/2	62 50	2.313 S	2.120	53.85	1.000	25.40	1 3/16-12 UN
2 1/2	03.50	2.313 X	2.140	54.36	1.000	25.40	1 3/4-12 UN
3 1/2	88.90	2.750 S	2.730	69.34	1.500	38.10	2-12 UN
4 1/2	114 30	3.813 S	3.720	94.49	2.000	50.80	2 7/8-12 UN
4 1/2	114.30	3.813 X	3.720	94.49	2.000	50.80	3 1/16-12SLB

## Ambient Safety Valves (Ball-Type Closure)

**Ordering Information** 

Specify: nipple bore and lock profile, service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines), pressure and temperature requirements, flowing pressure at closing rate, necessity of API monogramming or other certification requirements. Part Number Prefixes: 22HO, HOS, HOX: ball-closure



## Storm Choke® K Safety Valves

Storm Choke<sup>®</sup> K safety valves are ambient-type, wirelineretrievable valves with the largest flow area of all directcontrolled safety valves on the market. They are ideally suited for high-volume, low-pressure wells. These valves are normally closed and pre-charged with a set dome pressure.

When the well flowing pressure drops below the predetermined dome-pressure charge because of a rupture in flowline or surface equipment, the dome pressure and main valve spring close the valve, shutting in the well below the earth's surface. This valve contains a detent mechanism to provide a positive snap-action closure at the predetermined disaster rate of the valve. Its bore is not restricted by a flow bean. The valve is designed to resist pressure surges. A metal-to-metal poppet valve and seat comprise the valve's primary closure mechanism.

The K valve is ideal for protecting wells with declining bottomhole pressure. This valve closes in situations where a pressure decline would not activate a valve with a flow bean. To reopen the valve, the operator must fully equalize pressure either by applying pressure in the tubing from the surface or by an equalizing prong. The valve will reopen when the tubing pressure acting on the internal piston area overcomes the dome charge.

#### Applications

- » Wells with declining bottomhole pressure
- » High-volume, low-pressure wells
- » Wells with no provisions for surface-controlled valves

#### Features

- » Poppet closure
- » Large ports with capacity for high-volume wells
- » Designed to resist pressure surges

#### **Benefits**

- » Installed and retrieved under pressure using wireline methods
- » Adaptable to any Halliburton lock mandrel
- » Can be located in any Halliburton landing nipple
- » Can also be located on large bore intervention packers





Nor S	ninal ize	Compatible Lock Mandrel	c	D	I	ID	Top Thread (Box)	
in.	mm		in.	mm	in.	mm		
1 1/2	38.10	1.500 X <sup>®</sup>	1.463	37.16	0.78	19.81	1 1/8-16 UN	
2	50.80	1.875 S	1.750	44.45	0.650	16.51	1 3/16-14 UNS	
2	50.80	1.875 X	1.750	44.45	0.970	24.64	1 3/8 -14 UN	
2 1/2	63 50	2.313 S	2.170	55.12	1.250	31.75	1 3/16-12 UN	
2 1/2	05.50	2.313 X	2.160	54.86	1.380	32.51	1 3/4-12 UN	
3 1/2	88.90	2.750 X	2.500	63.50	1.620	41.15	2 1/4-12 SLB	
4	101.60	3.313 X	3.120	79.25	2.120	53.85	2 3/4-12 SLB	
4 1/2	114.30	3.813 X	3.500	88.90	2.250 to 2.41	57.15 to 61.21	3 1/16-12 SLB	
5	127.00	4.125 X	3.880	98.55	2.41	61.21	3 1/4-12.5 SLB	
5 1/2	139.70	4.562 X	4.440	112.78	2.880	73.15	4-12 SLB	
7	177.8	5.750 X	5.400	137.16	3.50	88.90	4 15/16-8 SLB	

## Ambient Safety Valves (Poppet-Type Closure)

**Ordering Information** 

Specify: nipple bore and lock profile, service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines), pressure and temperature requirements, flowing pressure at closing rate, necessity of API monogramming or other certification requirements. Part Number Prefixes: 22KX, KS: poppet-closure



# **Injection Safety Valves**

## WI Retrievable Injection Valve

The WI retrievable injection value is a high-performance, high-flow rate injection value.

High throughput is achieved by a unique valve configuration that minimizes turbulent and potentially erosive flow. Operation is not dependent on a specific flow rate, pressure, or setting depth, thus negating the need for adjustment over time.

The valve incorporates a metal-to-metal valve and seat energized by the combination of an integral spring and well pressure acting from below.

The WI injection valve can be deployed on a wireline lock or through-tubing pack-off device, providing flexibility not available with alternative injection valve systems.

As a result of the simple design with fewer parts, redress and repair costs are considerably lower than those for other injection valve systems.

## Applications

The WI injection valve is primarily used in water injection applications as an alternative to conventional tubing or wireline-set safety valves. The valve is also commonly used as a retrofit solution in water injectors in which a tubing to annulus leak has occurred. The valve can be deployed below the leak point to eliminate uncontrolled annulus pressure increases when the injection stops.

## Features

- » Compatible with all known lock systems
- » Dedicated designs to suit Halliburton EB0 intervention packers
- » Enhanced internal flow profile
- » Simple design and construction
- » Flow-loop testing performed to establish pressure drop versus pump rate

#### **Ordering Information**

Material Options: Alloy 718, alloy 925, alloy 925/25CR Specify: Intervention packer size or nipple bore and lock profile, service (standard, %H<sub>2</sub>O, %CO<sub>2</sub>, amines), pressure rating and temperature, flow rate. Part Number Prefix: P.610WI



VVI Retrievable Injection Valve



## Benefits

- » The WI injection valve is a standalone device that can be configured to run with any retrievable packer or any wireline lock system.
- » Minimal possibility of turbulent flow damage to tubing or casing. Injected fluid exits through a tapered end cap to further reduce turbulence entering the tubing.
- » Operation is not dependent on injection pressure or flow rate, and there is no requirement for adjustment to the WI injection valve for setting depth.
- » Low maintenance costs resulting from a simple design.

Maxi O	mum D	Pres Rat	sure ting	Temperature			
in.	mm	Below psi	Below bar	°F	ଂମ		
1.75	44.45	5,000	344.5	324	162		
2.62	66.54	5,000	344.5	324	162		
2.72	69.08	5,000	344.5	324	162		
3.25	82.55	5,000	344.5	324	162		
3.39	86.10	5,000	344.5	324	162		
3.50	88.90	5,000	344.5	324	162		
3.63	92.20	5,000	344.5	324	162		
3.66	92.96	10,000	689.0	324	162		
3.68	93.55	10,000	689.0	324	162		
3.78	96.01	6,000	413.4	324	162		
3.97	100.84	5,000	344.5	324	162		
4.25	107.95	5,000	344.5	324	162		
4.26	108.20	5,000	344.5	324	162		
4.31	109.52	5,000	344.5	400	204		
4.36	110.76	7,500	517.0	400	204		
4.36	110.76	5,000	344.5	324	162		
4.48	113.79	5,000	344.5	324	162		
4.51	114.55	5,000	344.5	324	162		
4.89	124.20	5,000	344.5	324	162		
5.40	137.16	5,000	344.5	324	162		
5.60	142.24	10,000	689.0	400	204		
5.71	145.03	10,000	689.0	400	204		

## WI Retrievable Injection Valves



## **MC Injection Valves**

MC (flapper-type) injection valves are used in injection wells to automatically shut-in the tubing string when injection stops or flow reverses. MC injection valves are spring-loaded, wireline-retrievable valves with large bores. The MC injection valves also feature sealing areas that are out of the direct flow path.

These valves are designed to be held open by injection pressure for fluid passage. If injection flow becomes static or reverses for any reason, the spring and/or reverse flow causes the valves to close. These valves are designed to remain closed until pressure differential across the valves is equalized and injection is resumed.

## Applications

» Injection wells

#### Features

» MC valves have sealing areas that are out of the direct flow path

## **Benefits**

- » Designed to automatically shut-in tubing string if injection is stopped or if flow reverses
- » Installed and retrieved by wireline under pressure
- » Designed to be set on various Halliburton lock mandrels
- » Can also be located on large bore intervention packers



Nominal Size		Compatible Lock	C	DD	ll Withou	) It Bean	Top Thread (Box)	
in.	mm	Wandrei	in.	mm	in.	mm		
1 1/2	38.10	1.500 X®	1.420	36.07	0.750	19.05	1 1/8-16 UN	
2	50.80	1.875 X	1.760	44.70	0.810	20.57	1 3/8-14 UN	
2 1/2	63.50	2.313 X	2.180	55.37	1.000	25.40	1 3/4-12 UN	
3 1/2	88.90	2.562 R <sup>®</sup>	2.310	58.67	1.000	25.40	2-12 SLB	
51/2	88.90	2.750 X	2.620	66.55	1.380	35.05	2 1/4-12 SLB	
4	101.60	3.313 X	3.270	83.06	1.830	46.48	2 3/4-12 SLB	
4 1/2	114.30	3.688 R	3.430	87.12	1.380	35.05	3 1/16-12 SLB	
+ 1/Z	114.30	3.813 X	3.710	94.23	2.000	50.80	3 1/16-12 SLB	
5	127.00	4.125 X	3.880	98.55	2.000	50.80	3 1/4-12 SLB	
5 1/2	139.70	4.562 X	4.420	112.27	2.620	66.55	4-12 SLB	
7	177.80	5.962 R	5.900	149.86	3.500	88.90	5 1/16-8 SLB	

## MC Injection Valves (Flapper-Type Closure)

#### **Ordering Information**

**Specify:** nipple bore and lock profile, service (standard, %H<sub>2</sub>O, %CO<sub>2</sub>, amines), pressure rating and temperature, flow rate.

Part Number Prefixes: 22MCR, MCX: flapper-type



# **Annular Safety Systems**

## **AV Annulus Safety Valve**

The AV annulus safety valve is a fully retrievable highperformance annulus safety system packer with integral annulus safety valve. The system provides annular bypass through a hydraulically operated poppet valve. The AV system is run in a single trip in conjunction with a setting sub that can be shifted for hydraulic tubing-set or can be alternatively control-line set from surface.

#### Applications

The AV system is used for controlling annulus fluids in gas lift applications, monitoring of annulus pressures in critical situations, and in one- or two-trip annulus safety system completions. The completion can be run to depth and set with the surface tubing hanger flanged up.

It can also be used in completions in which spacing out against a subsurface tubing hanger is required (i.e., no elastomeric expansion joint necessary).

The tailpipe can be left in either tension or compression.

The system can be used where high tensile loads and pressure differentials exist with the completion anchored in unsupported or poor condition casing.

## Features

- » Interlock system prevents preset
- » Tubing test facility while running
- » Hydraulically set in one trip on tubing with no mandrel movement
- » Annulus-mounted release mechanism
- » Internal/external components rotationally locked together
- » Element anti-extrusion system
- » One-trip system allows multiple control-line bypass
- » Premium thread connections no elastomeric seals tubing to annulus
- » Primary release method is applied tubing pressure using dedicated punch release tool on slickline
- » Secondary release method available with simple tubing cut





## Benefits

- » Tubing test facility also allows setting and testing of hydraulic production packer before annulus safety valve (ASV) setting.
- » AV valve provides ability to act as redundant wellhead.
- » Multiple control-line bypass allows for safety valve control, chemical injection, and the addition of downhole gauge below the valve.
- » Multi-cone slip provides large casing contact, which minimizes slip to casing stress levels.
- » Single elastomeric seal between the lower and upper annulus minimizes potential leak paths. All other elastomeric seals are redundant after setting procedure.
- » Annulus release mechanism removes potential leak path tubing to annulus and cannot be accidentally released during wireline runs.
- » ASV is run and retrieved with production tubing.
- » Primary punch release method permits retrieval of ASV with tubing no tubing cut required.

	Casi	ng		Th	read	ad Maximum			mum	Pressure		
Size Weight		ight	S	ize	OD ID Rati				iting			
in.	mm	lb/ft	kg/m	in.	mm	in.	mm	in.	mm	Below psi	Below bar	
		43.5	64.74			8.475	215.27					
9 5/8	244.48	47	69.94	5 1/2	139.7	8.400	213.34	4.680	118.87	5,000	344.5	
		53.5	79.61			8.255	210.82					
		55.5	82.60	5 1/2	139.7	9.480	240.79	4.680	118.87			
10 3/4	273.05	60.7	90.34	7	177.8	9.405	238.89	5.963	151.46	5,000	344.5	
		65.7	97.77	5 1/2	139.7	9.250	234.95	4.680	118.87			

## AV Annulus Safety Valve

**Ordering Information** 

Specify: Casing size and weight; tubing size; weight; grade; and thread; service environment (standard, %H<sub>2</sub>O, %CO<sub>2</sub>, amines/ other chemicals, chloride content, pressures, temperatures, etc.); maximum differential pressure requirement. Part Number Prefix: P.510AV



## Surface-Controlled Annular Vent and Sleeve Valves

An annular vent sleeve valve communicates between the casing annulus and producing formation. The valve is a hydraulically operated sliding sleeve device like a surfacecontrolled subsurface safety valve with a hydraulic piston and a power spring to maintain the valve in a normally closed position. The valve is used with a bull plug on top or as an annular safety valve by providing annular bypass while control pressure is applied. With an electrical feedthrough device, this valve functions through a single packer mandrel as an electric power cable passage and annular bypass.

On a dual hydraulic packer, the valve operates by a common hydraulic control line that sets the packer and operates the tubing-retrievable safety valve. Hydraulic pressure from the control line shifts the valve open to create a flow path across the packer in the annulus. Spring force closes the valve upon loss of control-line pressure to the piston. If the valve becomes inoperable or closed, an emergency shear feature allows fluid to be pumped into the producing formation from the annulus.

#### Applications

» Gas lift and electric submersible pump situations

## Features

- » Accurate fluid level shot during pumping because of large ported area through the vent sleeve
- » Maximum gas vent flow area allows increased gas flow rates and lower circulating pressures
- » Valve will shut off flow from either direction — production or injection

#### Benefits

- » Vent gas and electric pump cable use the same packer bore
- » In emergency situations, the valve can be pumped through without control-line pressure for circulation or kill operations
- » Can be operated with common control line used to operate subsurface safety valves







## **Annular Vent Valve**

The Halliburton gas vent valve is designed to be threaded onto a retrievable, hydraulic-set production packer. The vent valve is non-equalizing, hydraulically operated, and allows for gas bypass around the packer. The valve is opened by applying hydraulic control pressure and closes when the pressure is released. This particular vent valve allows pressure testing of the packer without affecting the functionality of the valve. Also, pressure from below the valve is not able to open the valve.

The gas vent valve is opened by hydraulic control-line pressure. The power spring acts against the piston to move the valve to the closed position when control-line pressure is released. The valve is designed with a metalto-metal seal to contain pressure.



Electric Submersible Pump Application with Annular Vent Valve



Non Si	Iominal Connection		Contro Conno	ol Line ection	Ecce	entric )D	ntric Concentric O OD		ID		Flow Area		Working Pressure		Maximum Setting Depth*		
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.²	cm²	psi	bar	ft	m
2	50.80	1.900 EU	48.26 EU	1/8 NPT	1/8 3.18	3.110	78.99	2.510	63.75	1.250	31.75	1.130	7.30	5,000	344.50	600	182.9
2	50.00	2 3/8 EU	60.33 EU		NPT	3.690	93.73	3.090	78.49	1.830	46.48	1.510	9.70	3,000	206.70	500	152.4
2 1/2	63.50	2 7/8 EU	73.03 EU	1/8 NPT	3.18 NPT	4.140	105.20	3.700	93.98	2.200	55.90	3.440	22.20	3,000	206.70	1,000	304.8

## Surface-Controlled Annular Vent and Sleeve Valves

\*Recommended measurements Ordering Information Specify: casing size and weight; tubing size, weight, grade, and thread; service (standard, %H<sub>2</sub>S, %CO<sub>2</sub>, amines); setting depth of valve; cable size for electric submersible pump temperature and pressure requirements. Part Number Prefix: 778AVS: vent sleeve

## Annular Vent Valve

Size		Connection	Maxi O	mum D	Flo Ar	ow rea	Pressure Rating		
in.	mm		in.	mm	in.²	mm²	psi	bar	
1 1/2	38.1	1 Nom NPT Pin	1.515	38.48	0.7854	506.71	5,000	344.50	



# **CV0 Retrievable Straddle with Integral Safety Valve**

The CV0 straddle is an isolation device designed to be installed across an existing tubing-retrievable subsurface safety valve (TRSSSV) or subsurface safety valve (SSSV) nipple profile that has lost integrity.

Run and retrieved in a single trip, the CV0 straddle incorporates dual packing elements that seal the flow couplings or pup joints on either side of the TRSSSV or SSSV nipple. A slip mechanism anchors the tool to the wellbore and is contained between the packing elements, protected from produced fines and well debris.

Once in position, the straddle's integral safety valve is operated conventionally by pressurizing the existing completion hydraulic control line. A selection of Halliburton insert valves is available to suit a variety of applications.

## Applications

- » Specifically designed for applications where an existing TRSSSV has lost integrity or the SSSV nipple sealbore has been damaged and can no longer provide a pressure seal
- » Provides a fully functional safety valve that helps prevent the need for a costly workover

#### Features

- » Uses existing completion control line
- » Adaptable to most completion designs
- » One-trip run and retrieve

- » One-piece dual-modulus packing element
- » High running and retrieval speeds
- » Large footprint segmented slips
- » Slip mechanism isolated from wellbore
- » Slips mechanically retained on retrieval
- » Controlled setting action
- » Field redressable

## Benefits

- Cost-effective solution in situations where the primary safety valve has lost integrity
- » Helps prevent the need for a costly workover
- Packing element design enhances ability to return to original shape upon release, thus reducing the risk of hanging up
- » Slip mechanism isolated from the wellbore and protected from well debris, thus improving reliability
- » Mechanically retained slips reduce risks of premature setting while running in hole and hanging up on retrieval
- Controlled setting action and slip design helps ensure stresses exerted on the tubing are evenly distributed, preventing damage
- Can be run and retrieved on slickline, electric line, coiled tubing, or workstring





	Casing/Tubing											
Size Weight		Maxim	um OD			Ab	ove	Ве	Length			
in.	mm	lb/ft	kg/m	in.	mm	in.	mm	psi	bar	psi	bar	ft
3 1/2	88.90	9.2	13.69	2.730	69.34	1.125	28.575	5,000	344.50	5,000	344.74	Various
1 1/2 11/	114 30	12.6	18.80	3.780	96.01	1.845	46.86	5,000	344.50	5,000	344.74	Various
4 1/2	114.00	15.1	22.47	3.650	92.71							
5 1/2	139 70	17	25.26	4 650	110 11	2 500	63 50	5 000	344 50	5,000	344.74	Various
5 1/2	100.70	20.0	29.89	4.000	110.11	2.000	00.00	3,000	544.50			Various
7	17780	29	43.15	5.965	151.51	3 22	81 79	5,000	344.50	5,000	344.74	Various
/	177.00	32.0	47.60	6.020	152.91	5.22	01.75					

## CV0 Retrievable Straddle with Integral Safety Valve

Part Number Prefix: P.815CV0





**Completion Tools**