

Safety Systems

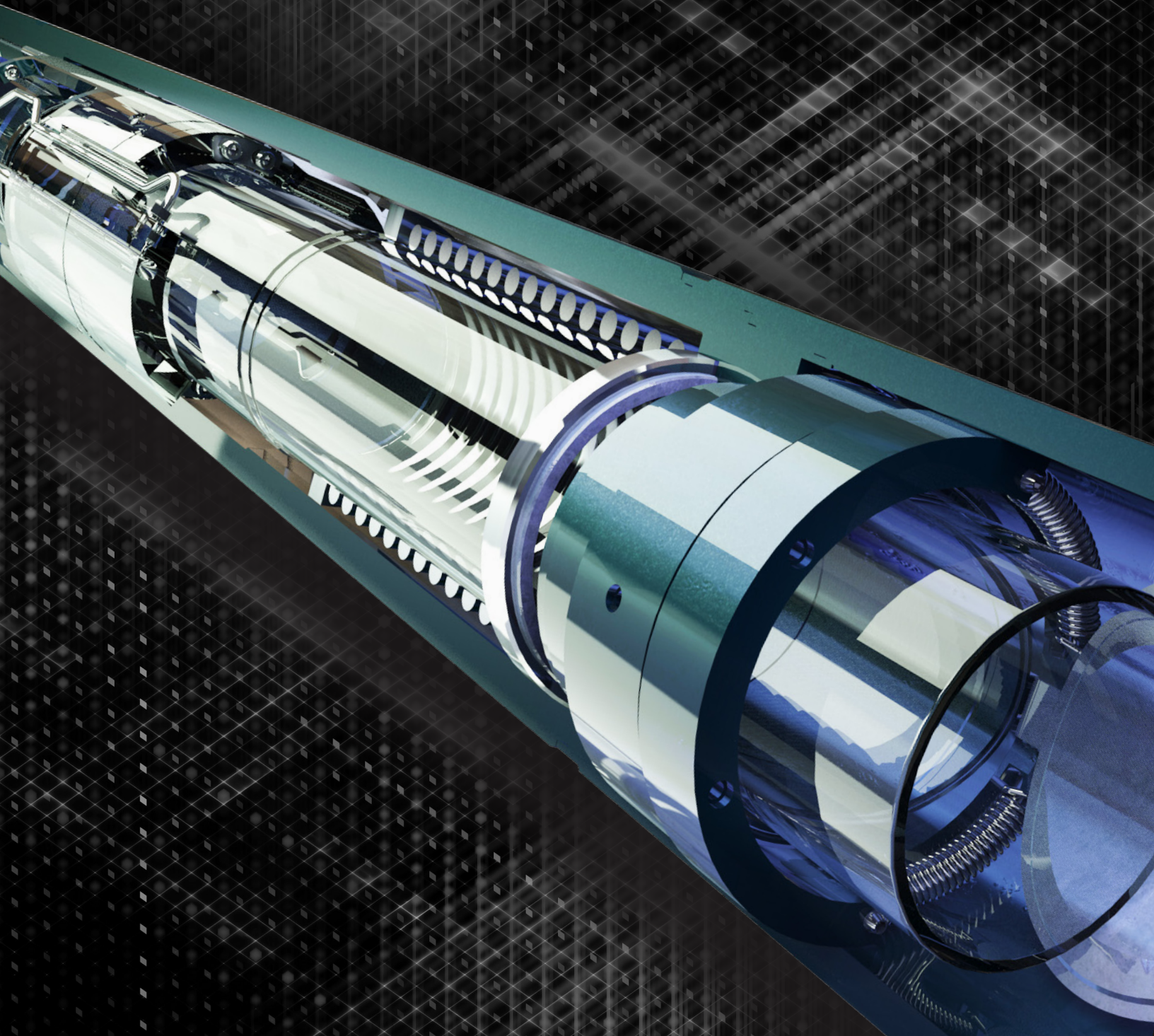


TABLE OF CONTENTS

Alphabetical Product Index

Accessories for Subsurface Safety Valves	19	REALM Series Subsurface Safety Valve	16
Annular Safety Valves	29	Safety Systems	3
Baker Hughes Jam Nut System	8	Safety Valve Fail Safe Setting Depth Input Sheet	36
CEMENTSAFE Series Subsurface Safety Valve	12	SelectT Subsurface Safety Valve	11
Control Line	35	Separation Sleeve	21
DeepShield Series Nitrogen-Charged Subsurface Safety Valve	18	Subsurface Accessories at a Glance	22
Design Basis Well Environment Data for Material Recommendations	37	Subsurface Safety Valves	10
ESP Vent Safety Valve	33	Thunder Series Subsurface Safety Valve	14
Flapper Lock Open Tool	20	Unique Flapper Design	6
Flow Tube Exercising Tool	20	V-Series Wireline Retrievable Safety Valve	26
Model A Wireline Retrievable Velocity Valve	24	Wear Sleeve	21
Model Annulus Pressure Compensation (APC) Valve	34	Wireline Damage-Resistant Flapper	7
Model AVLDM Annulus Safety Valves	31	Wireline Retrievable Subsurface Safety Valves	23
Model CASV Annulus Safety Valves	30	W-Series Wireline Retrievable Safety Valve	27
Model J Wireline Retrievable Injection Valve	25		
Model V and W Series Specification Guide	28		
Models VR and AGV Vent Valves	32		
Onyx Series Subsurface Safety Valves	13		
Puncture Communication Tool	19		
RBT Thread	9		
Reach Tubing Retrievable Safety Valve	17		

TABLE OF CONTENTS

Product Number Index

PRODUCT FAMILY NO.	DESCRIPTION	PAGE	PRODUCT FAMILY NO.	DESCRIPTION	PAGE
H73441	Model CASV Annulus Safety Valves	30	H82707, H82708, H82709, H82710, H82733 and H82734	Thunder Series Subsurface Safety Valve	14
H73460	Model Annulus Pressure Compensation (APC) Valve	34	H82735, H82736, H82742 and H82743	DeepShield Series Nitrogen-Charged Subsurface Safety Valve	18
H73491 and H73494	Model AVLDM Annulus Safety Valves	31	H82741	ESP Vent Safety Valve	33
H80849	Model A Wireline Retrievable Velocity Valve	24	H82741	Models VR and AGV Vent Valves	32
H80889	Model J Wireline Retrievable Injection Valve	25	H82751	V-Series Wireline Retrievable Safety Valve	26
H82004	Separation Sleeve	21	H82752	W-Series Wireline Retrievable Safety Valve	27
H82086	Wear Sleeve	21	H90501	Control Line	35
H82280	Flapper Lock Open Tool	20			
H82281	Puncture Communication Tool	19			
H82443, H82444 and H82448	CEMENTS SAFE Series Subsurface Safety Valve	12			
H82582 and H82583	SelecT Subsurface Safety Valve	11			
H82584, H82634 and H82700	REALM Series Subsurface Safety Valve	16			
H82624, H82625, H82626, H82627, H82630 and H82631	Onyx Series Subsurface Safety Valves	13			
H82645	Flow Tube Exercising Tool	20			
H82650, H82651 and H82659	Reach Tubing Retrievable Safety Valve	17			

INTRO TO HANDBOOK

Baker Hughes is a leader in well completion and intervention solutions that help exploration and production companies maximize the value of their oil and gas assets by optimizing recovery while reducing capital and operating expense. Baker Hughes was founded over 100 years ago on a simple, fundamental commitment to help our customers solve their oilfield problems by bringing them the highest quality and best performing products and services. Honoring that commitment and providing flawless execution at the well site continues to distinguish us from our competitors a century later. We believe that integrity is at the heart of our organization and that teamwork leverages individual strengths and contributes to our performance culture. We also believe that learning is never finished and that we can continue to grow and improve—as individuals and as a company—through learning. These are the principles that help guide us in our actions and decisions every day. Delivering unmatched value to our customers by meeting—and sometimes exceeding—their needs and expectations is our ultimate goal. Baker Hughes is a Fortune 500 energy technology company and one of the most respected names in the oil and gas service industry. Baker Hughes companies provide best-in-class technology and services in over 120 different countries to help take energy forward.

Safety Systems

OUR FACILITY

Baker Hughes safety systems manufactures industry-leading subsurface safety system equipment in Broken Arrow, Oklahoma and Singapore. The Broken Arrow facility, which opened in 1978, fills over 188,000 sq ft of space on a 28 acre site and includes a workforce of approximately 400 people. This site encompasses engineering, manufacturing, and marketing functions, all of which work in close cooperation through concurrent engineering processes and the Baker Hughes product development and management (PDM) initiatives.

As a division of Baker Hughes, safety systems has the strength to meet challenges head on. By focusing on the safety systems product lines, the Broken Arrow team can react with a personal responsiveness that provides our customers with the highest quality and unmatched service. Our technical support, quality assurance, manufacturing, engineering, and testing standards rank consistently as the industry's most stringent.

The machine shop contains over 100 major machines, most of which are computer controlled, and many have state-of-the-art conversational controls for fast, accurate, and repeatable output. Machinists have an average tenure exceeding 10 years. With a machining capacity exceeding 300,000 hours per year, we have the manufacturing capability to deliver on time, every time.

The Baker Hughes Singapore facility was opened in 1979, covering over 33,000 sq ft on a 4 acre site with the purpose of servicing Eastern Hemisphere operations. The facility houses the engineering, manufacturing and marketing personnel needed to support that region.

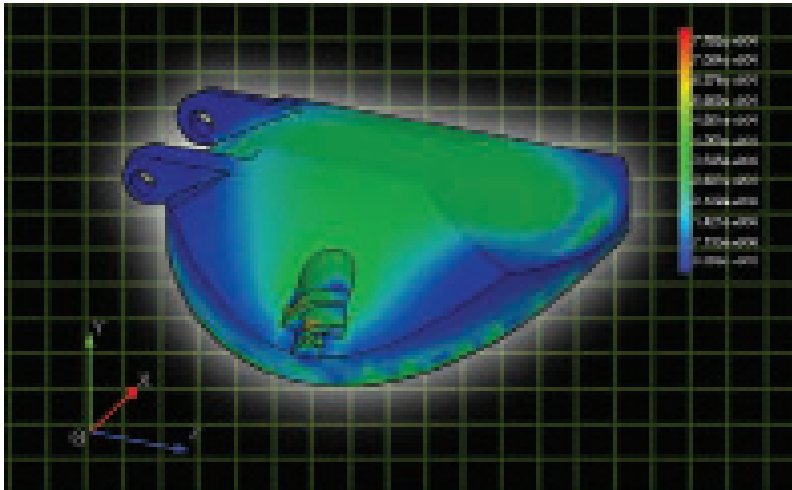
Similar to the Broken Arrow plant, this 24,000 sq ft manufacturing plant also uses some of the most modern machining equipment available and the machinist, averaging 12 years of experience, are able to produce approximately 75,000 hours of machine time per year.

Flawless execution is ensured by a total product quality assurance system that governs every step of every process in the design, manufacture and testing of the safety valve. This execution is enhanced by expert field technicians and technical support personnel who are available anywhere, anytime, to address and solve problems. The Baker Hughes Broken Arrow facility is a recent winner of the Oklahoma quality award of excellence which signifies our commitment to quality and continued process improvement. For us, quality is an attitude. It drives our people and shapes their approach to equipment, technology, processes and services—leading to the highest quality product for our customers.

SAFETY SYSTEMS

ENGINEERING AND TESTING

At Baker Hughes, our passion for perfection did not start yesterday and our attitude of innovation will not stop tomorrow. Operators worldwide continue to enjoy the peace of mind that comes with selecting equipment designed and tested to the industry's most rigorous requirements. Our dedicated 7,000 sq ft prototype test facility is equipped to complete most of the API 14A validation tests as well as the Norwegian TR2385 endurance flow test. Our test facility has two dedicated hot cells that can test equipment across temperature ranges from 20°F (-6.7°C) up to 600°F (316°C) and pressures as high as 30,000 psi (2,068 bar) with liquid or gas. A sophisticated data acquisition and automation system is utilized to perform a multitude of standard tests including life cycle temperature testing, liquid and slurry flow testing, equalization testing, and more. These automation systems provide enhanced consistency and accuracy which allows engineers to acquire, analyze, and present data never before visualized.



SAFETY SYSTEMS

To be the leader in innovation, Baker Hughes realizes personnel need to be equipped with the right tools. In-house finite element analysis (FEA), computational fluid dynamics (CFD) analysis, and 3D solid modeling software packages and expertise accelerate time-to-market and enhance design capabilities. These tools help identify potential problems before testing that conventional drafting, design, and stress calculations may overlook. Additional tools that engineers also enjoy include a rapid prototyping machine. This rapid physical modeling tool provides additional benefits to the design process such as:

- Decreased time-to-market helps react to urgent customer needs
- Increased visualization capability during early phases of design
- Detect design flaws before the manufacture of tooling
- Rapidly create tooling to manufacture physical prototypes

The return on these engineering investments is clear. With hundreds of subsurface safety systems patents, Baker Hughes engineers are committed to leading the way in providing innovative solutions for increasingly demanding customer applications.

As we move into the future, Baker Hughes safety systems continues to invest in our facility, quality programs, people and engineering technologies. These proactive investments ensure Baker Hughes will continue to design, manufacture, and deliver the most reliable safety systems equipment in the world.

SAFETY SYSTEMS

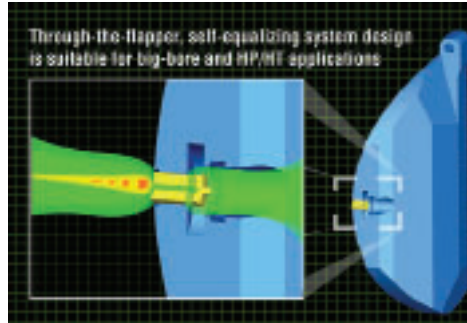
Unique Flapper Design

Application

Focusing on providing customer solutions along with using state of the art engineering practices, Baker Hughes has introduced several industry firsts relating to its unique flapper design. Baker Hughes was the first to offer a patented through the flapper self-equalizing feature which has proven to reduce operating costs for operators. The self-equalizing feature allows operators to open subsurface safety valves against differential pressure. This unique design is resilient to debris and erosion which provides ultimate long-term reliability which the customers desire. The equalizing system has been used successfully in HP/HT and Big Bore applications where equalizing high pressures and large volumes can prove challenging.

Baker Hughes also provided the industry's first wireline damage resistant flapper design. This design was created after careful review of mean-time-to-failure statistics relating to all subsurface safety valve designs. This analysis revealed that a good portion of failures could be eliminated with a wireline damage resistant flapper. The new flapper design protects the seal surface from wireline damage if an operator accidentally closes the valve during wireline operations. The protection offered by the wireline damage resistant flapper extends the safety valve life for operators.

Baker Hughes was the first company to design a 4½-in. (114-mm) safety valve to be installed inside 7-in. (178-mm) casing and a 7-in. (178-mm) safety valve to be installed inside 9⅝-in. (244-mm) casing. The key ingredient to this success was the unique curved flapper design. The curved flapper design was made possible by advanced machining processes, innovative engineering practices, and exceptional quality control.



These ultra-slimline curved flappers allow operators to reduce their overall costs and maximize their return on investment by maintaining a large bore ID while reducing the casing sizes needed for the completion.

For high flow rate natural gas applications, Baker Hughes recognized the need to design and manufacture one of the world's most rugged flapper designs. Every flapper design goes through an intricate engineering process to ensure the flapper can meet the demands of high gas velocities. The Baker Hughes flapper designs have been verified by gas slam tests to the highest rates available in the world. The flapper design and verification process provides ultimate protection for our customers.

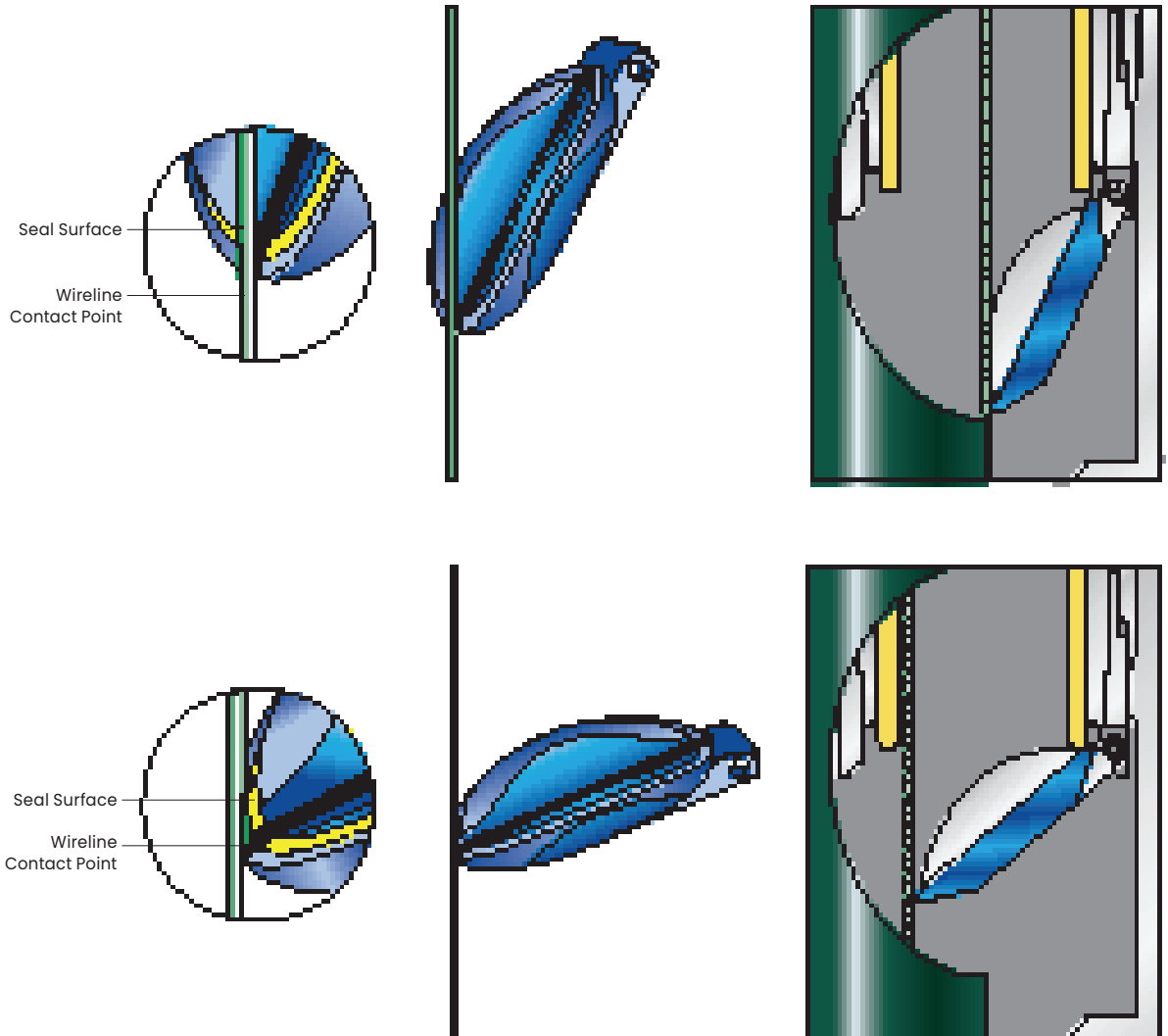


SAFETY SYSTEMS

Wireline Damage-Resistant Flapper

Application

The seal surface of the **flapper** is recessed away from its edge to protect sealing integrity if wireline operations are conducted through the safety valve when it is in the closed position. For cemented tubingless completions, this helps ensure the flapper—the most important component in a safety valve—seals reliably throughout the life of the application, even in the event of wireline intervention.

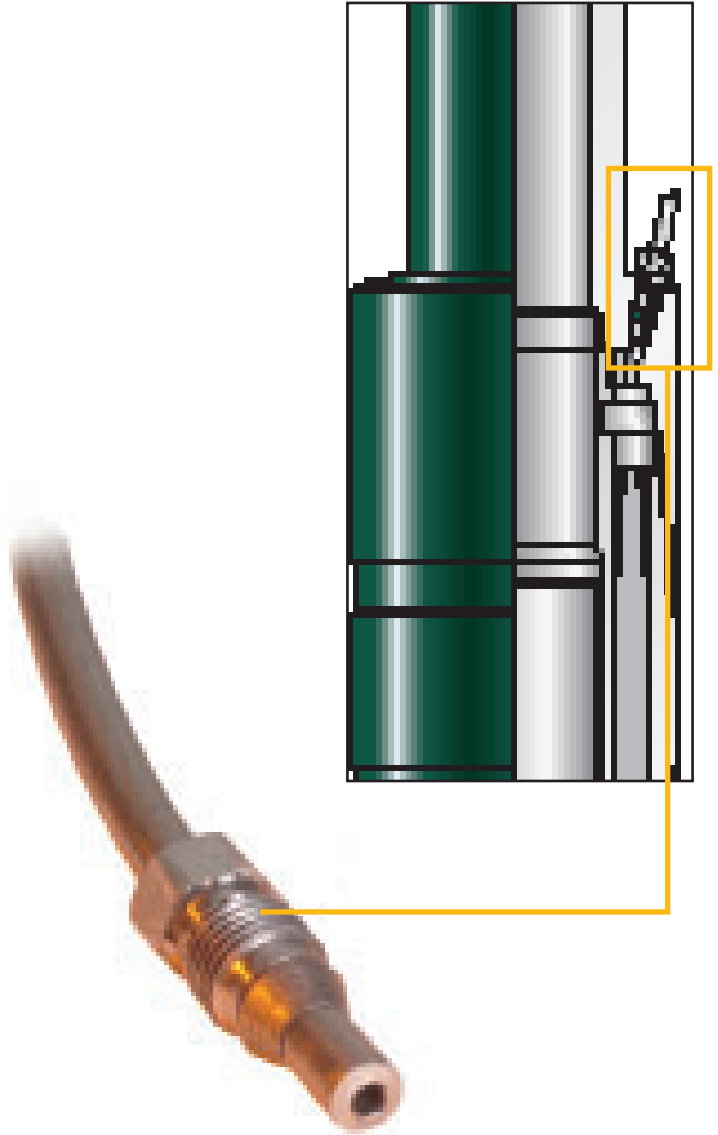


SAFETY SYSTEMS

Baker Hughes Jam Nut System

Application

Baker Hughes offers a variety of control line connections to match the application. The Baker Hughes **metal-to-metal jam nut**, which is standard for valve working pressures of 10,000 psi (689 bar) and below, provides reliable control line connections at the safety valve. This jam nut features a front and rear ferrule design that reduces the potential leak path from control line to annulus.



SAFETY SYSTEMS

RBT Thread

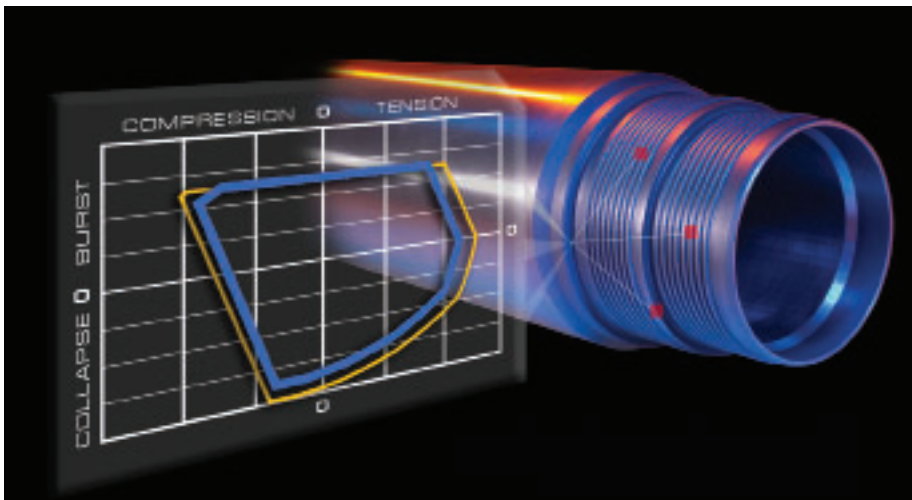
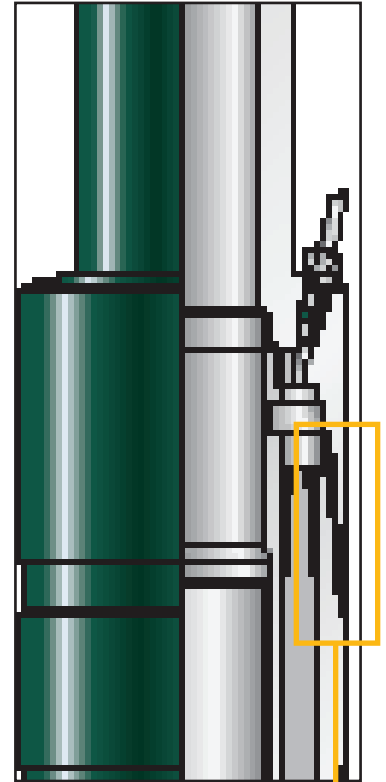
Application

Every **RBT™ thread** is validated through the Baker Hughes rigorous test program's graphically formatted load envelope, which indicates the thread's ability to withstand aggressive downhole environments and the valve's safe operating range. With this envelope, operators can safely plan their completions with confidence in the Baker Hughes safety valves.

Through extensive analysis and research, Baker Hughes RBT premium thread connections provide superior protection and life-extending metal-to-metal sealing technology. The connection's two-step design distributes thread load to provide greater strength than single-step designs, and the ultra-slim-profile thread allows for a larger inside diameter with some of the slimmest outside diameters on the market. Metal-to-metal seal points at the box and pin noses provide enhanced pressure-containing capabilities.

Advantages

- Innovative center torque shoulder design
- Superior resistance to back-off in downhole service
- Damage protection for metal-to-metal seals during high torque loads
- Precise control of make-up loss



SAFETY SYSTEMS

Subsurface Safety Valves

Product Application											
Model	Product Family No.	Applications									
		Shallow Set Valve with Limited Options	Standard Valve with Customer Options	HP/HT	Big Bore	Deepwater	Chemical Injection Capabilities	CemenThru Tubingless Completions	Max. Pressure (psi)	Max. Temp. (°F)	
Select	H82582 and H82583	■								5,000	300
CEMENTS SAFE	H82443, H82444 and H82448							■		10,000	300
Thunder	H82707, H82708, H82709, H82710, H82733 and H82734		■			■	■			10,000	350
Onyx	H82624, H82625, H82626, H82627, H82630 and H82631				■					10,000	350
REALM	H82584, H82634 and H82700			■						25,000	450
Reach	H82650, H82651 and H82659			■		■	■			15,000	400
DeepShield	H82735, H82736, H82742 and H82743					■	■			15,000	300

SAFETY SYSTEMS

SelectT Subsurface Safety Valve

Product Family Nos. H82582 and H82583

Application

The **SelectT™ tubing retrievable surface controlled subsurface safety valve** was designed to address the unique challenges that shallow set safety valves (typically <1,000 ft [305 m]) must endure. An ultra strong power spring delivers high closing forces needed to provide reliable and consistent closings in the presence of paraffin and other produced solids. One-quarter of all safety valve failures occur due to wireline damage during interventions into the wellbore. The SelectT design team developed an advanced flapper design to virtually eliminate this failure mode. This design ensures all seal surfaces are protected from wireline contact even during accidental closure of the valve during wireline operations. Combining design enhancements with the successful features of the industry leading **T-Series™**, the SelectT addresses applications for smaller tubing sizes ranging from 2³/₈ in. (60 mm) to 3¹/₂ in. (89 mm).

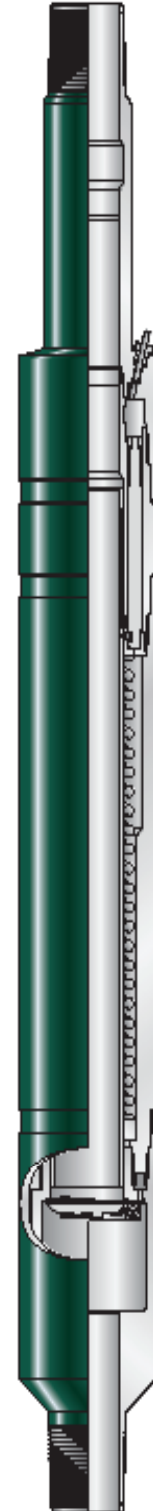
Advantages

- **Ultra strong power spring** - ensures smooth and reliable closures
- **Wireline damage resistant flapper** - design protects sealing integrity during wireline operations
- **Patented thru-the-flapper self-equalizing** - most successful and widely used system available to the market
- **Nonelastomeric dynamic seal assembly** - tested to withstand extreme pressures and temperatures exceeding 28,000 psi (1,931 bar) and 450°F (232°C)
- **Patented radial punch control fluid communication system** - eliminates accidental communication primarily associated with linear shifting sleeves
- **Metal-to-metal seal technology** - 100% metal-to-metal sealing and containment of wellbore fluids when the valve is in the closed position

Available Sizes

2.375 in., 2.875 in. and 3.500 in.

Specification Guide													
Size		Max OD		Max Seal Bore		Piston Displacement	Working Pressure		Setting Depth		Max Temp.		
in.	mm	in.	mm	in.	mm	cc	psi	bar	ft	m	°F	°C	
2 ³ / ₈	60.3	4.500	114.3	1.875	47.6	14.6							
2 ⁷ / ₈	73.0	5.000	127.0	2.312	58.7	16.7	5,000	345	2,000	610	300	149	
3 ¹ / ₂	88.9	5.700	144.8	2.810	71.3	19.5							



SelectT Subsurface Safety Valve
Product Family No. H82583

SAFETY SYSTEMS

CEMENTS SAFE Series Subsurface Safety Valve

Product Family Nos. H82443, H82444 and H82448

Application

The **CEMENTS SAFE™ series tubing retrievable surface controlled subsurface safety valve** is designed specifically for use in cement-through and frac-through applications. In addition, the CEMENTSAFE offers superior performance in applications that require the exclusion of flowing debris from the working components of the tubing retrievable safety valve (TRSV).

The CEMENTSAFE uses a piston with nonelastomeric dynamic seals to isolate the control chamber and spring cavity from cement and produced fluids. This exclusion feature not only protects the sealing surfaces of the actuation system but also excludes cement or other debris from entering the flapper cavity of the safety valve.

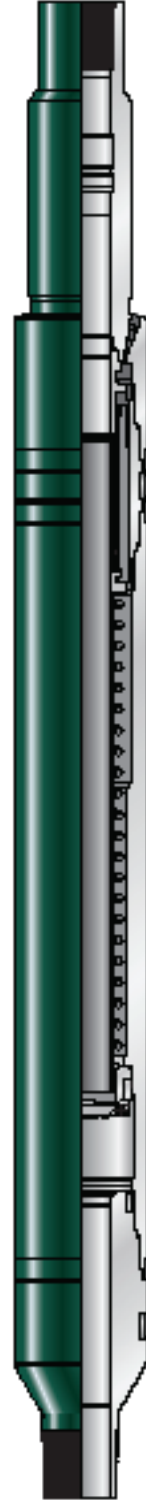
The CEMENTSAFE incorporates the successful features from the **T-Series™ product** offering such as metal-to-metal housing seals, metal-to-metal containment below the flapper, thru-the-flapper self-equalizing, and secondary puncture communication. This combination of features ensures the performance required to meet the demands of harsh environments in cement-through and frac-through applications.

Available Sizes

2.875 in., 3.500 in., 4.500 in. and 5.500 in.

Advantages

- **Complete exclusion of well bore fluids from the spring and flapper cavity** - ensures smooth and reliable operation in cement-through and frac-through applications
- **Nonelastomeric piston actuator system** - elimination of elastomers and their inherent problems
- **Unique curved flapper** - optimizes OD to ID relationships
- **Metal-to-metal seal technology** - 100% metal-to-metal sealing and containment of well bore fluids when the valve is in the closed position
- **Patented thru-the flapper equalizing system** - most successful and widely used system available to the market
- **RBT housing seals** - two step metal-to-metal sealing system provides strength and sealing under the harshest conditions
- **Patented radial punch control fluid communication system** - eliminates accidental communication primarily associated with linear shifting sleeves



CEMENTS SAFE-5(E)
Subsurface Safety Valve
Product Family No. H82448

Specification Guide											
Size		Max OD		Max Seal Bore		Working Pressure		Max Setting Depth		Max Temperature	
in.	mm	in.	mm	in.	mm	psi	bar	ft	m	°F	°C
2.875	73.0	5.000	127.0	2.312	58.7	5,000	345				
		5.135	130.4			7,500	517				
						10,000	689				
3.500	88.9	5.200	132.1	2.812	71.3	5,000	345	3,000	914	300	149
		5.650	143.5			10,000	689				
4.500	114.3	7.403	188.0	3.812	96.8	10,000	689				
5.500	139.7	8.000	203.2	4.562	115.8	8,000	552				
		7.760	197.1			10,000	689				

SAFETY SYSTEMS

Onyx Series Subsurface Safety Valves

Product Family Nos. H82624, H82625, H82626, H82627, H82630 and H82631

Application

Baker Hughes continues to lead the industry in innovative valve design. Introducing the **Onyx™ series**, the industry's first 7-in. (178-mm) tubing retrievable safety valve (TRSV) that can fit inside a 9 $\frac{5}{8}$ -in. (244-mm) casing with cable bypass capabilities. In addition, Baker Hughes has designed the industry's first 4 $\frac{1}{2}$ -in. (114-mm) TRSV to fit inside a 7-in. (178-mm) casing.

The Onyx series of tubing retrievable surface controlled subsurface safety valves are specifically designed for big bore applications. Onyx series safety valves are based on the successful **T-Series™**. The Onyx series combines a patented, state-of-the-art closure mechanism and premium housing threads to produce the industry's first tubing retrievable safety valves that offer full-opening production in smaller casing sizes. As a result, operators get multiple benefits: the lower cost of smaller-OD casing, flexibility in designing their completions, and higher production rates typical of larger tubing sizes.

Available Sizes

4.500 in., 7.000 in. and 9.625 in.

Advantages

- **Slimline OD** – enables larger tubing to be installed without sacrificing the full opening for maximized production
- **Reduces completion cost (CAPEX)** – the valve permits operators to use smaller casing programs
- **Broader application coverage** – ability to run capillary lines for downhole instrumentation or chemical injection and/or cables for electric submersible pump operation as well as dual completion installations
- **RBT Housing Seals** – two step metal-to-metal sealing system provides strength and sealing under the harshest conditions
- **Nonelastomeric dynamic seal assembly** – withstands extreme pressures and temperatures exceeding 28,000 psi (1,931 bar) and 450°F (232°C)
- **Metal-to-metal seal technology** – 100% metal-to-metal sealing and containment of well bore fluids when the valve is in the closed position
- **Patented thru-the flapper equalizing system** – most successful and widely used system available to the market
- **Ultra strong curved flapper design** – resistant to high impact loads in high flow rate applications



Onyx-5(E) Subsurface Safety Valves
Product Family No. H82627

Specification Guide											
Size		Max OD		Max Seal Bore		Working Pressure		Max Setting Depth		Max Temperature	
in.	mm	in.	mm	in.	mm	psi	bar	ft	m	°F	°C
4.500	114.3	5.970	151.6	3.812	96.8	5,000	345	6,000	1,829	300	149
		5.970	151.6			8,500	586			350	177
		6.860	174.2			10,000	689				
7.000	177.8	8.125	206.4	5.812	147.6	5,000	345	6,000	1,829	300	149
		8.375	212.7	5.875	149.2	7,500	517			350	177
		8.900	226.1			10,000	689				
		9.200	233.7	5.812	147.6	10,000	689				
9.625	244.5	11.770	299	8.405	213.5	5,000	345	2,000	610	300	149
		12.220	309.9	8.375	212.7	10,000	689			350	177

SAFETY SYSTEMS

Thunder Series Subsurface Safety Valve

Product Family Nos. H82707, H82708, H82709, H82710, H82733 and H82734

Application

The Baker Hughes commitment to innovation has resulted in the **Thunder™ series surface controlled subsurface safety valve**. Innovative field-proven technology that reduces the number of typical safety valve failure modes has been a hallmark of the Baker Hughes safety valves through the years. Thunder standard features include: wireline damage resistant flapper, nonelastomeric seal technology, and metal-to-metal containment of wellbore fluids in the closed position. These standard features deliver unprecedented reliability, efficiency, and adaptability. One-quarter of all safety valve failures occur due to wireline damage during interventions into the wellbore. The Thunder incorporates the damage resistant characteristics of the successful **Select™ flapper** design to virtually eliminate this failure mode. This design ensures all seal surfaces are protected from wireline contact even during accidental closure of the valve during wireline operations.

The Thunder can be tailored to your specific needs, with available options such as integral chemical injection capability, wireline damage resistant seal bores, and various control system stop seal versions. An optional through-the-flapper self-equalizing system is also available to minimize operational expenses while maximizing productivity.

Available Sizes

2.375 in., 2.875 in., 3.500 in., 4.500 in., 5.000 in., 5.500 in. and 7.000 in.

Advantages

- Through-the-flapper self-equalizing system provides high integrity seal without the conventional failure modes
- Robust flapper design resists high impact loads in high-flow-rate applications
- Baker Hughes RBT metal-to-metal thread technology maximizes outside diameter and sealing capabilities and enables high tensile rating
- Puncture communication system builds on field-proven T-Series valve design and eliminates linear sleeves and inadvertent communication and the possibility of accidental activation of the lockopen feature by a tool passing through the ID of the valve
- Nonelastomeric dynamic seal assembly eliminates explosive decompression and thermal degradation that can occur with elastomers



Thunder Series Subsurface Safety Valve
Product Family No. H82707

SAFETY SYSTEMS

Thunder Series Subsurface Safety Valve

Specification Guide											
Size		Max OD		Max Seal Bore		Working Pressure		Max Setting Depth		Max Temperature	
in.	mm	in.	mm	in.	mm	psi	bar	ft	m	°F	°C
2.375	60.3	3.625	192.1	1.875	47.6	5,000	344.7	4,000	1,219	300	149
						10,000	689.5				
2.875	73.0	4.625	117.5	2.312	58.7	5,000	344.7	4,000	1,219	300	149
		5.135	130.4			10,000	689.5				
3.500	88.9	5.000	127	2.812	71.3	5,000	344.7	6,000	1,829	300	149
		5.200	132.1			8,000	551.6	9,000	2,743	350	177
		5.400	137.2								
		5.650	143.5								
		6.600	167.6			5,000	344.7				
4.500	114.3	6.850	174	3.812	96.8	8,000	551.6	9,000	2,743	350	177
		7.048	179			10,000	689.5				
		7.030	178.6								
		7.403	188								
5.000	127.0	7.700	195.6	4.125	104.7	5,000	344.7	2,000	610	300	149
		7.730	196.3			5,000	344.7				
5.500	139.7	8.000	203.2	4.562	115.8	8,000	551.6	6,500	1,981	350	350
		7.760	197.1			10,000	689.5				
		8.080	205.2								
7.000	177.8	9.200	233.7	6.000	152.4	5,000	344.7	6,500	1,981	300	149
						7,500	517.1				

SAFETY SYSTEMS

REALM Series Subsurface Safety Valve

Product Family Nos. H82584, H82634 and H82700

Application

The new **REALM™ series tubing retrievable surface controlled subsurface safety valves** are specifically designed for high pressure/high temperature (HP/HT) applications. REALM series safety valves build upon the success of the **T-Series™** and use state-of-the-art technology to provide the industry's most reliable safety valve for these critical applications.

The REALM series reduces operating expenses by providing absolute pressure ratings. The control chamber, dynamic seal system, and rod piston are capable of withstanding full differential pressures. This capability eliminates the requirement to stage tubing pressures during installation, thus reducing installation cost and risk of over pressuring the valve.

Baker Hughes uses a unique design approach combining cutting edge design techniques with the industry's most rigorous test program to provide safety valves specifically designed for HP/HT applications.

Available Sizes

3.500 in., 4.500 in. and 5.500 in.

Advantages

- **Absolute pressure ratings** - no staging of tubing pressure
- **Nonelastomeric dynamic seal assembly** - withstands extreme pressures and temperatures exceeding 28,000 psi (1,931 bar) and 450°F (232°C)
- **Metal-to-metal seal technology** - 100% metal-to-metal sealing and containment of well bore fluids when the valve is in the closed position
- **Patented thru-the flapper equalizing system** - most successful and widely used system available to the market
- **Ultra strong curved flapper design** - designed to withstand extreme differential pressures
- **RBT housing seals** - two step metal-to-metal sealing system provides strength and sealing under the harshest conditions
- **HP/HT leader** - successful field experience minimizes operating risk



REALM Series
Subsurface Safety Valve

Specification Guide											
Size		Max OD		Max Seal Bore		Working Pressure		Max Setting Depth		Max Temperature	
in.	mm	in.	mm	in.	mm	psi	bar	ft	m	°F	°C
3.500	88.9	5.400	137.2	2.312	58.7	15,000	1034	2,000	610	350	177
				2.812	71.4	15,000	1034	5,000	1,524		
		5.651	143.5	2.562	65.1	16,750	1155	5,000	1,524	400	204
				2.562	65.1	20,000	1379	2,000	610		
4.500	114.3	5.500	139.7	2.562	65.1	20,000	1379	2,000	610	400	204
				2.312	58.7	25,000	1724	1,000	305		
		7.500	190.5	3.812	96.8	15,000	1034	4,000	1,219	350	177
				3.437	87.3	20,000	1379	2,000	610	400	204
5.500	139.7	7.970	202.4	4.562	115.9	12,500	862	2,000	610	350	177
						15,000	1034				

SAFETY SYSTEMS

Reach Tubing Retrievable Safety Valve

Product Family Nos. H82650, H82651 and H82659

Application

The Baker Hughes **REACH™ surface controlled subsurface safety valve** delivers fail-safe performance in a wide range of deep-set completions that require low operating pressures due to control system limitations, and extends operating capabilities to accommodate high-pressure/high-temperature (HP/HT) wells. The REACH safety valve offers VI validation as defined in API SPEC 14A Specification for Subsurface Safety Valve Equipment, Twelfth Edition. Per this specification, subsurface safety valves must now undergo more stringent prototype testing than was previously required. With only minor modifications, the Baker Hughes subsurface safety valve prototype test program was able to accommodate the new VI-validation specifications, and continues to exceed the requirements set forth by API.

Available Sizes

3.500 in., 4.500 in., 5.500 in., and 7.000 in.

Advantages

- Low valve operating pressure allows use in applications with opening pressure limitations and reduces cost of umbilicals because of lower pressure requirement
- Heavy sprung valve closure technology ensures fail safe closed functionality without needing a nitrogen charge
- Slim outside diameter (OD) for high pressure applications allows control line bypass and smaller casing programs, helping reduce cost
- Baker Hughes RBT metal to metal thread technology provides gas tight sealing in harsh environments and enables high tensile rating. 100% metal to metal sealing contains wellbore fluids when the valve is closed
- Piston wear bearing and scraper ring minimize debris ingress and maintain functionality in harsh, debris laden environments



Reach Tubing Retrievable Safety Valve
Product Family No. H82650

Specification Guide													
Size		Max OD		Max Seal Bore		Working Pressure		Max Setting Depth		Max Temperature			
in.	mm	in.	mm	in.	mm	psi	bar	ft	m	°F	°C		
3.500	88.9	5.940	150.9	2.812	71.4	10,000	689	20,000	6,096	300	149		
				2.562	65.0	15,000	1034						
4.500	114.3	7.560	192.0	3.812	96.8	10,000	689.4			350	177		
				3.812	96.8	15,000	1034					300	149
				3.75	95.3	20,000	1379						
5.500	139.7	8.265	209.9	8.125	206.4	10000	689			350	177		
				4.437	112.6	12,500	862	400	204				
				8.415	213.7	15,000	1034					400	204
7.000	177.8	9.020	229.1	5.950	151.1	7,500	517	300	149				
				5.875	149.2	10,000	689			350	177		

SAFETY SYSTEMS

DeepShield Series Nitrogen-Charged Subsurface Safety Valve

Product Family Nos. H82735, H82736, H82742 and H82743

Application

The **DeepShield™ series nitrogen charged tubing retrievable surface controlled subsurface safety valve** is designed for completions requiring low operating pressures due to control system limitations. The DeepShield operating system contains many patented features that provide simple, reliable, and failsafe operation in the most critical applications.

The DeepShield series incorporates integral nitrogen charged systems within the valve, which oppose the hydrostatic pressure acting on top of the piston. The dynamic seal configuration used for the operating piston is a significant engineering achievement that utilizes the industry's first non-elastomeric seal technology for nitrogen charged safety valves. Unlike other nitrogen charged designs, the DeepShield series' patented operating system is designed to be fail-safe closed in all applications even if the primary nitrogen chamber pressure is lost. The operating system is also far less susceptible to failing due to debris in the control line or hysteresis as all ball check seats, Belleville washers, and collets have been eliminated. The DeepShield series comes standard with two totally independent operating systems and an integral control line filter. These features deliver the redundancy and assurance required in remote subsea wells. When it comes to your critical applications, the DeepShield's innovative design and simple operation make it the only logical choice to protect your investment.

Available Sizes

3.500 in., 4.500 in., 5.500 in. and 7.000 in.

Advantages

- Field adjustable primary nitrogen chamber enables last minute adjustments to match changing well conditions
- Two independent, patented operating systems offer redundancy to maintain dependable valve operation and ensure fail safe operation in critical applications
- Same moving parts as a conventional tubing retrievable subsurface safety valve simplifies operation and increases certainty
- Piston wear bearing and scraper ring minimizes ingress of debris and maintains functionality in harsh, debris laden environments
- Low operating pressure at any setting depth reduces operating system cost
- Baker Hughes RBT metal to metal thread technology provides gas tight sealing in harsh environments and enables high tensile rating
- Optional integral control line offers clean and trouble free operation

Specification Guide											
Size		Max OD		Max Seal Bore		Working Pressure		Max Setting Depth		Max Temperature	
in.	mm	in.	mm	in.	mm	psi	bar	ft	m	°F	°C
3.500	88.9	5.940	150.9	2.812	71.4	10,000	689				
				2.562	65.0	15,000	1034				
4.500	114.3	7.400	188.0	3.812	96.8	10,000	689	15,000	4,572	300	149
						7,560	192.0				
5.500	139.7	8.260	209.8	4.562	115.9	10,000	689	15,000	4,572	300	149
						8,600	218.4				
7.000	177.8	9.375	238.1	5.950	151.1	6,000	413				
						7,500	517				



DeepShield Series Safety Valve
Product Family No. H82735

SAFETY SYSTEMS

Accessories for Subsurface Safety Valves

Baker Hughes accessory tools are designed to interface and operate reliably with downhole safety valves. Each tool is designed for a specific need in addressing the operators' safety system needs throughout the life of the well. Reliable operation is achieved by simplicity in design and field-proven operations.

Puncture Communication Tool

Product Family No. H82281

Application

The **puncture communication tool** is designed to establish control line communication to the tubing through the ID of a tubing retrievable safety valve (TRSV) or landing nipple in one wireline trip. Communication is achieved by radial motion while wireline jarring which punctures a hole in the control system area of the tubing retrievable equipment. The communication tool was developed to remove all communication methods from the TRSV which caused premature communication during wireline operations.



Puncture Communication Tool
Product Family No. H82281

SAFETY SYSTEMS

Flow Tube Exercising Tool

Product Family No. H82645

Application

The **flow tube exercising tool** enables mechanical actuation of the downhole safety valve in either direction. The exercising tool is used as a troubleshooting device in situations where the flow tube is impeded by scale, paraffin, or debris. This tool operates by locating in the nipple profile of the safety valve and grabbing the ID of the flow tube for mechanical shifting. Wireline manipulation is used while the exercising tool is attached to the flow tube of the tubing retrievable safety valve (TRSV) which returns the safety valve to normal operation.

Flapper Lock Open Tool

Product Family No. H82280

Application

The **flapper lock open tool** is designed to lock the TRSV open for preparation of wireline insert safety valve installation or retrieval of the TRSV while pulling the completion. The flapper lock open tool deposits an expanding sleeve into the flapper cavity to permanently lock the safety valve open. The tool is easily installed into the nipple profile of the safety valve and is actuated by removal of an inner mandrel. The lock open tool design guarantees proper placement of the lock open ring for reliable lock open.



Flow Tube Exercising Tool
Product Family No. H82645



Flapper Lock Open Tool
Product Family No. H82280

SAFETY SYSTEMS

Separation Sleeve

Product Family No. H82004

Application

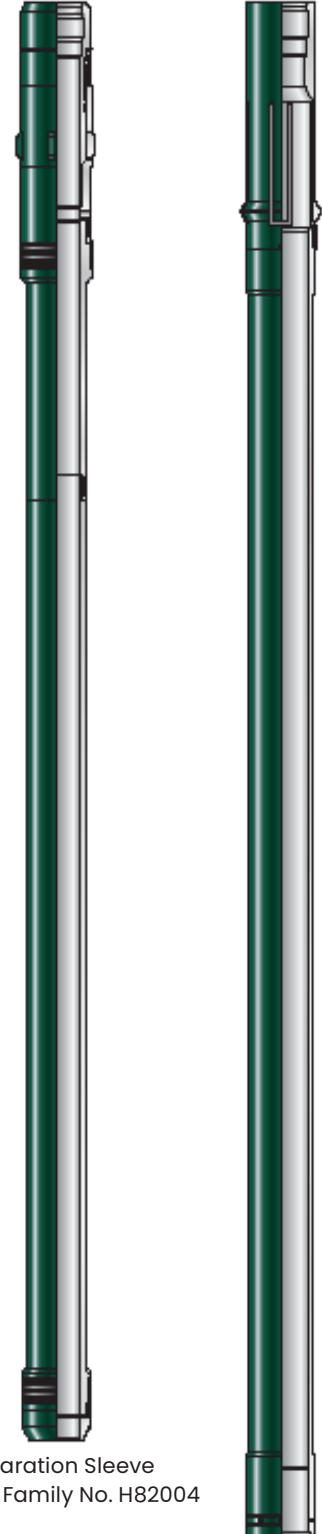
The **separation sleeve** is used to isolate the subsurface safety valve from well bore pressure by sealing in the upper and lower seal bores. This accessory tool can be used primarily in three ways. First, the sleeve is used to prevent well bore contaminants from entering the control system. Second, it can be installed to permanently lock open the TRSV and continue flowing operations. Third, the separation sleeve can be installed to hold the flapper open while pulling the tubing string.

Wear Sleeve

Product Family No. H82086

Application

The Baker Hughes **wear sleeve** or seal bore protection sleeve is designed for the sole purpose of protecting the inner workings of the tubing retrievable surface controlled subsurface safety valves (TRSCSSV) during wireline operations. The wear sleeve is run in prior to wireline work. This eliminates the chance for damaging seal bores with grooves in the TRSCSSV. By preventing such grooves this will allow a good seal in case of insert applications. This sleeve also reduces the opportunity for scale deposits. Furthermore the wear sleeve is used to protect the flapper during wireline operations. The wear sleeve is typically designed for use in non-flowing and non-pressured conditions.

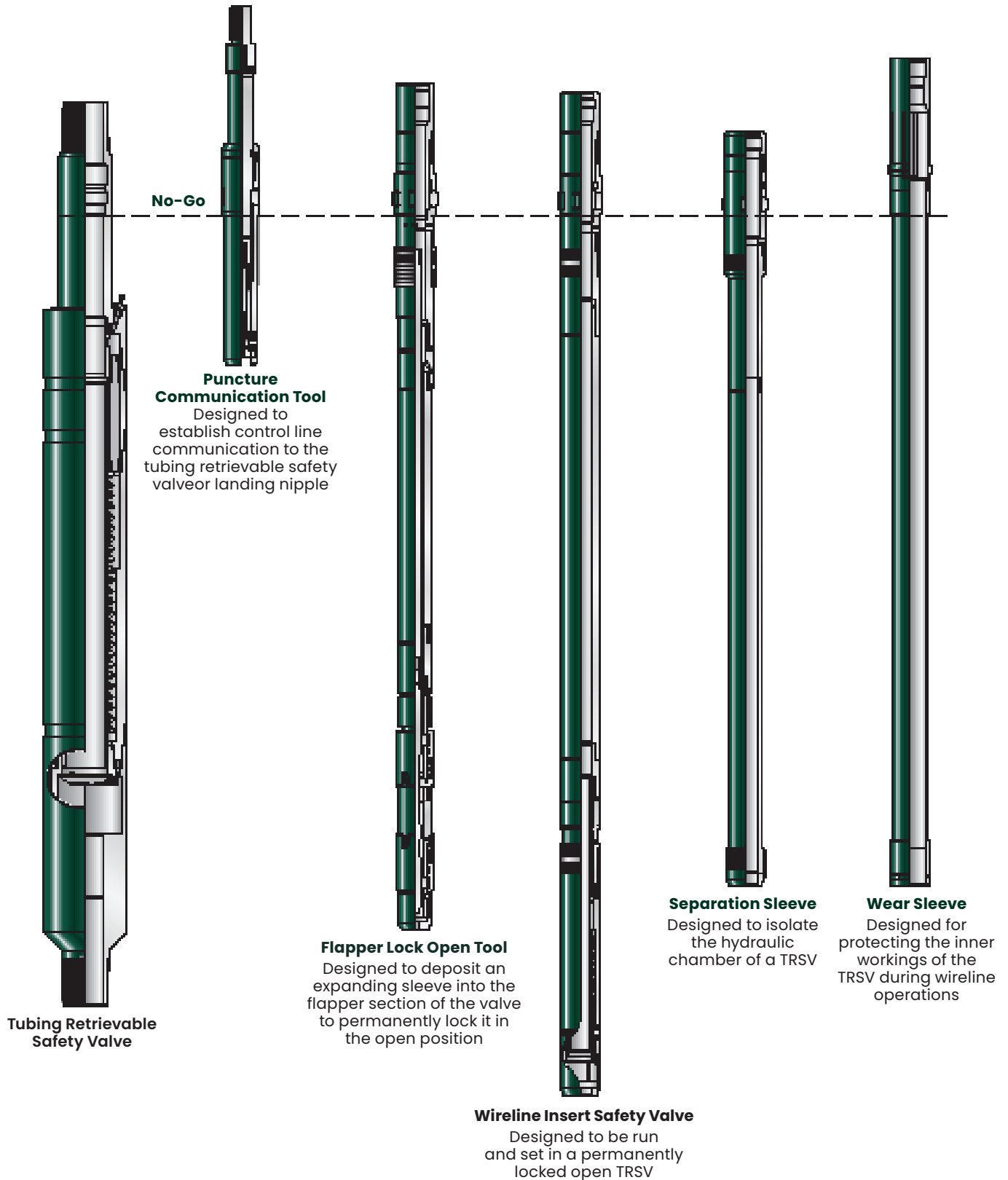


Separation Sleeve
Product Family No. H82004

Wear Sleeve
Product Family No. H82086

SAFETY SYSTEMS

Subsurface Accessories at a Glance



SAFETY SYSTEMS

Wireline Retrievable Subsurface Safety Valves

Product Application													
Model	Product Family No.	Working Pressure				Piston-Type		Dynamic Seal Type			Flapper Type		
		5k	6k	10k	15k	Concentric	Rod	Elastomeric	Non-Elastomeric	Wedge	Slimline	Equalizing	
A	H80849			■								■	
J	H80889			■									
V			■			■		■		■			
VE	H82751		■			■		■		■		■	
VH	H82751			■		■		■		■			
VHE	H82751			■		■		■		■		■	
VD	H82751		■				■	■		■			
VDE	H82751		■				■	■		■		■	
VHD	H82751			■			■	■		■			
VHDE	H82751			■			■	■		■		■	
VDS	H82751		■				■	■			■		
VDES	H82751						■	■			■	■	
VQD	H82751				■		■	■		■			
WS	H82752			■	■		■			■		■	
WSE	H82752			■	■		■			■		■	

SAFETY SYSTEMS

Model A Wireline Retrievable Velocity Valve

Product Family No. H80849

Application

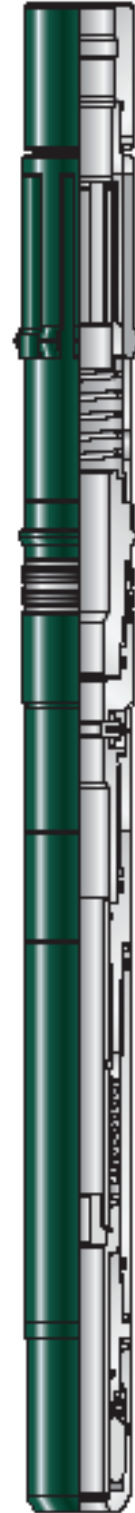
The **Model A™ valve** is a subsurface controlled subsurface safety valve that is designed to be normally open. The valve closes when the flow rate exceeds the valve's preset closing conditions. If loss of normal well control occurs at the surface, any increase in flow velocity creates a pressure drop across an orifice. The force created by the pressure drop causes the flow tube to retract and the valve to close, thus shutting in the well. The valve will reopen once pressures across the flapper are equalized. The Model A includes a unique equalizing subassembly which permits self-equalizing prior to retrieving the valve. The Model A is compatible with any of Baker Hughes or competitor's lock assemblies. Adjustment of the valve closure mechanism is accomplished by changing the orifice size and internal spring rate. This adjustment requires specific well information and is determined through the use of computer programs designed for this purpose. Sizes range from nominal tubing sizes of 2 $\frac{3}{8}$ in. (60 mm) to 7 in. (178 mm) with working pressure ranges to 10,000 psi (689 bar).

Available Sizes

2.375 in., 2.875 in., 3.500 in., 4.500 in., 5.500 in. and 7.000 in.

Advantages

- **Large bore** – allows unrestricted flow and protection of the flapper and sealing areas from erosional effects of production fluid
- **Wireline retrievable** – valve can be run and retrieved under pressure by conventional wireline methods
- **Easily adaptable** – can be run on Baker Hughes or competitor's locks and landed in non-ported seating nipples
- **Deep set capability** – valve may be set at any depth as it is not surface controlled
- **Adjustable on-site** – valve may be pulled and readjusted on-site to meet changing well characteristics
- **Rugged construction** – a series velocity valve uses a field-proven wedge shaped flapper design which is used across the wireline safety valve portfolio
- **Optional equalizing sub** – used to equalize pressure from below the valve. The unloading sub can be run if the valve is intended to be pulled with differential pressure below the valve assembly



Model A4 Controlled Wireline Retrievable Velocity Valve
Product Family No. H80849

Specification Guide								
Tubing	Available Seal Bores		Working Pressure		Flow Tube ID		Temperature Range	
	in.	mm	psi	bar	in.	mm	°F	°C
2 $\frac{3}{8}$	1.810	45.97	6,000	414	0.995	25.27		
2 $\frac{7}{8}$	2.312	58.72	6,000	414	0.995	25.27		
3 $\frac{1}{2}$	2.563	65.10	6,000	414	0.995	25.27		
	2.812	71.42	6,000	414	0.995	25.27		
4 $\frac{1}{2}$	3.812	96.82	5,000	345	1.906	48.41	32 to 275	0 to 177
5 $\frac{1}{2}$	4.125	104.78	5,000	345	2.062	52.37		
	4.562	115.87	5,000	345	2.649	67.28		
7	5.750	146.05	6,000	414	3.265	82.93		
	6.000	152.40	10,000	689	3.250	82.55		

SAFETY SYSTEMS

Model J Wireline Retrievable Injection Valve

Product Family No. H80889

Application

The **Model J™ injection valve** is a subsurface controlled subsurface safety valve. This dependable normally closed valve is designed to automatically close when injection ceases or the direction of flow is reversed. Injection flow immediately opens the flapper to allow fluids to pass through the valve. Once the injection flow reaches a predesigned rate, the pressure drop that is created across the orifices, allows the flow tube to extend past the flapper to its open position. The valve's durable flow tube protects the flapper and seat from erosion effects of the injection fluid while in the open position. When injection ceases and the differential pressure is eliminated, the flow tube retracts and allows the flapper to close. The J injection valve can be set at any depth and is available from nominal tubing sizes from 3½ in. (89 mm) to 7-in. (178-mm) tubing with working pressure up to 10,000 psi (689 bar).

Advantages

- **Large bore** - allows unrestricted flow and protection of the flapper and sealing areas from erosional effects of injection fluid
- **Wireline retrievable** - valve can be run and retrieved under pressure by conventional wireline methods
- **Easily adaptable** - can be run on Baker Hughes or competitor's locks and landed in non-ported seating nipples
- **Rugged construction** - J-series injection valve uses a field-proven wedge shaped flapper design which is used across the wireline safety valve portfolio
- **Optional equalizing sub** - used to equalize pressure from below the valve. The unloading sub can be run if the valve is intended to be pulled with differential pressure below the valve assembly
- **Deep set capability** - valve may be set at any depth as it is not surface controlled

Available Sizes

2.375 in., 2.875 in., 3.500 in., 4.500 in., 5.500 in. and 7.000 in.

Specification Guide								
Tubing	Seal Bores		Working Pressure		Flow Tube ID		Temperature Range	
	in.	in.	mm	psi	bar	in.	mm	°F
2¾	1.812	45.97	6,000	414	0.750	19.05	20 to 275	-7 to 177
	2.310	58.74	7,500	517	1.00	25.40		
3½	2.750	69.85	6,000	414	1.421	36.09		
			10,000	689	1.265	32.13		
	2.812	71.42	6,000	414	1.421	36.09		
			10,000	689	1.421	36.09		
4½	3.487	87.30	10,000	689	1.421	36.09		
	3.680	93.47	6,000	414	1.400	35.56		
			10,000	689	1.400	35.56		
	3.750	95.25	6,000	414	1.421	36.09		
5½	4.560	115.82	6,000	414	2.062	52.37		
			10,000	689	2.500	63.50		
7	5.750	146.05	6,000	414	1.920	48.77		
			6,000	414	3.250	82.55		
			10,000	689	3.250	82.55		



Model J Wireline Retrievable Injection Valve
Product Family No. H80889

SAFETY SYSTEMS

V-Series Wireline Retrievable Safety Valve

Product Family No. H82751

Application

The **V-series safety valve** is a wireline retrievable surface controlled subsurface safety valve that offers a wide range of wireline safety equipment. The wireline valve incorporates a modular concept to allow flexibility and adaptability to existing and new completions. V-series safety valves may be supplied with a Baker Hughes safety valve lock, as a complete assembly, or as a subassembly with adapter to a competitor lock. When assembled to a wireline lock, the assembly can be installed in a safety valve nipple. Hydraulic control line connects the safety valve nipple to the surface emergency shut-down system. Loss of control line pressure will close the valve and shut-in the well.

Available Sizes

2.375 in., 2.875 in., 3.500 in., 4.500 in., 5.500 in. and 7.000 in.

Model Designations

- **V** - V-series
- **E** - Incorporates Baker Hughes patented self-equalizing system
- **H** - Designed to work in applications requiring 10,000 psi (689 bar)
- **D** - For deep set applications
- **Q** - Designed to work in applications requiring up to 15,000 psi (1,034 bar) working pressure
- **S** - Slimline design incorporates Baker Hughes curved flapper design



V-Series Wireline Retrievable
Safety Valve
Product Family No. H82751

SAFETY SYSTEMS

W-Series Wireline Retrievable Safety Valve

Product Family No. H82752

Application

The **W-series** is a wireline retrievable surface controlled subsurface safety valve that offers premium features similar to a tubing retrievable safety valve. The W-series are nonelastomeric safety valves that can be supplied with or without a self equalizing feature. W-series valves are designed to be insert safety valves for tubing retrievable safety valves; however, they can easily be adapted for use in a wireline nipple completion. These wireline valves are premium valves due to the use of nonelastomeric seal material, metal-to-metal housing threads, high tensile strength metallurgy, and unique HP/HT packing and piston seal stacks when required by the application. These design features are imperative when considering applications for big bore, high temperature, high pressure, extremely corrosive, and hostile.

Available Sizes

3.500 in., 4.500 in., 5.500 in., 7.000 in. and 9.625 in.

Advantages

- **Patented thru-the-flapper self-equalizing** - most successful and widely used system available to the market
- **RBT housing seals** - two step metal-to-metal sealing system provides strength and sealing under the harshest conditions
- **Nonelastomeric dynamic seal assembly** - withstands extreme pressures and temperatures exceeding 28,000 psi (1,931 bar) and 450°F (232°C)
- **Large bore design** - minimizes pressure drop and maximizes production capability through the valve. Also, allows access for certain wireline tools to be run through the valve, thereby saving downtime expenses normally associated with pulling a wireline retrievable valve
- **Rugged flapper construction** - a large high strength alloy hinge pin eliminates bending
- **Deep-set capabilities** - rod-piston design maximizes setting depth options up to a maximum of 6,500 ft (1,981 m) in some models.



W-Series Wireline Retrievable Safety Valve
Product Family No. H82752

SAFETY SYSTEMS

Model V and W Series

Specification Guide												
Size		Model	Minimum Seal Bore		Working Pressure		Maximum Setting Depth		ID		Maximum Temperature	
in.	mm		in.	mm	psi	bar	ft	m	in.	mm	°F	°C
2.375	60.3	V(E)	1.875	47.6	6,000	413.7	1,000	304.8	0.807	20.5	300	149
		VH	1.710	45.4	10,000	689.5	1,700	518.2	0.650	16.5		
2.875	73.0	V(E)	2.312	58.7	6,000	413.7	1,137	346.6	1.125	28.6	300	149
		VD(E)	2.312	58.7	5,000	344.7	2,000	609.6	1.000	25.4		
		VH	2.188	55.6	10,000	689.5	2,500	762	0.935	23.7		
		VH(E)	2.312	58.7	10,000	689.5	1,500	457.2	0.650	16.5		
3.500	88.9	V(E)	2.812	71.4	6,000	413.7	1,000	304.8	1.560	39.6	300	149
		VH(E)	2.562	65.1	10,000	689.5	2,500	762	1.265	32.1	300	149
		VQD	2.562	65.1	15,000	1034.2	2,000	609.6	0.955	24.3	325	163
		W(E)	2.750	69.9	5,000	344.7	3,000	914.4	1.560	39.6	300	149
4.500	114.3	V(E)	3.812	96.8	6,000	413.7	800	243.8	2.122	53.9	300	149
		VHD(E)	3.688	93.7	10,000	689.5	3,300	1005.9	1.960	49.8		
		VD(E)S	3.812	96.8	5,000	344.7	2,200	670.6	2.500	63.5		
		WS(E)	3.688	93.7	10,000	689.5	6,500	1981.2	2.100	53.3		
		WS(E)	3.688	93.7	15,000	1034.2	5,000	1524	2.100	53.3		
5.500	139.7	V(E)	4.437	112.7	6,000	413.7	4,000	1219.2	2.562	65.1	300	149
		VH(E)	4.562	115.9	10,000	689.5	777	236.8	2.100	53.3		
		VHD(E)	4.312	109.5	10,000	689.5	3,300	1005.9	1.960	49.8		
		VD(E)S	4.437	112.7	5,000	344.7	2,000	609.6	3.062	77.8		
		WS(E)	4.312	109.5	10,000	689.5	6,500	1981.2	2.100	53.3		
		WS(E)	4.312	109.5	15,000	1034.2	4,000	1219.2	2.100	53.3		
7.000	177.8	V(E)	5.75	146.1	6,000	413.7	1,053	321	3.265	82.9	300	149
		VHD(E)	5.75	146.1	8,000	551.6	2,000	609.6	3.375	85.7		
		VD(E)S	5.812	147.6	5,000	344.7	2,000	609.6	4.115	104.5		
		WS(E)	5.625	142.9	6,000	413.7	5,000	1524	3.245	82.4		
		WS(E)	5.625	142.9	10,000	689.5	5,000	1524	3.245	82.4		
9.625	213.4	WS	8.385	213.0	5,000	344.7	3,000	914.4	5.860	148.8	300	149

SAFETY SYSTEMS

Annular Safety Valves

Product Application				
Model	Product Family No.	Applications		
		Gas Lift	ESP	Annulus Gas Cap
CASV	H73441	■		
AVLDM	H73441	■		
VR	H82741		■	
AGV	H82741		■	
ESP	H82741		■	
APC	H73460			■

SAFETY SYSTEMS

Model CASV Annulus Safety Valves

Product Family No. H73441

Application

The **Model CASV™ tubing retrievable annulus safety valve** is a surface controlled, subsurface, concentric sleeve type, safety valve with metal-to-metal housing connections and nonelastomeric rod piston. It is controlled from the surface via a small diameter hydraulic control line connecting the safety valve to the surface emergency shut-down system. Since the valve is of the fail-safe closed type, when the applied control line pressure is removed, the valve automatically returns to the closed position, thus shutting in annular flow from the well.

The CASV has been designed as a sliding sleeve type device to minimize the pressure drop and turbulence through the tool, and hence minimize the possibility of debris and particles fouling on the valve closure and sealing mechanisms. Baker Hughes has utilized field-proven nonelastomeric technology in the design of the valve, with the use of the same rod piston actuator as is currently being utilized in the highly reliable **T-Series™ of tubing retrievable safety valves**. The design of the main sealing elements for the ported sleeve has been based on the same nonelastomeric technology which is used in the **Model CM™ sliding sleeves**. When used in conjunction with the **Model FLX™ pack-off tubing hanger** and **Model CTA™**, the CASV becomes part of a complete annular safety system.

Advantages

- Uses premium metal-to-metal twin sealing RBT tubing threads
- Large annular flow area
- The valve uses the same field-proven nonelastomeric rod piston actuator as used in the T-Series tubing retrievable safety valves
- Uses a nonelastomeric sliding sleeve type sealing mechanism
- Uses nonelastomeric debris barriers
- Pump through capabilities



Model CASV Annulus Safety Valve
Product Family No. H73441

Specification Guide

Size	Max OD		Min ID		Flow Area	Working Pressure		Setting Depth	
	in.	in.	mm	in.		mm	in. ²	psi	bar
9 5/8 x 5 1/2	8.290	210.6	4.67	118.6	4.09	5,000	345	2,400	732
10 3/4 x 7	9.440	239.8	5.771	146.6	3.10	6,500	448	2,400	732

SAFETY SYSTEMS

Model AVLDM Annulus Safety Valves

Product Family Nos. H73491 and H73494

Application

The **Model AVLDM™** is a tubing retrievable, surface controlled, subsurface annular safety valve. The surface control is via a small diameter control line connecting the safety valve to the emergency shut-down system. Since the valve is of the normally closed type, the valve automatically returns to the closed (fail-safe) position, thus shutting in the annulus.

The AVLDM annular safety valve when used in conjunction with the **Model FLX™ pack-off tubing hanger** provides a secondary barrier to annular flow and a means to control the flow of fluids from the lower annulus to the upper annulus or dedicated injection line. Primary applications include gas lift installations and wells where pressurization of the upper casing as a result of the downhole leak is not permissible.

Advantages

- Field-proven metal-to-metal seal technology
- Large annular flow area minimizes pressure drop to enhance gas lift operations
- High tensile rating does not compromise tubing rating
- ID compatible with tubing, allowing no reduction in production rate
- Optional deep-set capabilities
- Critical components not susceptible to erosion



Model AVLDM Annulus Safety Valve
Product Family No. H73494

Specification Guide

Size		Max OD		Min ID		Flow Area	Working Pressure		Setting Depth	
in.	in.	mm	in.	mm	in. ²	psi	bar	ft	m	
9 5/8 x 5 1/2	8.000	203.2	4.625	117.5	0.787	5,000	345	2,400	732	
10 3/4 x 7	9.500	241.3	6.14	156	1.060	5,000	345	3,000	914	

SAFETY SYSTEMS

Models VR and AGV Vent Valves

Product Family No. H82741

Application

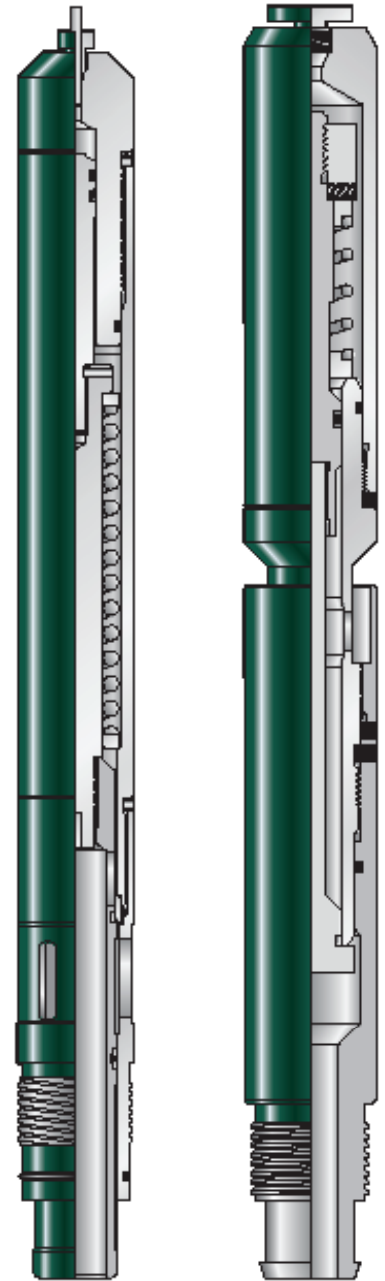
The **Model VR™** and **Model AGV™ vent valves** are annulus control safety valves that are control line actuated valves which attach directly to the top of the twin-seal submersible pump packer. Both valves are used to control the flow of annulus gas across the twin-seal packer. Applications include venting for submersible pump completions or injecting for gas injection completions. These valve models are normally closed and loss of control line pressure results in a fail-safe closure.

The VR vent safety valve is a normally closed valve which is opened by applying control line pressure. An optional feature of the VR is activation of the recirculation port in the twin-seal packer. Upon loss of control line pressure, this feature allows pumped fluid to be re-circulated from tubing to annulus below the packer.

The AGV valve is a normally closed valve which is opened by applying control line pressure. The AGV is similar in design to the VR vent valve; however, the AGV has a smaller OD for limited drift applications.

Advantages

- **Simple operation** – simplicity in design ensures reliable operations
- **Modular design** – vent valves designed in conjunction with twin-seal packer
- **Ultra-strong closure mechanism** – enables absolute sealing for annulus gas



Model VR Vent Valve

Model AGV Vent Valve

Model VR Vent Valve

Specification Guide							
Size		Max OD		Flow Area	Working Pressure		Setting Depth
in.	in.	mm	in. ²	psi	bar	ft	m
2.122 Thread Down	2.165	55.0	0.74	2,500	172	1,100	335
				6,000	414	1,150	351
				3,000	207	4,000	1,219

Model AGV Vent Valve

Specification Guide							
Size		Max OD		Flow Area	Working Pressure		Setting Depth
in.	in.	mm	in. ²	psi	bar	ft	m
7.000 x 2.875	1.780	45.2	0.32	2,500	172	1,245	379
						1,500	457

SAFETY SYSTEMS

ESP Vent Safety Valve

Product Family No. H82741

Application

The Baker Hughes **Model “ESP” vent safety valve** is a control line actuated valve which attaches into a Baker Hughes twin seal packer. On application of control line pressure, the valve opens and allows gas trapped in the annulus below the twin seal packer to be vented to the annulus above. The Model “ESP” valve is of the fail-safe closed design, therefore if control line pressure is lost, then the valve will automatically return to the closed position.

Advantages

- Simple operation - simplicity in design ensures reliable operation
- Modular design vent valves designed in conjunction with ESP packer
- Strong spring for deep setting depth capability



ESP Vent Safety Valve
Product Family No. H82741

SAFETY SYSTEMS

Model Annulus Pressure Compensation (APC) Valve

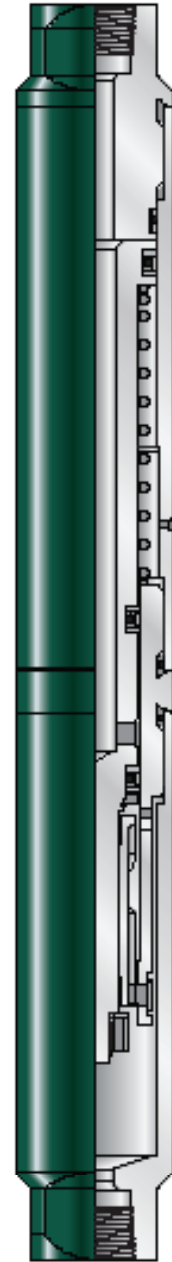
Product Family No. H73460

Application

The Baker Hughes **Model Annulus Pressure Compensation (APC) valve** is a device designed to be mounted in the A annulus vent line to prevent the undesirable release of fluid/gas pressure from the well annulus in the event that the subsea Christmas tree is removed from the tubing hanger. Once installed, the valve is also used to aid in control of the fluid level within the annulus to prevent an increase in A annulus pressure due to thermal expansion.

Advantages

- Provides a conduit for annulus fluid displacement through wellhead
- Provides testable barrier for displacement line during well tree removal and BOP landing in case of lost production casing integrity
- Helps to maintain better control of annulus pressure buildup (APB) in gas capped annulus completions



Annulus Pressure
Compensation (APC) Valve
Product Family No. H73460

SAFETY SYSTEMS

Control Line

Product Family No. H90521

Application

Control line is used to operate surface controlled subsurface safety valves. Control line can be provided to meet the specific application of each customer. The control line provided by Baker Hughes complies with ASTM specifications and can be offered in wide range of metallurgies. Encapsulated control line is also available and improves the crush and abrasion resistance of the control line. Encapsulated control line is available in several configurations and materials to suit the customers' application.

Baker Hughes provides control line in a wide variety of options and sizes. Standard control line materials include 316SS, Nickel Alloy 825 and Nickel Alloy 625. The control line can be provided bare or with a variety of encapsulation materials. It can be provided as a single line or as part of a multiple line flat pack. Welded or seamless options are available.



Control Line

Safety Valve Fail Safe Setting Depth Input Sheet



Customer:		Supplied By:	
Project:		Email:	
Well:		Phone #:	
Country:		RIH Date:	

CUSTOMER INPUTS				
Description	Symbol	Value	Units	Comments
Safety Valve Setting Depth (TVD)	TVD		ft	Maximum anticipated depth at which the safety valve will be set. The safety valve setting depth should be at least 100 ft below mud line.
Water Depth	MSL		ft	Water depth
Sea Water Gradient	g _{SW}		psi/ft	Density of Sea Water
Annulus Fluid Gradient	g _{Ann}		psi/ft	Density of fluid in annulus (a.k.a. "packer fluid")
Control Fluid Gradient	g _{CL}		psi/ft	Density of fluid in the operating control line of the subsurface safety valve.
Surface HPU Limit	P _{HPU}		psi	Maximum sustained pressure HPU can supply to hold the SCSSV open. (N/A if subsea HPU used)
Subsea Wellhead Pressure Limit	P _{WH}		psi	Maximum sustained pressure that can be applied at the HPU to hold the SCSSV open.
Minimum Tubing Pressure @ SCSSV	TP _{min}		psi	This is the minimum tubing pressure that is anticipated at the safety valve setting depth throughout the life of the well. This is typically tubing pressure at abandonment in producing wells.
Maximum Tubing Pressure @ SCSSV	SITP		psi	This is the maximum pressure that can be in the tubing section at the SCSSV whenever the safety valve must be open. It is typically referred to as the Shut-in Tubing Pressure under Initial Conditions.
Minimum Temperature at Safety Valve Setting Depth	T _{min}		°F	For producing wells, this is typically resting earth temperature at safety valve setting depth. (Input for gas-charged valves only)
Max Temperature at Safety Valve Setting Depth	T _{max}		°F	For producing wells, this is typically flowing tubing temperature at safety valve setting depth. (Input for gas-charged valves only)
Casing Size	--		in.	Casing size at safety valve setting depth
Casing Weight	--		lb./ft.	Casing weight at safety valve setting depth
Tubing Size	--		in.	Tubing size at safety valve setting depth
Tubing Weight	--		lb./ft.	Tubing weight at safety valve setting depth
Number of Bypass Lines at Safety Valve	--		--	Further details can be provided in comments section
Largest Bypass Line Size	--		--	Further details can be provided in comments section

Additional Comments:

Design Basis Well Environment Data for Material Recommendations



Customer:	Date:
Well Name or Location:	Requester Name/Company:
	Phone:
Well Type:	<input type="checkbox"/> Gas <input type="checkbox"/> Oil <input type="checkbox"/> Injection/Disposal* <input type="checkbox"/> Other:

*For injection/disposal wells, **provide a report listing all liquids and gases injected. If well will initially be used as a producer, fill out two forms. Oxygen ppb is critical for injection wells.**

Casing/Tubing Selections			
Tubing OD:	Tubing Grade (e.g. L80/13Cr):	/	Tubing ID Coated: <input type="checkbox"/> Y <input type="checkbox"/> N
Casing OD:	Casing Grade (e.g. L80/13Cr):	/	Tubing Coating Type:

****List units of measure for ALL data below****

Applicable Equipment Type	Depth (ft, m)	Exposure time to Produced Fluids/Total Well Life
Packer:		/ (yrs, days)
SSSV:		/ (yrs, days)
BFC:		/ (yrs, days)
Liner Hanger:		/ (yrs, days)
Other (specify):		/ (yrs, days)

Downhole Conditions			
Location	Max. Temperature	Min. Temperature	Bubble point (for oil wells) or Max. Pressure
@ Reservoir	(°F, °C)	(°F, °C)	(psi, KPa)
@ Wellhead	(°F, °C)	(°F, °C)	(psi, KPa)

Reservoir Depth:	(ft, m)
Gas Phase CO ₂ @ (reservoir or WH):	(psia, mole %, ppm)
Gas Phase H ₂ S @ (reservoir or WH):	(psia, mole %, ppm)
Elemental Sulfur:	(None or g/l)
Design max. Water Production (Gas):	(bbl/MMSCF, m ³ /m ³)
Design max. Water Cut (Oil):	(%)
Design (max.) Chlorides:	(ppm, mg/l)
Bicarbonate Ion Concentration:	(ppm, mg/l)
Organic Acid Concentration:	(ppm, mg/l)

Production Inhibitors:	(continuous, batch, none)	Inhibitor type:	(e.g. amine)
Annulus/completion fluid:	(e.g. CaCl ₂)	Inhib/type:	/
Other fluid exposure/ concentration/time:	(e.g. mud acid, 15% HCl, xylene, toluene, methanol, caustic, >9 pH mud, scale inhibitor)		

Note: Request water and gas analysis reports and include with this form.

Copyright 2019 Baker Hughes (UNPUBLISHED WORK). All rights reserved. Terms and conditions of use: By accepting this document, the recipient agrees this document (together with the contents) is confidential and proprietary property of Baker Hughes and includes valuable trade secrets, proprietary information of Baker Hughes (collectively "information"). Baker Hughes retains all rights under copyright laws and trade secret laws of the United States of America and other countries. The recipient further agrees the documents may not be distributed, transmitted, copied or reproduced in whole or part by any means, without express written consent of Baker Hughes, and may not be used in any way detrimental to Baker Hughes.

