



Weatherford®

Safety Valves



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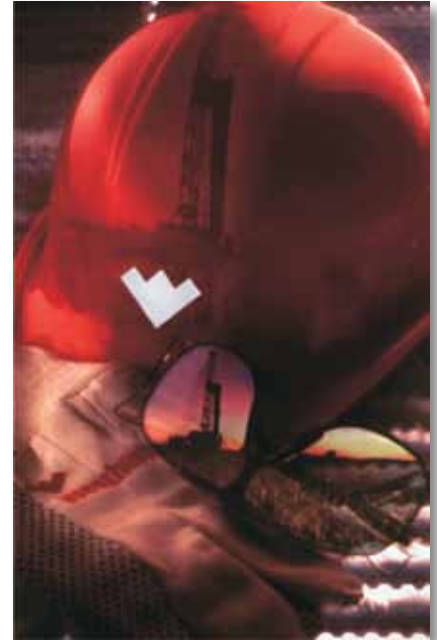
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Weatherford Portfolio

Weatherford International Ltd. is one of the largest global providers of innovative mechanical solutions, technology, and services for the drilling and production sectors of the oil and gas industry. An industry leader for more than 55 years, Weatherford has built its reputation by providing high-quality products, responsive client service, and a commitment to safety in all aspects of operations. Our continued pledge to our clients is to provide production-enabling technologies and superior services that maximize production. Our vast global infrastructure enables us to offer one of the industry's most diversified portfolios of products and services for drilling, intervention, completion, and production applications.

Since 1998 Weatherford has strategically combined an array of well-known brands from the completions sector with one goal in mind: making your reservoir recovery operations more productive.



A Full Range of Completion Products and Services

- Packers
- Liners
- Inflatable Packers
- **Safety Valves**
- Downhole Control Valves
- Expandable Technology
- Conventional Sand Screens
- Flow Control Systems
- Artificial Lift Systems
- Intelligent Wells

Weatherford Portfolio



Engineering Depth

Weatherford's product engineering resources are based around the world. We also employ a staff of engineers, designers, and technical support personnel whose breadth and depth of experience ranges from mechanical and electrical engineering to highly specialized disciplines of optical science and metallurgy.



Industry-Leading Testing, R&D, and Training Facilities

Weatherford has two of the largest research-and-development (R&D), testing, and training facilities in the industry. Our Houston-based Technology & Training Center houses the world's most advanced safety valve engineering lab and three hot cells that simulate downhole conditions. Our Aberdeen facility is Europe's foremost research, testing, and development center for offshore well services. This facility includes two fully operational drilling rigs and test boreholes.

Manufacturing Infrastructure

Weatherford's certified manufacturing facilities are strategically located throughout the world. Since 2002 we have doubled our completions manufacturing capacity by adding new facilities, expanding existing ones, and investing significantly in the latest machining equipment.

Weatherford Portfolio

Enterprise Excellence

Weatherford International Ltd. is committed to pursuing the highest standards of excellence in all our business processes. It is the policy of the company to

- comply with all applicable laws and regulations of the areas within which we operate or exceed compliance where our stated expectations require;
- conduct all operations in a manner that promotes safe work practices and minimizes risk to our employees, our communities and the environment;
- implement the programs, training and internal controls necessary to achieve our goals.



Objective

To achieve complete internal and external client satisfaction and to conform to mutually agreed requirements the first time, every time, while protecting the well-being of all personnel, assets and the environment.

This objective is achieved through a commitment to understanding and applying defined business processes, complying with established standards and implementing continual improvements. Paramount attention will be given to achieving error-free processes, products and services and maintaining a safe environment.

Commitment

We empower each employee to take the appropriate action to ensure compliance with this policy and objective.



This policy and the associated objective and commitment statement describe the targets we have set ourselves in achieving excellence. The principles described in this document define the corporation's expectations that must be incorporated into the culture of the enterprise in order to achieve excellence.

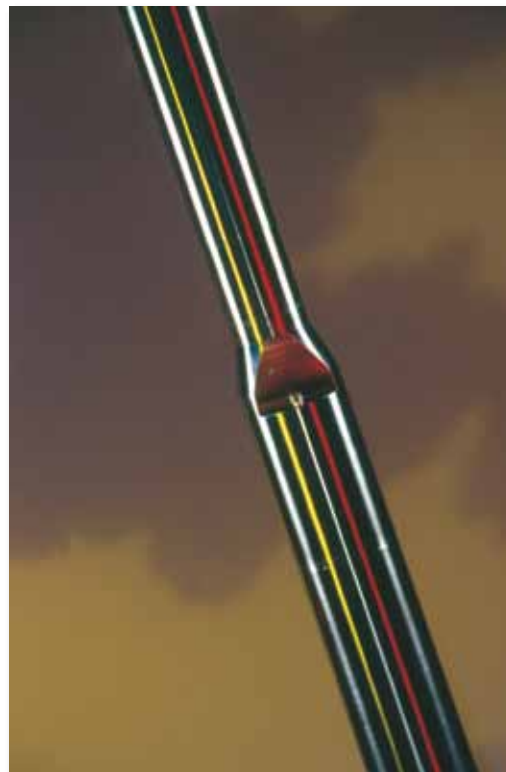
Introduction to Safety Valves

Weatherford's Safety Systems

Discover Premium Performance

You'll discover Weatherford's industry-leading reliable safety technology with our Optimax™ series of subsurface safety valves. With more than 2,000 years of cumulative in-well valve life, the *Optimax* series of valves provide positive shutoff protection in case of catastrophic loss of well control.

Weatherford entered the safety systems market in 2000. Since that time we have gained a reputation of providing innovative and reliable safety valves. In fact, we have the best mean-time-between-failure (MTBF) rate in the industry. Our safety valves are designed for maximized simplicity and reliability of operation. Weatherford has applied this evolutionary technology and produced the next generation of subsurface safety valves, which brings even greater simplicity of design to the market. We firmly believe that, in terms of safety valve performance, simplicity of design and the use of today's technology equate directly to reliability.



Quality Assurance

The Quality Assurance Group maintains a Quality Management System for Subsurface Safety Systems, which conforms to the requirements of American Petroleum Institute (API) Standards Q1 and 14A. Each and every person who works under the system is given extensive training in all aspects of their job. Each manufacturing facility maintains quality processes that ensure conformance to specified industry and client requirements.

A comprehensive traceability system is maintained for each and every part—from raw material to final destination. The system ensures that all requirements are met and that adequate records are created and maintained to document compliance with the standard.

Manufacturing and R&D Facilities

Weatherford has concurrently invested in R&D test facilities, manufacturing facilities and infrastructure, quality systems, training and an international network of operational bases to support the global completions marketplace.

Bellocq, France

The Weatherford France manufacturing facility is located in Bellocq, approximately 37 mi (60 km) west of Pau, in southwestern France. This facility opened in June 1999. In 2000 it was identified as Safety System's preferred location for Eastern Hemisphere safety-valve design and manufacturing.

Weatherford France is our Center of Excellence for the Optimax™ wireline safety valve, safety-valve landing nipple, and slimline tubing-mounted safety-valve products.

The physical resources available in Bellocq

- 53,820 ft² (5,000-m²) floor area, 538,196 ft² (50,000-m²) land
- 65 people (3 R&D), working 3 shifts
- 10 N/C machines (including 5 × Integrex) and phosphating plant
- Test facility: two vertical 23-ft (7-m) test towers; one 66-ft (20-m) test well; two dedicated safety-valve test panels; one general product test panel

On-site competencies

- Design and development, CAD (Autocad and ProE) with safety-valve specialists
- Precision manufacturing expertise, CAM (Gibbs & Mazatrol), ERP (Helios)
- Assembly and testing with field operations-experienced manager
- ISO 9001 and VAM certification; API Q1 and 14A accreditation

Production management ERP

HELIOS

- Purchase management and production planning
- Materials requirements planning (MRP)
- Product database management
- Stock management
- Production follow-up (bar codes)
- Management of nonconformances
- Quality management and traceability



Manufacturing and R&D Facilities



Industrial engineering

Computer-aided programming

- Programming languages
- GIBBS, CAMWARE, MAZATROL
- NC Milling (5 axes)
- Turning (2-, 3-, 4- and 5-axis machines)
- 3D visual simulation with tool path movements

Program management

- Transfer by direct numerical control (DNC)

Tool preset station

- Diameter measured max. 15.7 in. (400 mm)
- Length measured max. 23.6 in. (600 mm)
- 20 × magnification
- Diameter of projector 5.9 in. (150 mm)
- Precision of measurement 0.0002 in. (0.005 mm)

NC machine tools

Vertical machining center (Mazak V655/60)

- Machine management system (Fusion 640)
- Travel 1,500 × 650 × 660 mm-table 1,740 × 650
- Power 25 cv
- Spindle speed 25 to 6,000 rpm
- Feed rate 0 to 8,000 mm/min; allowable load 2 ton
- Precision of movement 0.0002 in. (0.005 mm)
- Tool station (30 tools)

Quality management system

Quality assurance

The facility has operated under ISO 9001 since 1999 and API Q1 and 14A license since September 2002.

Traceability

All products manufactured at Bellocq have 100 percent up-and-down traceability recorded in HELIOS.

Inspection

Total (100 percent) operator auto-control is in place in the plant. The inspection department is equipped with all required measuring equipment including ultrasonic depth measurement, bore scope, and so on.

Assembly and functional test

This facility features two 23-ft (7-m) test cells with labVIEW data-acquisition software. Two of the test panels were specifically designed for safety-valve API 14A functional testing. The system is rated up to 25,000-psi (1,700 bar).

Manufacturing and R&D Facilities

Premium Completions Center, Houston, Texas, USA

Weatherford's Houston, Texas, USA, location, has been identified as Safety System's preferred location for western hemisphere safety-valve design and manufacturing. The Premium Completions Center is our Center of Excellence for the Optimax™ tubing-retrievable safety-valve and accessory tools.

On-site competencies

- Design and development, CAD (Autocad and ProE) with safety-valve specialists
- Assembly and test with field operations-experienced manager
- API 14A and 5CT certified production management

Purchase management and production planning

- Product database management
- Stock management
- Production follow-up (bar codes)
- Management of nonconformances
- Quality management and traceability

Quality management system

Quality assurance

This facility's commitment to quality control and documentation has sustained API licenses under Specifications 14A and 5CT since 1989.

Traceability

All products manufactured at Weatherford have 100 percent up-and-down traceability on file for a minimum of ten years.

Inspection

The inspection department is equipped with all required measuring instruments, including ultrasonic depth measurement, bore scope, and so on.

Commitment to quality

Weatherford produced their first API-certified subsurface safety valve in April 2002. To show our commitment to quality, our president and CEO symbolically monogrammed the first safety valve.

Assembly and functional test

- Two 22-ft (6.7-m) test cells with LabVIEW data-acquisition software
- Two test panels specifically designed for safety-valve API 14A functional testing
- System rated up to 25,000-psi (1,700 bar)



Manufacturing and R&D Facilities



R&D Test Facilities

Weatherford designed its state-of-the-art test facility to support the testing needs of the company's research, development, and engineering efforts. The facility also provides hands-on experience for Training Center courses and showcases Weatherford's products and services.

The facility, in Houston, Texas, covers more than 55,000 ft² (5,110 m²), providing engineering services, indoor air-conditioned test bays, outdoor test fixtures, and a fully functional drilling rig.

Weatherford invites clients and oilfield service companies to take advantage of this training and test facility. We welcome inquiries regarding the facility and our testing capabilities.

Drilling rig

- 180-ft (55-m) triple derrick, 30- × 38-ft (9- × 12-m) rig floor
- Vertical cased test hole, 1,500 ft (457 m) deep
- Deviated cased hole, 1,700 ft (518 m) total vertical depth, 2,200 ft (670 m) measured depth, 86° from vertical at total depth
- 1,000-hp (746 kW) electric drawworks and 300,000-lb (136,078 kg) (maximum pull) running block
- Two 850-hp (634 kW) mud pumps with water and mud circulating fluids
- Mechanized rig equipment (PowerFrame[®], TorkWinder[®] and StabMaster[®] systems)
- Inventory of various sizes of drillpipe, casing, pup joints, and crossovers

Safety-valve test lab

Weatherford established its Safety Valve Test Lab as a facility for rapid prototype development and testing. The lab eliminates the need for outside resources and provides a safe and accurate qualification-testing environment needed for developing and testing industry-leading technologies. Clients and oilfield service companies are encouraged to take advantage of this first-rate facility.

Inside vertical flow loops

- Two flow loops with variable speed pumps capable of 600-gpm (600-l/min) flow rate
- Heated mix tanks, each with 500-gal (1,893-l) capacity, 200°F (93°C)
- High-pressure pump system
- High-pressure nitrogen system
- Two 15-gal (57-l), 30,000-psi (207-MPa) accumulators
- Two 10-gal (38-l), 10,000-psi (69-MPa) accumulators

Manufacturing and R&D Facilities

Three inside vertical test cells

- Ambient test cell or cold test cell, 30-in. (762-mm) cased hole
- Hot test cell (550°F [288°C])
- Cold test cell, 15-in. (381-mm) cased hole

Pressure isolated control room

- Independent multichannel data-acquisition stations for test cells and flow loops
- Full remote testing operations
- 30,000-psi (207-MPa) electric air-actuated test panels

Outside vertical flow loop

- 250-gpm (946-l/min), 3,500-psi (24-MPa) triplex system with 40-ft (12-m) mast/hoist
- Wireline test unit

Small vertical load frame

- 100,000-lb (378,541 l) single-piston load frame
- Strain gauge and load cell data-acquisition system (4-ft [1.2-m] maximum assembly length)

Large vertical load frame

- 1 MM-lb (453,592-kg), 4-piston, tension and compression load frame
- Frame can be loaded into hot cells for temperature testing
- 5-ft (1.5-m) maximum assembly length (modular design for longer assemblies)

Bucking unit

- Maximum 11 3/8-in. OD
- Maximum 34,000 ft-lb (46,098 N•m) torque in continuous rotating head
- Maximum 100,000 ft-lb (135,582 N•m) torque in 1/4-turn bucking head
- Data-acquisition system

High bay area

- Two bridge cranes: one 10-ton (9.1-t) and one 5-ton (4.5-t) crane
- Five work benches: four horizontal vices and one vertical vice for tool assembly
- Portable test carts
- Fully air-conditioned workspace



Manufacturing and R&D Facilities



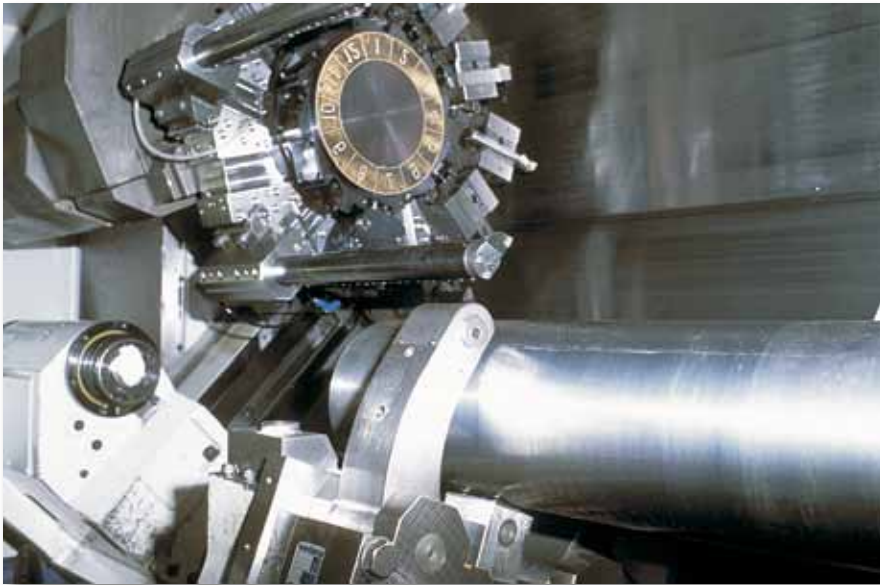
Inspection room

- On-site optical comparator and surface roughness gauge
- Hardness testing capabilities in HS, HB, HRB, HRC, HL (D), HV and N/mm (tensile strength)
- Capability to measure bore diameters of 0.2250 to 13.0 in. (5.715 to 330.200 mm)
- Capability to measure ODs of 0.001 to 39 in. (0.0254 to 990.60 mm)
- Large inventory of measuring instruments currently calibrated to API and ISO

Material Selection for Subsurface Safety Valves

Metallurgy	Service	Well Environment
9Cr1Mo	Mild H ₂ S + CO ₂	200°F (93°C) maximum, 1.5 psi (10 kPa) H ₂ S maximum, 15 psi (103 kPa) CO ₂ maximum 300°F (149°C) maximum, 2.0 psi (14 kPa) H ₂ S maximum, 5 psi (34 kPa) CO ₂ maximum 350°F (177°C) maximum, 2.0 psi (14 kPa) H ₂ S maximum, 1.5 psi (10 kPa) CO ₂ maximum
13% Cr	Mild H ₂ S + CO ₂	350°F (177°C) maximum, 1.5 psi (10 kPa) H ₂ S maximum, 25 psi (172 kPa) CO ₂ maximum
INCOLOY® 925	Highly corrosive	300°F (149°C) maximum, H ₂ S + CO ₂ = 400 psi (2,758 kPa) maximum 400°F (204°C) maximum, H ₂ S + CO ₂ = 200 psi (1,379 kPa) maximum
INCONEL® 718		

1. This table is provided as a guidance only. If corrosion is a potential problem, chloride content and acidity also need to be considered. Analysis and recommendations are provided upon request.
2. Standard materials are shown above. Other materials available upon request.
3. Maximum allowable partial pressure for H₂S and CO₂ shown above.



INCOLOY and INCONEL are registered trademarks of the Special Metals Corporation group of companies.

Tubing-Retrievable,
Surface-Controlled,
Subsurface Safety Valves

Distinguishing Design Features

Flapper and seat

Two types of flapper/seat designs are used in the Optimax™ series safety valves. The standard design incorporates a flat flapper/seat interface with a resilient secondary soft seat. Special attention to flapper hinge geometry ensures maximum sealing capability, even in debris-laden environments. When a reduced outside diameter is required (i.e., a slimline safety valve), a contoured flapper is used with full metal-to-metal flapper/seat interface with a resilient secondary soft seat. Unique interface geometry ensures maximum sealing capability as well as stability during slam closures and high-pressure differentials. A testament to the durability of Weatherford's contoured flapper/seat system is the successful gas-slam test, which is conducted to the highest test-flow rates available in the industry at 485 MMscfd and 455 ft/sec (138.7 m/sec).

Hydraulic system

The reliability of the hydraulic system in the *Optimax* series safety valves is enhanced by multiple design features. Only two potential leak paths exist—the piston seals, and the control-line connection. No other potential leak path is present to facilitate secondary communication. The preparation and finish of the hydraulic cylinder sealbore is unique to the industry and extends the life expectancy of the dynamic seals. The dynamic seal stack consists of spring-energized thermoplastic seals with a reinforced fluoropolymer secondary seal system. Unique carbon-composite backups are used to allow reduced clearances with no possibility of galling. Carbon-composite bearings are added to protect the seals from wear. These developments represent the next step in dynamic seal technology. Weatherford has developed a superior piston stop system that provides a static seal in both the fully *open* and fully *closed* positions using a primary metal-to-metal seal with a non-elastomeric secondary seal. This allows for unloading of the dynamic seals and extends the life of the hydraulic system.

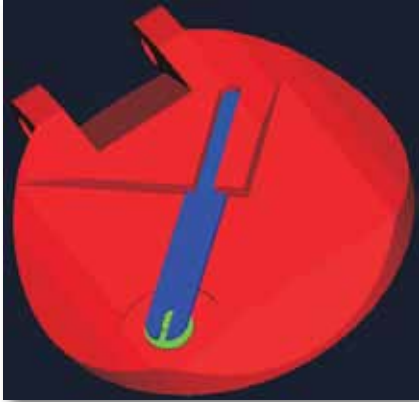
Body joint design: Weatherford premium thread

Optimax series safety valves use the Weatherford premium thread for the body joint connections for high strength, accurate alignment and low stress. The thread is a single-step, high flank-angle, dual-metal seal thread for maximum strength and sealing capability and high resistance to flexing and bending. The single-step design achieves maximum strength using minimum wall thickness. The high flank angle minimizes hoop stress at high-tensile loads. And the dual metal-to-metal seal provides pressure-assisted sealing against both internal and external pressure. To verify the integrity of Weatherford's premium thread, each thread design is put through a stringent test program. The six-step program consists of the following tests.

1. Make-and-break test (repeated makeups without galling)
2. Torque failure test (over-torque joint to failure)
3. Tensile failure test
4. Maximum burst pressure test
5. Unzip test (verify thread integrity with inner pressure seal leak)
6. Envelope test (combined load testing)



Distinguishing Design Features



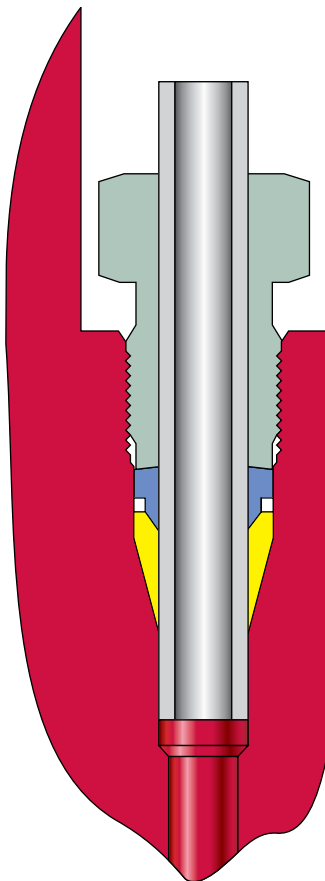
Equalizing system

The Optimax™ series safety valve is offered with self-equalizing capability using the field-proven metal-to-metal, through-the-flapper equalizing technology.

This system provides an equalizing flow path that prevents flow directly across the critical metal-to-metal seal interface.

Control-line connection

Optimax series safety valves use an integral dual-ferrule swage connection with the fitting receptacle machined directly into the valve body. The dual-ferrule design ensures maximum pressure containment capability, which will exceed that of the control-line tubing itself.



Lockout and communication

The *Optimax* series lockout and communication system is a two-trip, wireline-conveyed system. The lockout tool locates in the nipple profile of the safety valve, cycles the valve to the *open* position, and swages the flow tube into the flapper seat, permanently locking the valve out of service. The communication tool is then run by slickline, electric line or coiled tubing. This tool incorporates a lock system, electric motor, gearbox, milling head and battery system. After locating in the safety valve's nipple profile, hydraulic communication is established by milling through the interior wall of the safety valve into the hydraulic chamber.

Coatings

Proper use of coatings on internal parts helps to reduce friction and extends the useful life of the safety valve. *Optimax* series safety valves use a modified Teflon® coating that is resistant to chemical attack in harsh well environments to maintain smooth operation and discourage scale buildup.

Teflon is a registered trademark of DuPont.

Model W(E)-5

Weatherford's Optimax™ Model W(E)-5 tubing-retrieveable, surface-controlled, subsurface safety valve (TRSCSSV) is a rod-piston, flapper-type safety valve designed to shut in a well in the event of uncontrolled flow caused by equipment failure or damage. An integral part of the completion string, the W(E)-5 TRSCSSV is controlled by a single hydraulic control line. Application of control-line pressure keeps the valve in the *open* position; when pressure is bled off, the valve closes to protect property, personnel, and the environment. In the unlikely event the safety valve malfunctions, Weatherford's *Optimax* WLT lockout tool and *Optimax* WCT control-line communication tool can be deployed to adapt the valve to accept the Weatherford's WIT-10 wireline-insert safety valve, thus minimizing disruption to production operations.

The model W(E)-5 TRSCSSV, like all *Optimax* series TRSCSSVs, is designed to maximize simplicity and reliability of operation.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Several features of the model W(E)-5 valve maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium housing connections are standard.
 - The non-elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
 - The simple design of this valve incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.
- The field-proven non-elastomeric dynamic seal system avoids fluid-compatibility and explosive-decompression issues, enhancing safety.
- Accessories can be deployed on slickline, avoiding complex operational requirements.
- The optimized safety-valve design facilitates the use of control-line communication and lockout tools to insert a wireline-insert safety valve in the event of a malfunction, thus minimizing production disruption.



Model W(E)-5

Specifications

Size (in./mm)	2-3/8 60.3	2-7/8 73.0	3-1/2 88.9	4-1/2 114.3
Maximum OD (in./mm)	3.625 92.075	4.610 117.094	5.170 131.318	6.925 175.895
Overall length (in./cm)	64 163	62 157	68 173	72 183
Standard sealbore (minimum bore) (in./mm)	1.875 47.625	2.313 58.750	2.813 71.450	3.813 96.850
Housing threads (in.) ^a	3.300 and 2.400	4.250 and 2.875	4.687 and 3.500	6.250 and 4.500
Working pressure (psi/MPa)	5,000 34.5			
Test pressure (psi/MPa)	7,500 51.7			
Standard nipple profile	Petrolin [®] QN profile ^b			
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line			
Rated working temperature (°F/°C)	30° to 300° -1° to 149°			
Failsafe setting depth (ft/m)	1,000 305		2,000 610	
Operating pressure, full open (psi/MPa) ^c	1,500 10.3		2,000 13.8	
Operating pressure, full closed (psi/MPa) ^c	500 3.4		1,000 6.9	
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)			
Flapper soft seal	Proprietary design of filled plastic material to provide a reliable low-pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).			

^aWeatherford premium threads.

^bOther manufacturers' profiles available on request.

^cValues shown are estimates, subject to verification.

Standard metallic materials ^a	
Housing and internal components	9 chrome, 1 moly, or 13% chrome, 80,000-psi (551.6-MPa) minimum yield
Flapper and seat	INCONEL [®] 718
Power spring, piston rod, flapper pin, and torsion spring	MP 35 N
Tubing thread connection	As requested
Design and manufacturing compliance	API Q1 and API 14A
Class of service	API 14A 3S2

^aAll materials are heat-treated in accordance with NACE MR 01 75.

Options

- An optional internal through-the-flapper self-equalizing feature simplifies safety-valve operation while ensuring reliability.

INCONEL is a registered trademark of the Special Metals Corporation group of companies.

Models WP(E)-5 and WP(E)-10

Weatherford's Optimax™ models WP(E)-5 and WP(E)-10 tubing-retrievable, surface-controlled, subsurface safety valves (TRSCSSVs) are rod-piston, flapper-type safety valves designed to shut in a well in the event of uncontrolled flow caused by equipment failure or damage. An integral part of the completion string, each model is controlled by a single hydraulic control line. Application of control-line pressure keeps the valve in the *open* position; when pressure is bled off, the valve closes to protect property, personnel, and the environment. In the unlikely event the safety valve malfunctions, Weatherford's *Optimax* WLT lockout tool and *Optimax* WCT control-line communication tool can be deployed to adapt the valve to accept the Weatherford's WIT-10 wireline-insert safety valve, thus minimizing disruption to production operations.

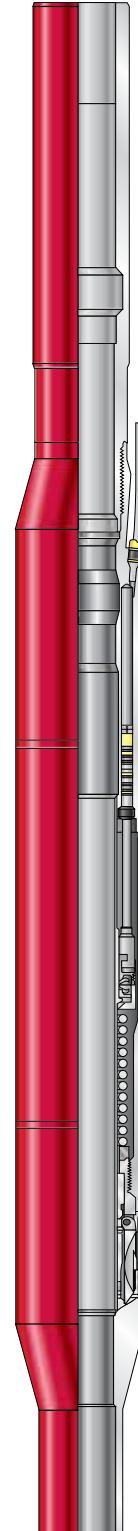
The models, like all *Optimax* series TRSCSSVs, are designed to maximize simplicity and reliability of operation. Both models have a premium piston seal feature which provides full-open and full-closed stop seals.

Applications

- Fluid and gas environments
- High-pressure production and injection applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Several features of the models maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium housing connections are standard.
 - The non-elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
 - The simple design of the valves incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.
- The field-proven non-elastomeric dynamic seal system avoids fluid-compatibility and explosive-decompression issues, enhancing safety.
- Accessories can be deployed on slickline, avoiding complex operational requirements.
- The optimized safety-valve design facilitates the use of control-line communication and lockout tools to insert a wireline-insert safety valve in the event of a malfunction, thus minimizing production disruption.
- The safety valve contains a premium piston mechanism for demanding gas or high-pressure applications.



Models WP(E)-5 and WP(E)-10

Specifications

Model WP(E)-5

Size (in./mm)	2-3/8 60.3	2-7/8 73.0	3-1/2 88.9	4-1/2 114.3
Maximum OD (in./mm)	3.625 92.075	4.610 117.094	5.170 131.318	6.925 175.895
Overall length (in./cm)	64 163	62 157	68 173	72 183
Standard sealbore (minimum bore) (in./mm)	1.875 47.625	2.313 58.750	2.813 71.450	3.813 96.850
Housing threads (in./mm) ^a	3.300 and 2.400 83.820 and 60.960	4.250 and 2.875 107.950 and 73.025	4.687 and 3.500 119.050 and 88.900	6.250 and 4.500 158.750 and 114.300
Working pressure (psi/MPa)	5,000 34.5			
Test pressure (psi/MPa)	7,500 51.7			
Standard nipple profile	Petroline® QN profile ^b			
Control-line connection	Industry-standard metal seal compression fitting for 1/4-in. (6.35-mm) control line			
Rated working temperature (°F/°C)	30° to 300° -1° to 149°			
Failsafe setting depth (ft/m)	1,000 305			
Operating pressure, full open (psi/MPa) ^c	1,500 10.3			
Operating pressure, full closed (psi/MPa) ^c	500 3.4			
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^d			

^aWeatherford premium threads.

^bOther manufacturers' profiles available on request.

^cValues shown are estimates, subject to verification.

^dP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

Models WP(E)-5 and WP(E)-10

Model WP(E)-10

Size (in./mm)	2-3/8 60.3	2-7/8 73.0	3-1/2 88.9	4-1/2 114.3
Maximum OD (in./mm)	3.625 92.075	5.110 129.794	5.810 147.574	7.470 189.738
Overall length (in./cm)	64 163	62 157	68 173	72 183
Standard sealbore (minimum bore) (in./mm)	1.875 47.625	2.313 58.750	2.813 71.450	3.813 96.850
Housing threads (in./mm) ^a	3.300 and 2.400 83.820 and 60.960	4.250 and 2.875 107.950 and 73.025	4.687 and 3.500 119.050 and 88.900	6.250 and 4.500 158.750 and 114.300
Working pressure (psi/MPa)	10,000 68.9			
Test pressure (psi/MPa)	15,000 103.4			
Standard nipple profile	Petrolin [®] QN profile ^b			
Control-line connection	Industry-standard metal seal compression fitting for 1/4-in. (6.35-mm) control line			
Rated working temperature (°F/°C)	30° to 300° -1° to 149°			
Failsafe setting depth (ft/m)	2,000 610			
Operating pressure, full open (psi/MPa) ^c	2,000 13.8			
Operating pressure, full closed (psi/MPa) ^c	1,000 6.9			
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^d			

^aWeatherford premium threads.

^bOther manufacturers' profiles available on request.

^cValues shown are estimates, subject to verification.

^dP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

Model WP(E)-5 and WP(E)-10

Standard metallic materials ^a	
Housing and internal components	9 chrome, 1 moly or 13% minimum chrome; 80,000-psi (552-MPa) minimum yield
Flapper and seat	INCONEL [®]
Power spring, piston rod, flapper pin, and torsion spring	MP 35 N
Tubing thread connection	As requested
Design and manufacturing compliance	API Q1 and API 14A
Class of service	API 14A 3S2

^aAll materials are heat-treated in accordance with NACE MR 01 75.

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Models WP(E)-5 and WP(E)-10

Options

- An optional internal through-the-flapper self-equalizing feature simplifies safety-valve operation while ensuring reliability.

Available Accessories

- Optimax™ WLT lockout tool
- *Optimax* WCT control-line communication tool
- *Optimax* WIT-10 wireline-insert safety valve

Slimline Models WSP(E)-5, WSP(E)-7.5 and WSP(E)-10

Weatherford's Optimax™ slimline models WSP(E)-5, WSP(E)-7.5, and WSP(E)-10 tubing-retrievable, surface-controlled, subsurface safety valves (TRSCSSVs) are rod-piston, curved flapper-type safety valves designed to shut in a well in the event of uncontrolled flow caused by equipment failure or damage. An integral part of the completion string, each model is controlled by a single hydraulic control line. Application of control-line pressure keeps the valve in the *open* position; when pressure is bled off, the valve closes to protect property, personnel, and the environment. In the unlikely event the safety valve malfunctions, Weatherford's *Optimax* WLT lockout tool and *Optimax* WCT control-line communication tool can be deployed to adapt the valve to accept the Weatherford's WIT-10 wireline-insert safety valve, thus minimizing disruption to production operations.

The models, like all *Optimax* series TRSCSSVs, are designed to maximize simplicity and reliability of operation. The WSP(E)-5 has a working pressure rating of 5,000 psi (34 MPa). The WSP(E)-7.5 has a working pressure rating of 7,500 psi (52 MPa). The WSP(E)-10 has a working pressure rating of 10,000 psi (69 MPa). All the models have a premium piston seal feature which provides full-open and full-closed stop seals.

Applications

- Fluid and gas environments
- High-pressure production and injection applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Curved flapper technology enables a smaller OD, which eases running and accommodates bypass lines.
- Several features of the models maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium housing connections are standard.
 - The non-elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
 - The simple design of the valves incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.
- The field-proven non-elastomeric dynamic seal system avoids fluid-compatibility and explosive-decompression issues, enhancing safety.



Slimline Models WSP(E)-5, WSP(E)-7.5 and WSP(E)-10

Features, Advantages and Benefits (continued)

- Accessories can be deployed on slickline, avoiding complex operational requirements.
- The optimized safety-valve design facilitates the use of control-line communication and lockout tools to insert a wireline-insert safety valve in the event of a malfunction, thus minimizing production disruption.
- The safety valve contains a premium piston mechanism for demanding gas or high-pressure applications.

Specifications

Size (in./mm)	3-1/2 88.9			4-1/2 114.3		
Overall length (in./cm)	69 175			78 198		
Standard sealbore (minimum bore) (in./mm)	2.813 71.450			3.813 96.850		
Weatherford housing threads (in./mm)	4.687 and 3.500 119.050 and 88.900			6.000 and 4.500 152.400 and 114.300		
Working pressure (psi/MPa)	5,000 34.5	7,500 51.7	10,000 68.9	5,000 34.5	7,500 51.7	10,000 68.9
Test pressure (psi/MPa)	7,500 51.7	11,250 77.6	15,000 103.4	7,500 51.7	11,250 77.6	15,000 103.4
Maximum OD (in./mm)	5.000 127.000	5.110 129.794	5.200 132.080	6.550 166.370		6.810 172.974
Standard nipple profile	Petroline® QN profile ^a					
Control-line connection	Industry-standard metal-seal compression fitting for 1/4-in. (6.35-mm) control line					
Rated working temperature (°F/°C)	30° to 300° -1° to 149°					
Failsafe setting depth (ft/m)	2,000 610					
Operating pressure, full open (psi/MPa) ^b	2,000 13.8					
Operating pressure, full closed (psi/MPa) ^b	1,000 6.9					
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^c					
Standard metallic materials ^d						
Housing and internal components	9 chrome, 1 moly or 13% minimum chrome 80,000-psi (551.6-MPa) minimum yield					
Flapper and seat	INCONEL® 718					
Piston rod and power spring	MP 35 N					
Tubing thread connection	As requested					
Design and manufacturing compliance	API Q1 and API 14A					
Class of service	API 14A 3S2					

^aOther manufacturers' profiles available upon request.

^bValues shown are estimates, subject to verification.

^cP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

^dAll materials are heat-treated in accordance with NACE MR 01 75.

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Slimline Models WSP(E)-5, WSP(E)-7.5 and WSP(E)-10

Size (in./mm)	5-1/2			Large Bore 5-1/2			7		
	139.7			139.7			177.8		
Overall length (in./cm)	92 234			84 213			99 251		
Standard sealbore (minimum bore) (in./mm)	4.578 116.281			4.750 120.650			6.000 and 5.963 ^a 152.400 and 151.460 ^a		
Weatherford housing threads (in./mm)	6.937 and 5.500 176.200 and 139.700			7.125 and 5.600 180.975 and 142.240			8.465 and 7.088 215.011 and 180.035		
Working pressure (psi/MPa)	5,000 34.5	7,500 51.7	10,000 68.9	5,000 34.5	7,500 51.7	10,000 68.9	5,000 34.5	7,500 51.7	10,000 68.9
Test pressure (psi/MPa)	7,500 51.7	11,250 77.6	15,000 103.4	7,500 51.7	11,250 77.6	15,000 103.4	7,500 51.7	11,250 77.6	15,000 103.4
Maximum OD (in./mm)	7.700 195.580	7.760 197.104	8.100 205.740	7.700 195.580	—		9.200 233.680	9.288 235.915	9.430 239.522
Standard nipple profile	Petroline [®] QN profile ^b								
Control-line connection	Industry-standard metal-seal compression fitting for 1/4-in. (6.35-mm) control line								
Rated working temperature (°F/°C)	30° to 300° -1° to 149°								
Failsafe setting depth (ft/m)	2,000 610								
Operating pressure, full open (psi/MPa) ^c	2,000 13.8								
Operating pressure, full closed (psi/MPa) ^c	1,000 6.9								
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^d								
Standard metallic materials ^e									
Housing and internal components	9 chrome, 1 moly or 13% minimum chrome 80,000-psi (551.6-MPa) minimum yield								
Flapper and seat	INCONEL 718								
Piston rod and power spring	MP 35 N								
Tubing thread connection	As requested								
Design and manufacturing compliance	API Q1 and API 14A								
Class of service	API 14A 3S2								

^aStaggered sealbore.

^bOther manufacturers' profiles available upon request.

^cValues shown are estimates, subject to verification.

^dP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

^eAll materials are heat-treated in accordance with NACE MR 01 75.

Slimline Models WSP(E)-5, WSP(E)-7.5 and WSP(E)-10

Options

- An optional internal through-the-flapper self-equalizing feature simplifies safety valve operation while ensuring reliability.

Available Accessories

- Optimax™ WLT lockout tool
- *Optimax* WCT control-line communication tool
- *Optimax* WET exercise tool
- *Optimax* WIT-10 wireline-insert safety valve

Super Slim Models WSSP(E)-5 and WSSP(E)-7.5

Weatherford's Optimax™ models WSSP(E)-5 and WSSP(E)-7.5 super-slim tubing-retrieveable, surface-controlled, subsurface safety valves (TRSCSSV) are rod-piston, curved flapper-type safety valves designed to shut in a well in the event of uncontrolled flow caused by equipment failure or damage. An integral part of the completion string, each model is controlled by a single hydraulic control line. Application of control-line pressure keeps the valve in the *open* position; when pressure is bled off, the valve closes to protect property, personnel, and the environment. In the unlikely event the safety valve malfunctions, Weatherford's *Optimax* WLT lockout tool and *Optimax* WCT control-line communication tool can be deployed to adapt the valve to accept the Weatherford's WIT-10 wireline-insert safety valve, thus minimizing disruption to production operations.

Models WSSP(E)-5 and WSSP(E)-7.5 valves, like all *Optimax* series TRSCSSVs, are designed to maximize simplicity and reliability of operation. Through application of optimized design, the radically contoured flapper mechanism, and use of high-yield, corrosion-resistant alloys, these super-slim valves provide the smallest OD for any given bore, or the largest bore for any given OD. The premium piston seal feature provides full-open and full-closed stop seals.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Super-slim flapper technology enables a smaller OD than equivalently sized, curved-flapper safety valves, which permits installation in smaller casing strings than standard slim-line valves and accommodates bypass lines.
- Several features of the models maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium housing connections are standard.
 - The non-elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
 - The simple design of this valve incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.



Super Slim Models WSSP(E)-5 and WSSP(E)-7.5

Features, Advantages and Benefits (continued)

- The field-proven non-elastomeric dynamic seal system avoids fluid-compatibility and explosive-decompression issues, enhancing safety.
- Accessories can be deployed on slickline, avoiding complex operational requirements.
- The optimized safety-valve design facilitates the use of control-line communication and lockout tools to insert a wireline-insert safety valve in the event of a malfunction, thus minimizing production disruption.
- The safety valve contains a premium piston mechanism for demanding gas or high-pressure applications.

Specifications

Model WSSP(E)-5

Size (in./mm)	4-1/2 114.3	7 ^a 177.8
Maximum OD (in./mm)	6.020 152.908	8.375 212.725
Overall length (in./cm)	103 262	113 287
Housing threads (in./mm) ^b	5.495 and 4.500 139.573 and 114.300	7.625 and 7.000 193.675 and 177.800
Working pressure (psi/MPa)	5,000 34.5	
Test pressure (psi/MPa)	7,500 51.7	
Standard nipple profile	Petroline [®] QN profile ^c	
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line	
Rated working temperature (°F/°C)	30° to 300° -1° to 149°	
Failsafe setting depth (ft/m)	1,000 305	2,000 610
Operating pressure, full open (psi/MPa)	1,000 6.9	2,000 13.8
Operating pressure, full closed (psi/MPa)	500 3.4	1,000 6.9
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^d	
Flapper soft seal	Proprietary design of filled plastic material to provide a reliable low-pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).	

^aContact Weatherford for availability.

^bWeatherford premium threads.

^cOther manufacturers' profiles available on request.

^dP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

Super Slim Models WSSP(E)-5 and WSSP(E)-7.5

Model WSSP(E)-7.5

Size (in./mm)	4-1/2 114.3
Maximum OD (in./mm) ^a	5.980 1521.892
Overall length (in./cm)	103 262
Housing threads (in./mm) ^b	5.495 and 4.500 139.573 and 114.300
Working pressure (psi/MPa)	7,500 51.7
Test pressure (psi/MPa)	11,250 77.6
Standard nipple profile	Petrolin [®] QN profile ^c
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line
Rated working temperature (°F/°C)	30° to 300° -1° to 149°
Failsafe setting depth (ft/m)	1,000 305
Operating pressure, full open (psi/MPa)	1,950 13.5
Operating pressure, full closed (psi/MPa)	600 4.1
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^d
Flapper soft seal	Proprietary design of filled plastic material to provide a reliable low-pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).

^aOther ODs are available depending on selected material yield.

^bWeatherford premium threads.

^cOther manufacturers' profiles available on request.

^dP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

Standard metallic materials ^a	
Housing and internal components	Nickel alloy, 120,000-psi (827.4-MPa) minimum yield
Internal components	9 chrome, 1 moly, or 13% chrome, 80,000-psi (551.6-MPa) minimum yield
Flapper and seat	INCONEL [®] 718
Power spring, piston rod, flapper pin, and torsion spring	MP 35 N
Tubing thread connection	As requested
Design and manufacturing compliance	API Q1 and API 14A
Class of service	API 14A 3S2

^aAll materials are heat-treated in accordance with NACE MR 01 75.

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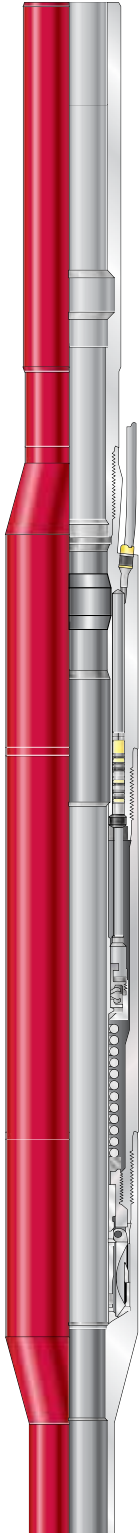
Options

- An optional internal through-the-flapper self-equalizing feature simplifies safety-valve operation while ensuring reliability.

Available Accessories

- Optimax[™] WLT lockout tool
- Optimax WCT control-line communication tool
- Optimax WIT-10 wireline-insert safety valve

Model WSSP(E)-10



Weatherford's Optimax™ model WSSP(E)-10 tubing-retrieveable, surface-controlled, subsurface safety valve (TRSCSSV) is a rod-piston, curved flapper-type safety valve designed to shut in a well in the event of uncontrolled flow caused by equipment failure or damage. An integral part of the completion string, the WSSP(E)-10 TRSCSSV is controlled by a single hydraulic control line. Application of control-line pressure keeps the valve in the *open* position; when pressure is bled off, the valve closes to protect property, personnel, and the environment. In the unlikely event the safety valve malfunctions, Weatherford's *Optimax* WLT lockout tool and *Optimax* WCT control-line communication tool can be deployed to adapt the valve to accept Weatherford's WIT-10 wireline-insert safety valve, thus minimizing disruption to production operations.

The model WSSP(E)-10 valve, like all *Optimax* series TRSCSSVs, is designed to maximize simplicity and reliability of operation. Through application of optimized design, the radically contoured flapper mechanism, and use of high-yield, corrosion-resistant alloys, this super-slim valve provides the smallest OD for any given bore, or the largest bore for any given OD. The premium piston seal feature provides full-open and full-closed stop seals.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Super-slim flapper technology enables a smaller OD than equivalently sized, curved-flapper safety valves, which permits installation in smaller casing strings than standard slim-line valves and accommodates bypass lines.
- Several features of the model WSSP(E)-10 valve maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium housing connections are standard.
 - The non-elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
 - The simple design of this valve incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.

Model WSSP(E)-10

- The field-proven non-elastomeric dynamic seal system avoids fluid-compatibility and explosive-decompression issues, enhancing safety.
- Accessories can be deployed on slickline, avoiding complex operational requirements.
- The optimized safety-valve design facilitates the use of control-line communication and lockout tools to insert a wireline-insert safety valve in the event of a malfunction, thus minimizing production disruption.
- The safety valve contains a premium piston mechanism for demanding gas or high-pressure applications.

Specifications

Size (in./mm)	7 ^a 177.8
Maximum OD (in./mm)	8.500 ^b 215.900
Overall length (in./cm)	113 287
Housing threads (in./mm) ^c	7.625 and 7.000 193.675 and 177.800
Working pressure (psi/MPa)	10,000 68.9
Test pressure (psi/MPa)	15,000 103.4
Standard nipple profile	Petroline [®] QN profile ^d
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line
Rated working temperature (°F/°C)	30° to 300° -1° to 149°
Failsafe setting depth (ft/m)	2,000 610
Operating pressure, full open (psi/MPa)	2,000 13.8
Operating pressure, full closed (psi/MPa)	1,000 6.9
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C) ^e
Flapper soft seal	Proprietary design of filled plastic material to provide a reliable low-pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).

^aContact Weatherford for availability.

^bOther ODs are available depending on selected material yield.

^cWeatherford premium threads.

^dOther manufacturers' profiles available on request.

^eP feature safety valve also contains a non-elastomeric piston stop seal, which isolates the dynamic seals at the full-open and full-closed positions.

Model WSSP(E)-10

Specifications (continued)

Standard metallic materials ^a	
Housing and internal components	Nickel alloy, 120,000-psi (827.4-MPa) minimum yield
Internal components	9 chrome, 1 moly, or 13% chrome, 80,000-psi (551.6-MPa) minimum yield
Flapper and seat	INCONEL [®] 718
Power spring, piston rod, flapper pin, and torsion spring	MP 35 N
Tubing thread connection	As requested
Design and manufacturing compliance	API Q1 and API 14A

^aAll materials are heat-treated in accordance with NACE MR 01 75.

Options

- An optional internal through-the-flapper self-equalizing feature simplifies safety-valve operation while ensuring reliability.

Available Accessories

- Optimax™ WLT lockout tool
- Optimax WCT control-line communication tool
- Optimax WIT-10 wireline-insert safety valve

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Cement-Through Valves Models WCP(E)-5 and WCP(E)-10

Weatherford's Optimax™ series cement-through tubing-retrieveable, surface-controlled, subsurface safety valve (TRSCSSV), (Model WCP(E)-5 and Model WCP(E)-10), is a rod-piston, flapper-type safety valve—5,000 and 10,000 psi (39.4 and 68.9 MPa) working pressure ratings, 1,000 ft (304.8 m) and 2,000 ft (609.6 MPa) setting depth configurations—reflecting new technology developed by Weatherford to address cement-in-place completion techniques. The Model WCP(E)-5 and Model WCP(E)-10 are available with an optional self-equalizing flapper mechanism. This product was developed to provide total isolation of the valve's operations to eliminate the possibility of debris contamination during cementing operations.

An integral part of the completion string, both the Model WCP(E)-5 and Model WCP(E)-10 are controlled via a hydraulic control line. Application of control-line pressure maintains this safety valve in the *open* position; when pressure is bled off, the safety valve closes. In the event of uncontrolled flow, this failsafe closure protects property, personnel, and the environment on command. In the event of malfunction, the deployment of lockout and control-line communication tools adapts the valve to accept a wireline-insert safety valve, minimizing disruption to production operations.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention are in accordance with API Q1 and API 14A quality programs, ensuring integrity to industry standards, as well as qualification to API Class 1 and 2.
- Several features of the model WCP(E)-5 and Model WCP(E)-10 maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium housing connections are standard.
 - The simple design of this safety valve incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, thus preventing premature control-line communication.
 - The number of pressure seals minimizes potential leak paths.
 - Premium metal-to-metal up stop is part of the dynamic seal system.
 - Non-elastomeric flapper soft seat backs up the metal-to-metal primary seat.



Cement-Through Valves Models WCP(E)-5 and WCP(E)-10

Features, Advantages and Benefits (continued)

- The valve's field-proven through-the-flapper self-equalizing mechanism provides simple operation.
- The pressure-rated flow tube isolates the critical components of the safety valve from cement during the cementing operation.
- The non-elastomeric seals avoid fluid compatibility and explosive decompression issues, enhancing safety.
- Accessories can be deployed on slickline, avoiding complex operational requirements.
- The optimized safety-valve design facilitates the use of control-line communication and lockout tools, and the wireline-insert safety valve in the event of a malfunction, minimizing production disruption.

Specifications

Model WCP(E)-5

Size* (in./mm)	2-3/8 60.3	2-7/8 73.0	3-1/2 88.9	4-1/2 114.3
Maximum OD (in./mm)	3.626 92.075	4.610 117.094	5.170 131.318	6.925 175.895
Overall length (in./cm)	64 163	62 157	68 173	72 183
Standard sealbore (minimum bore) (in./mm)	1.875 47.625	2.313 58.750	2.813 71.450	3.813 96.850
Housing threads (in./mm)	3.300 and 2.400 88.320 and 60.960	4.250 and 2.875 107.950 and 73.025	4.687 and 3.500 119.050 and 88.900	6.250 and 4.500 158.750 and 114.300
	Weatherford premium thread			
Working pressure (psi/MPa)	5,000 34.5			
Test pressure (psi/MPa)	7,500 51.7			
Nipple profile	Petroline® QN profile as standard, other manufacturers' profiles available on request.			
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line			
Rated working temperature (°F/°C)	30° to 300° -1° to 149°			
Fail-safe setting depth (ft/m)	1,000 305		2,000 610	
Operating pressures	1,500 psi (10.3 MPa) full open, 500 psi (3.4 MPa) full close		2,000 psi (13.8 MPa) full open, 1,000 (6.9 MPa) psi full close	
	These are estimated operating pressures, subject to verification			
Equalizing feature	Available on (E) versions of these safety valves—our reliable through the flapper equalizing technology.			
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).			
Flapper soft seal	Proprietary design of filled plastic material to provide a reliable low pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).			
Standard metallic materials	9 Chrome – 1 moly or 13% minimum chrome 80,000-psi (551.6-MPa) minimum yield as standard material for all housings and internal components. INCONEL® 718 flapper and seat material. MP 35 N power spring, piston rod, flapper pin and torsion spring. All materials are heat treated in accordance with NACE MR0175.			
Accessory tools	Lockout tool Wireline insert safety valve Control-line communication tool			
Tubing thread connection	As requested			
Design and manufacturing compliance	API Q1 and API 14A			
Class of service	3S2			

*Contact Weatherford for availability.

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Cement-Through Valves Models WCP(E)-5 and WCP(E)-10

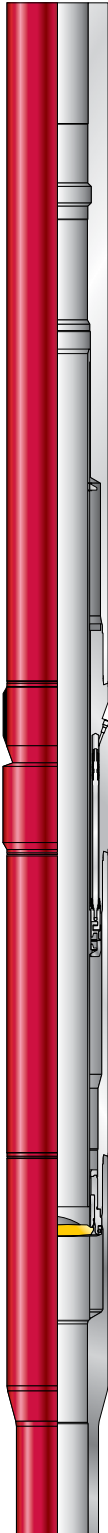
Model WCP(E)-10

Size* (in./mm)	2-3/8 60.3	2-7/8 73.0	3-1/2 88.9	4-1/2 114.3
Maximum OD (in./mm)	3.625 92.075	5.110 129.794	5.810 147.574	7.470 189.738
Overall length (in./cm)	64 163	62 157	68 173	72 183
Standard sealbore (minimum bore) (in./mm)	1.875 47.625	2.313 58.750	2.813 71.450	3.813 96.850
Housing threads (in./mm)	3.300 and 2.400 88.320 and 60.960	4.250 and 2.875 107.950 and 73.025	4.687 and 3.500 119.050 and 88.900	6.250 and 4.500 158.750 and 114.300
	Weatherford Premium Thread			
Working pressure (psi/MPa)	10,000 68.9			
Test pressure (psi/MPa)	15,000 103.4			
Nipple profile	Petrolin [®] QN Profile as standard, other manufacturers' profiles available on request			
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line.			
Rated working temperature (°F/°C)	30° to 300° -1° to 149°			
Fail-safe setting depth (ft/m)	2,000 610			
Operating pressures	2,000 psi (13.8 MPa) full open, 1,000 psi (6.9 MPa) full close			
	These are estimated operating pressures, subject to verification.			
Equalizing feature	Available on (E) versions of these safety valves—our reliable through the flapper equalizing technology			
Dynamic seal system	Proprietary design non-elastomeric rod piston seal stack, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).			
Flapper soft seal	Proprietary design of filled plastic material to provide a reliable low pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).			
Standard metallic materials	9 Chrome – 1 moly or 13% minimum chrome 80,000-psi (551.6-MPa) minimum yield as standard material for all housings and internal components. INCONEL [®] 718 flapper and seat material. MP 35 N power spring, piston rod, flapper pin and torsion spring. All materials are heat treated in accordance with NACE MR0175.			
Accessory tools	Lockout tool Wireline insert safety valve Control-line communication tool			
Tubing thread connection	As requested			
Design and manufacturing compliance	API Q1 and API 14A			
Class of service	3S2			

*Contact Weatherford for availability.

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Metal-to-Metal Deep-Set Models WDSP(E)-5 and WDSP(E)-10



Weatherford's Optimax™ series metal-to-metal, deep-set, tubing-retrievable, surface-controlled, subsurface safety valves (TRSCSSVs) are designed to maximize simplicity and reliability of operation, regardless of setting depth. Model WDSP(E)-5, rated to 5,000 psi (34.5 MPa) working pressure, and model WDSP(E)-10, rated to 10,000 psi (68.9 MPa), are premium rod-piston, flapper-type safety valves. Their design allows extremely deep setting depths, up to 25,000 ft (7,620 m).

All models feature the field-proven *Optimax* premium rod-piston mechanism for the most demanding applications. These mechanisms incorporate full-*open* and full-*closed* metal-to-metal piston stop seals as well as non-elastomeric dynamic seals for high durability and long life.

Integral parts of the completion string, the valves are controlled by a single hydraulic control line. A second control line allows closure assistance if required. Application of control-line pressure maintains the TRSCSSVs in the *open* position; when pressure is bled off, the TRSCSSVs close.

These valves are the first in the industry to use the benefits of well-assist closure on an ultradeep-set safety valve. Deep-set valves typically require either a large power-spring load or nitrogen-charged chambers to compensate for the higher hydrostatic control-line pressure. These valves, however, use a second, identical, uncoupled, premium piston assembly, with dedicated control line, to balance the hydrostatic control-line pressure and allow use of conventional power springs, typically used on shallow-set valves, for closure. This combination of low-force power spring and balance-line design allows for greater setting depths without the extremely high operating pressures normally associated with deep-set safety valves. In the event of uncontrolled flow, this “failsafe” closure protects property, personnel, and the environment.

In the event of malfunction, a lockout tool is deployed to adapt the valve to accept a model PB (pressure-balanced) subsurface-controlled insert safety valve, minimizing disruption to production operations.

Applications

- Fluid and gas environments in both production and injection applications
- Ultra-deep setting depths
- Subsea applications

Metal-to-Metal Deep-Set Models WDSP(E)-5 and WDSP(E)-10

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- The simple design of these safety valves incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.
- Metal-to-metal premium thread housing connections are standard to optimize reliability.
- The field-proven non-elastomeric dynamic seal system, with metal-to-metal rod-piston stop seals, avoids fluid compatibility and explosive decompression issues.
- The non-elastomeric flapper soft seat backs up the metal-to-metal primary seat for low-pressure seal integrity.
- The second rod-piston design enables unlimited setting depths.
- The lockout tool is designed for deployment, actuation, and retrieval by slickline to avoid complex operational requirements associated with coiled-tubing and electric-line operations.
- The additional control line allows remote exercising capabilities and can be used to circulate the hydraulic fluid as a maintenance measure that is not available in any other safety valve-design in the industry.

Metal-to-Metal Deep-Set Models WDSP(E)-5 and WDSP(E)-10

Specifications

Model	WDSP(E)-5				WDSP(E)-10			
Size (in./mm)	2-7/8 ^a 73.0	3-1/2 ^a 88.9	4-1/2 ^a 114.3	5-1/2 ^a 139.7	2-7/8 73.0	3-1/2 ^a 88.9	4-1/2 ^a 114.3	5-1/2 ^a 139.7
Maximum OD (in./mm)	4.600 116.840	5.160 131.064	6.920 175.768	7.700 195.580	5.100 129.540	5.570 141.478	7.470 189.738	8.100 205.74
Overall length (in./cm)	78 198	85 216	92 234	75 191	78 198	85 216	92 234	75 191
Standard sealbore (minimum bore) (in./mm)	2.313 58.750	2.813 71.450	3.813 96.850	4.750 120.650	2.313 58.750	2.813 71.450	3.813 96.850	4.750 120.650
Housing threads (in.) ^b	4.250 and 2.875 107.950 and 73.025	4.687 and 3.500 119.050 and 88.900	5.687 and 4.500 144.450 and 114.300	6.937 and 5.500 176.200 and 139.700	4.250 and 2.875 107.950 and 73.025	4.687 and 3.500 119.050 and 88.900	5.687 and 4.500 144.450 and 114.300	6.937 and 5.500 176.200 and 139.700
Working pressure (psi/MPa)	5,000 34.5				10,000 68.9			
Test pressure (psi/MPa)	7,500 51.7				15,000 103.4			
Nipple profile	Petrolite® QN profile as standard; other manufacturers' profiles available on request							
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line							
Rated working temperature (°F/°C)	30° to 300° -1° to 149°							
Operating pressure, full open (psi/MPa) ^c	2,000 13.8							
Operating pressure, full closed (psi/MPa) ^c	1,000 6.9							
Dynamic seal system ^d	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 15,000-psi (103.4-MPa) gas differential pressure at 300°F (149°C)							
Flapper soft seal	Proprietary design of non-elastomeric material to provide a reliable low-pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)							
Standard metallic materials ^e								
Housings and internal components	9 chrome, 1 moly, or 13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield							
Flapper and seat	Alloy 925 or 718							
Power spring, piston rod, flapper pin, and torsion spring	MP 35 N							
Accessory tools	Lockout tool, subsurface-controlled wireline insert safety valve, exercise tool							
Tubing thread connection	As requested							
Design and manufacturing compliance	API Q1 and API 14A							
Class of service	API 14A 3S2							

^aContact Weatherford for availability.

^bWeatherford premium threads

^cOperating pressures are estimated and are subject to verification.

^dP feature safety valves also contain metal-to-metal piston stop seals, which isolate the dynamic seals at the full-open and full-closed positions.

^eAll materials are heat-treated in accordance with NACE MR 01 75.

Annular Model WA(E)-5

Weatherford's Optimax™ model WA(E)-5 annular tubing-retrievable, surface-controlled, subsurface safety valve (TRSCSSV) is designed to shut in a well in the event of uncontrolled flow caused by equipment failure or damage. An integral part of the completion string, the WA(E)-5 TRSCSSV is controlled by a single hydraulic control line. Application of control-line pressure keeps the valve in the *open* position; when pressure is bled off, the valve closes to protect property, personnel, and the environment.

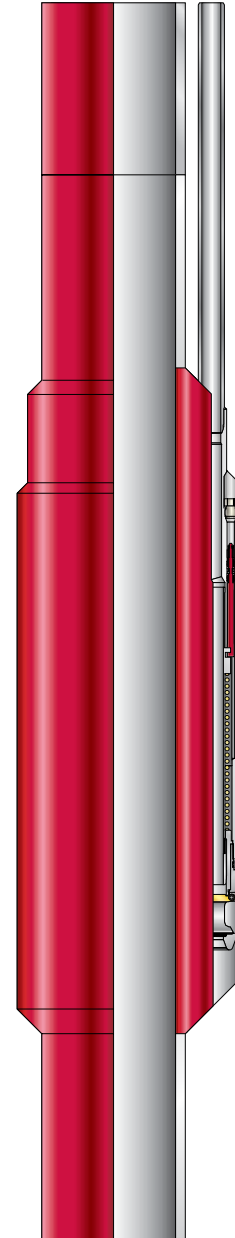
The model WA(E)-5 valve, like all *Optimax* series TRSCSSVs, is designed to maximize simplicity and reliability of operation. Conventional annular safety valves typically incorporate either poppet or sliding sleeve-type closure mechanisms, which increase the complexity of the valve design. In addition, their elastomeric components limit the life expectancy of conventional valves. The model WA(E)-5 valve, rated to 5,000 psi (35.2 MPa), features the field-proven rod-piston mechanism of the *Optimax* series valves for the most demanding applications. This mechanism incorporates non-elastomeric dynamic seals for high durability and long life. *Optimax* series valves are the first in the industry to incorporate the benefits of totally non-elastomeric operating and closure systems in an annular safety system.

Applications

- Production and injection applications in fluid and gas environments
- Gas-lift applications

Features, Advantages and Benefits

- Design, material, manufacturing, assembly, and test documentation retention in accordance with API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Several features of the model WA(E)-5 valve maximize reliability:
 - The hydraulic control system has only two potential leak paths (the industry minimum).
 - Metal-to-metal premium tubing thread connections are standard.
 - Single-piece housing reduces the number of potential leak paths.
 - The non-elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
- The simple design of this valve incorporates no sleeves, plugs, or other mechanisms that can be inadvertently actuated, causing premature control-line communication.
- The field-proven non-elastomeric dynamic seal system avoids fluid-compatibility and explosive-decompression issues, enhancing safety.



Annular Model WA(E)-5

Specifications

Size (in./mm) ^{a,b}	4-1/2 × 0.850 114.3 × 21.6	5-1/2 × 0.850 139.7 × 21.6	7 × 0.850 177.8 × 21.6
Maximum OD (in./mm)	6.500 165.100	7.500 190.500	9.000 228.600
Overall length (in./cm)	46 117		
Housing threads (in./mm) ^c	4-1/2 and 3/4 114.300 and 19.050	5-1/2 and 3/4 139.700 and 19.050	7 and 3/4 177.800 and 19.050
Working pressure (psi/MPa)	5,000 34.5		
Test pressure (psi/MPa)	7,500 51.7		
Control-line connection	Industry standard metal seal compression fitting for 1/4-in. (6.35-mm) control line		
Rated working temperature (°F/°C)	30° to 300° -1° to 149°		
Operating pressure, full open (psi/MPa) ^d	2,000 13.8		
Operating pressure, full closed (psi/MPa) ^d	1,000 6.9		
Dynamic seal system	Proprietary design non-elastomeric rod-piston seal stack, verified in tests to 15,000-psi (103.4-MPa) gas differential pressure at 300°F (149°C)		
Flapper soft seal	Proprietary design of non-elastomeric material to provide a reliable low-pressure seal, verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).		
Standard metallic materials ^e			
Housing and internal components	9 chrome, 1 moly, or 13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield		
Flapper and seat	Alloy 925 or 718		
Power spring, piston rod, flapper pin, and torsion spring	MP 35 N		
Tubing thread connection	As requested		
Design and manufacturing compliance	API Q1 and API 14A		
Class of service	API 14A 3S		

^aContact Weatherford for availability.

^bAnnular flow area is dependent on tubing casing combination. Listed flow area is the minimum achievable.

^cWeatherford premium threads.

^dOperating pressures are estimated and are subject to verification.

^eAll materials are heat-treated in accordance with NACE MR 01 75.

Model WLT Lockout Tool

Weatherford's Optimax™ series WLT lockout tool (patent pending) is designed for use in all *Optimax* series tubing-retrieveable, subsurface safety valves (TRSSSVs). This mechanical tool can be deployed in a single trip to permanently lock open a malfunctioning TRSSSV or to lock open a TRSSSV so that the tubing string can be pulled during workover operations.

The WLT lockout tool is deployed on slickline with spang jars and stem to lock out the TRSSSV in a five-stage process. The tool is landed in the TRSSSV nipple profile. Then the tool locks itself into position. It pushes the TRSSSV flow tube downward, which opens the flapper valve. Further downward jarring locates and radially expands a set of hardened balls against the flow-tube bore. Continued jarring expands the flow tube against the bore of the hard seat, which prevents the flow tube from closing and leaves the TRSSSV fully opened and locked. Because the lockout tool removes and implements the lockout mechanism from the TRSSSV, the reliability of both devices is enhanced.

Applications

- TRSSSV malfunction. The tool can lock open the TRSSSV before deployment of the WCT communication tool and the *Optimax* WIT-10 wireline-insert safety valve.
- Workover operations. The tool can lock open the TRSSSV before the tubing string is pulled.
- Gas or oil wells.

Features, Advantages and Benefits

- Tool deployment is controlled by slickline in five interdependent stages that ensure complete lockout and avoid accidental lockout.
- The simple mechanical operation of the tool improves efficiency and provides surface verification of the staged lockout process.
- The tool mechanism is self-contained so that no additional components are needed to lock open the TRSSSV.
- Single-trip deployment capability saves rig time.
- Robust design extends tool life.
- Upshear emergency release feature for the unlikely case in which the tool becomes stuck after installation in the valve or does not stroke fully during operation.



Model WLT Lockout Tool

Specifications

TRSSSV size and sealbores (in./mm)	2-3/8 × 1.875 60.3 × 47.6	2-7/8 × 2.312 73.0 × 58.7	3-1/2 × 2.812 88.9 × 71.4	4-1/2 × 3.812 114.3 × 96.8	5-1/2 × 4.562 139.7 × 115.9	7 × 5.963 177.8 × 151.5
Standard TRSSSV lock profile	Petroline® QN profile ¹					
Maximum OD, no-go (in./mm)	1.895 48.133	2.362 59.995	2.863 72.720	3.871 98.323	4.675 118.745	6.055 153.797
Maximum OD, tool body (in./mm)	1.756 44.602	2.138 54.305	2.508 63.703	3.634 92.303	4.395 111.633	5.690 144.526
Tool weight (lb/kg)	28 13	38 17	72 33	202 92	270 122	614 279
Overall length (in./cm)	65 165	62 158	77 195	106 268	112 283	149 378
Maximum working pressure (psi/MPa)	N/A					
Temperature rating (°F/°C)	N/A					
Metallic materials	AISI 4130 36-40 Rc complete with QPQ surface finish					
Tool-string connections	Sucker rod ²					

¹Tool can be configured for other manufacturers' lock profiles on request.

²Petroline QLS tool-string connections are also available.

Model WCT Control-Line Communication Tool

Weatherford's Optimax™ series model WCT communication tool (patent pending) provides hydraulic fluid communication into the bore of all Optimax series tubing-retrievable, subsurface safety valves (TRSSSVs). The tool is deployed after TRSSSV lockout for hydraulic control to communicate with and operate Weatherford's WIT-10 wireline-insert safety valve. The WCT communication tool has a modular design and consists of a motor, lock assembly, gearbox, milling head, and battery system. The tool also features a field-proven, high-temperature sensorless controller.

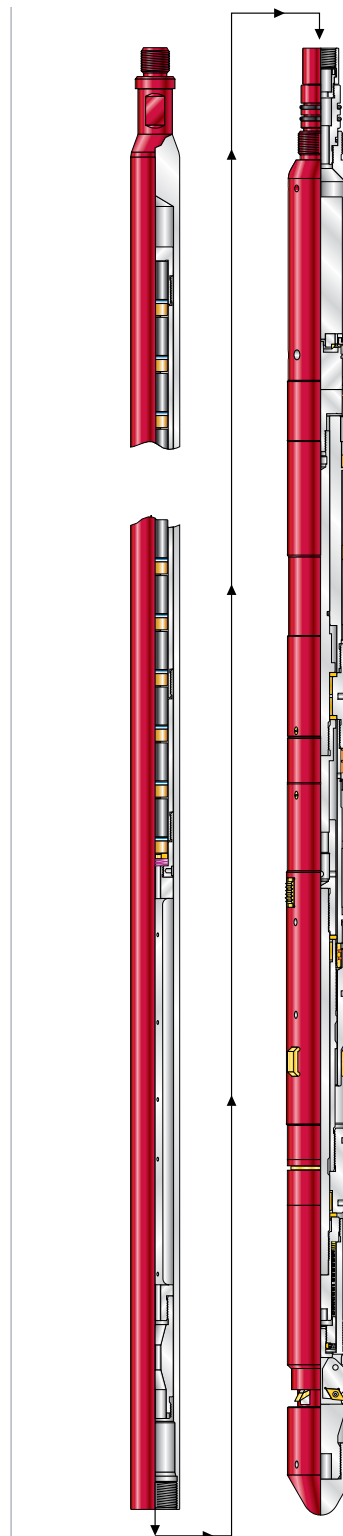
The WCT communication tool is designed to withstand temperatures up to 300°F (149°C) and pressures up to 10,000 psi (68.9 MPa). It can be deployed, used, and retrieved from the well in a single trip, using slickline, coiled tubing, or electric line. After the tool is accurately positioned and locked into the TRSSSV nipple profile, milling is initiated into the TRSSSV chamber housing piston bore. After milling is completed, the tool is released with upward jarring and then retrieved. After hydraulic communication is attained, the Weatherford wireline-insert safety valve can be used to maintain well integrity.

Applications

- Hydraulic control of a Weatherford wireline-insert safety valve after TRSSSV lockout

Features, Advantages and Benefits

- Modular design makes the WCT communication tool adaptable for a range of TRSSSV sizes and configurations and enables easy assembly on the floor rig.
- Modular design also allows removal of the communication feature from the TRSSSV, thereby eliminating potential leak paths within the hydraulic system of the TRSSSV.
- The slickline version of the tool uses high-power, rechargeable batteries that are thermally protected for long life downhole.
- Field-proven, sensorless brushless DC motor eliminates electromagnetic interference and provides longer life and greater energy efficiency.
- Simple downward/upward jarring functionality for setting/releasing enables single-trip operation, saving rig time.
- Anti-rotation buttons ensure transmission of torque, thus improving milling efficiency.
- Locking-dog actuation ensures that milling can be initiated only when the tool is correctly positioned within the TRSSSV, thus preventing inadvertent damage to the production tubing.



Model WCT Control-Line Communication Tool

Specifications

TRSSSV size and sealbores (in./mm)	2-3/8 × 1.875 60.3 × 47.6	2-7/8 × 2.312 73.0 × 58.7	3-1/2 × 2.812 88.9 × 71.4	4-1/2 × 3.812 114.3 × 96.8	5-1/2 × 4.562 139.7 × 115.9	7 × 5.963 177.8 × 151.5
Standard TRSSSV lock profile	Petroline® QN profile ¹					
Maximum OD, no-go (in./mm)	1.890 48.006	2.330 59.182	2.827 71.806	3.828 97.231	4.578 116.281	6.050 153.670
Maximum OD, tool body (in./mm)	1.857 47.168	2.310 58.674	2.795 70.993	3.795 96.393	4.544 115.418	5.980 151.892
Tool weight (lb/kg)	70 32	75 34	80 36	100 45	125 57	150 68
Overall length (in./cm)	146 372	142 360	144 367	124 314	125 317	125 317
Maximum working pressure (psi/MPa)	10,000 68.9					
Temperature rating (°F/°C)	30 to 300° -1° to 149°					
Metallic materials	AISI 4130 36-40 Rc complete with QPQ surface finish					
Tool-string connections	Sucker rod ²					

¹Tool can be configured for other manufacturers' lock profiles on request.

²Petroline QLS tool-string connections are also available.

Wireline-Retrievable, Surface-Controlled, Subsurface Safety Valves

Distinguishing Design Features



Flapper and seat

The standard design incorporates a flat flapper/seat interface with a resilient secondary soft seat. Special attention to flapper-hinge geometry ensures maximum sealing capability, even in debris-laden environments. Unique interface geometry ensures maximum sealing capability as well as stability during slam closures and high-pressure differentials.

Hydraulic system

The reliability of the hydraulic system in the Optimax™ series safety valves is enhanced by multiple design features. The *Optimax* series of wireline safety valves incorporates a unique offset rod-piston design. This unique feature provides significant increases in flow area through the valve, 10-30% larger flow area than our competitors' valves. The preparation and finish of the hydraulic cylinder sealbore is unique to the industry and extends the life expectancy of the dynamic seals.

Equalizing system

The *Optimax* series safety valve is offered with self-equalizing capability using the field-proven, metal-to-metal, through-the-flapper equalizing technology.

This system provides an equalizing flow path that prevents flow directly across the critical metal-to-metal seal interface.

Models WVE-10, WVN-10 and WIT-10

Weatherford's Optimax™ series wireline-retrieveable, surface-controlled, subsurface safety valves, models WVE-10, WVN-10 and WIT-10, are rod-piston actuated, flapper valves designed to shut in a well during an uncontrolled flow caused by equipment failure or damage.

An integral part of the valves function is the capability to apply pressure through the control line. The WVE-10 and WVN-10 safety valves are designed for use in a safety-valve landing nipple (WNI), which is part of the tubing string and is connected by control line to surface. The WIT-10 safety valve is designed for use in a locked-open and communicated TRSV, which is connected by control line to surface. While the WVE-10, WVN-10 and WIT-10 all operate in the same manner, the WIT-10 uses a spacer tube that aligns the seals across the appropriate sealbores of the TRSV. Application of control-line pressure keeps the valve open during well production or injection. When pressure is bled off during an uncontrolled flow, the valve closes on command to protect property, personnel, and the environment.

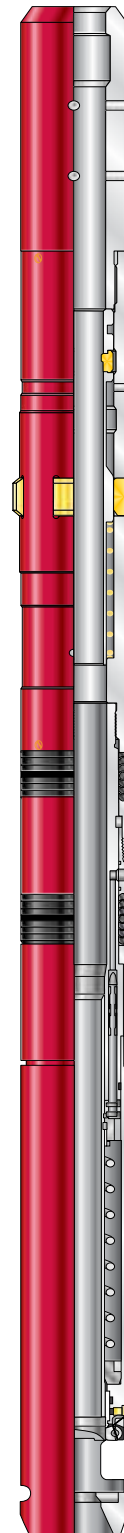
Each model can be installed and retrieved on slickline and is installed using an *Optimax* OQXSV safety-valve lock. The standard *Optimax* OQXSV safety-valve lock is a large-bore version of Weatherford's Petroliner® QXSV lock.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- The design, material, manufacturing, assembly, and test documentation retention according to API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Several features of the models maximize reliability:
 - The reduction in the number of seals minimizes potential leak paths and simplifies redressing.
 - The hydraulic control system has only two potential leak paths, the industry minimum.
 - The elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
- The eccentric valve design enables use of flat-flapper technology while maintaining a large throughbore, yielding up to 30 percent larger flow areas than other products, and a lower flowing pressure drop.



Models WVE-10, WVN-10 and WIT-10

Features, Advantages and Benefits (continued)

- The flat flapper, mounted eccentrically, provides an equivalent bore to curved-flapper designs. The flat flapper and seat require only simple lapping to remove slight imperfections discovered during redress, saving time in the field.
- The chevron-type packing can be totally replaced without disassembling or disturbing the valve internals, saving time.
- Elastomeric dynamic rod-piston seal is used with bearing backup rings.
- The minimized number of threaded connections minimizes leak paths and reduces the potential for galling damage.

Specifications

Size (in./mm)	2-3/8 × 1.875 60.3 × 47.6	2-7/8 × 2.188 73.0 × 55.6	2-7/8 × 2.313 73.0 × 58.8	3-1/2 × 2.75 88.9 × 69.9	3-1/2 × 2.813 88.9 × 71.5
Maximum lock no-go OD (in./mm)	1.928 48.971	2.243 56.972	2.366 60.096	2.803 71.196	2.866 72.796
Maximum safety valve OD (in./mm)	1.862 47.295	2.175 55.245	2.302 58.471	2.740 69.596	2.801 71.145
Standard sealbore (minimum bore) (in./mm)	0.787 19.990		1.291 32.791	1.575 40.005	1.630 41.402
Working pressure (psi/MPa)	10,000 68.9				
Test pressure (psi/MPa)	15,000 103.4				
Rated working temperature (°F/°C)	30 to 300 -1 to 149				
Fail-safe setting depth (ft/m)	2,000 610				
Operating pressure, full open ¹ (psi/MPa)	2,000 13.8				
Operating pressure, full closed ¹ (psi/MPa)	1,000 6.9				
Dynamic seal system	Rod piston with proprietary Viton® elastomeric T-seal and bearing backup rings of Teflon® filled with molybdenum disulfide solid lubricant, verified in tests to a 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)				
Flapper soft seal	Proprietary Viton seal material to provide a reliable low-pressure seal				
Standard metallic materials ²					
Lock and most safety-valve components	13% minimum chrome 80,000-psi (551.6-MPa) minimum yield				
Piston rod, flapper, and seat	INCOLOY® 925				
Power spring, flapper pin, and torsion spring	MP 35 N				
Design and manufacturing compliance	API Q1 and API 14A				
Class of service	API 14A 3S2				

¹Estimated, subject to verification

²All materials are heat-treated according to NACE MR 01 75

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Models WVE-10, WVN-10 and WIT-10

Size (in./mm)	4-1/2 × 3.688 114.3 × 93.7	4-1/2 × 3.813 114.3 × 96.9	5-1/2 × 4.562 139.7 × 115.9	5-1/2 × 4.578 139.7 × 116.3	5-1/2 × 4.75 139.7 × 120.7
Maximum lock no-go OD (in./mm)	3.749 95.225	3.873 98.374	4.622 117.399	4.638 117.805	4.808 122.123
Maximum safety valve OD (in./mm)	3.677 93.396	2.803 71.196	4.551 115.595		4.740 120.396
Standard sealbore (minimum bore) (in./mm)	2.335 59.309	2.461 62.509	2.953 75.006		
Working pressure (psi/MPa)	10,000 68.9				
Test pressure (psi/MPa)	15,000 103.4				
Rated working temperature (°F/°C)	30 to 300 -1 to 149				
Fail-safe setting depth (ft/m)	2,000 610				
Operating pressure, full open ¹ (psi/MPa)	2,000 13.8				
Operating pressure, full closed ¹ (psi/MPa)	1,000 6.9				
Dynamic seal system	Rod piston with proprietary Viton® elastomeric T-seal and bearing backup rings of Teflon® filled with molybdenum disulfide solid lubricant, verified in tests to a 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)				
Flapper soft seal	Proprietary Viton seal material to provide a reliable low-pressure seal				
Standard metallic materials ²					
Lock and most safety-valve components	13% minimum chrome 80,000-psi (551.6-MPa) minimum yield				
Piston rod, flapper, and seat	INCOLOY® 925				
Power spring, flapper pin, and torsion spring	MP 35 N				
Design and manufacturing compliance	API Q1 and API 14A				
Class of service	API 14A 3S2				

¹Estimated, subject to verification²All materials are heat-treated according to NACE MR 01 75

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Models WVE-10, WVN-10 and WIT-10

Specifications (continued)

Size (in./mm)	7.000 × 5.813 × 5.750 177.8 × 147.7 × 146.1	7.000 × 5.875 × 5.813 177.8 × 149.2 × 147.7	7.000 × 6.000 × 5.963 177.8 × 152.4 × 151.5	9-5/8 × 8.410 × 8.375 244.4 × 213.6 × 212.7
Maximum lock no-go OD (in./mm)	5.893 149.682	5.955 151.257	6.080 154.432	8.416 213.766
Maximum safety valve OD (in./mm)	5.740 145.796	5.803 147.396	5.953 151.206	8.377 212.775
Standard sealbore (minimum bore) (in./mm)	3.622 91.999			6.000 152.400
Working pressure (psi/MPa)	10,000 68.9			
Test pressure (psi/MPa)	15,000 103.4			
Rated working temperature (°F/°C)	30 to 300 -1 to 149			
Fail-safe setting depth (ft/m)	2,000 610			
Operating pressure, fully open ¹ (psi/MPa)	2,000 13.8			
Operating pressure, fully closed ¹ (psi/MPa)	1,000 6.9			
Dynamic seal system	Rod piston with proprietary Viton® elastomeric T-seal and bearing backup rings of Teflon® filled with molybdenum disulfide solid lubricant, verified in tests to a 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)			
Flapper soft seal	Proprietary Viton seal material to provide a reliable low-pressure seal			
Standard metallic materials ²				
Lock and most safety-valve components	13% minimum chrome 80,000-psi (551.6-MPa) minimum yield			
Piston rod, flapper, and seat	INCOLOY® 925			
Power spring, flapper pin, and torsion spring	MP 35 N			
Design and manufacturing compliance	API Q1 and API 14A			
Class of service	API 14A 3S2			

¹Estimated, subject to verification²All materials are heat-treated according to NACE MR 01 75

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Models WVE-10, WVN-10 and WIT-10

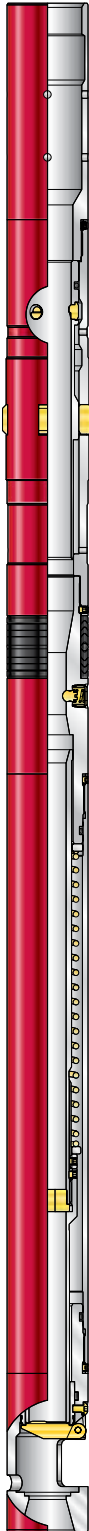
Options

- A robust, field-proven, through-the-flapper, self-equalizing subassembly is available for the model WVE-10. This subassembly is simple to operate.
- The safety valve can be configured to accept any manufacturer's lock.
- A wide choice of seal materials is available to ensure fluid compatibility.

Available Accessories

- Optimax™ OQXSV running tool
- *Optimax* OQXSV pinning handle
- *Optimax* OQXSV pulling probe
- *Optimax* running prong
- *Optimax* pulling probe

Model WWV-10



Weatherford's Optimax™ series wireline-retrievable subsurface-controlled subsurface safety valve, model WWV-10, is a flapper velocity safety valve designed to shut in a well during an uncontrolled flow caused by equipment failure or damage. The valve has a similar design and many of the same parts as Weatherford's *Optimax* series wireline-retrievable surface-controlled subsurface safety valve. When the valve is exposed to a pre-determined flow rate, it closes to seal off the well and acts as a barrier to flow.

The valve usually remains open in the well for production to flow to the surface. If well control is compromised, the increased flow rate causes a pressure drop across the orifice. The orifice and spring are sized so that, at a specified flow rate, the orifice and flow tube move upward, compressing the power spring. The tube then frees the flapper to swing closed, sealing the well. The closure protects property, personnel, and the environment. A probe, run on wireline, unseats the equalizing dart in the equalizing subassembly when the valve is to be re-opened or retrieved.

The valve has no setting depth limitation, and is installed and retrieved on slickline. The standard *Optimax* OQXSV safety-valve lock is a large-bore version of Weatherford's Petrolin[®] QXSV lock.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- The design, material, manufacturing, assembly, and test documentation retention according to API Q1 and API 14A quality programs ensure design and manufacturing integrity and conformance to industry standards.
- Several features of the model maximize reliability:
 - The reduction in the number of seals minimizes potential leak paths and simplifies redressing.
 - The elastomeric flapper soft seat reinforces the primary metal-to-metal seat for low-pressure seal integrity.
 - The orifice is manufactured from INCONEL[®] 718 material heat treated to a maximum of 40 Rockwell hardness C scale to avoid the effects of erosion.
- The chevron packing can be totally replaced without disassembling or disturbing the valve internals, saving time.
- Minimizing the number of threaded connections minimizes leak paths and reduces the potential for galling damage during redress.
- The robust, field-proven equalizing feature provides a simple, safe operation, and retrieval.

Model WWV-10

Specifications

Size* (in./mm)	3-1/2 88.9		4-1/2 114.3
Maximum valve OD (in./mm)	2.70 68.58	2.80 71.12	3.60 91.44
Minimum bore	Depends on the selected orifice size		
Overall length (in./cm)	40 102		
Standard safety-valve lock	Optimax OQXSV		
Working pressure (psi/MPa)	10,000 68.9		
Test pressure (psi/MPa)	15,000 103.4		
Rated working temperature (°F/°C)	30° to 300° -1° to 149°		
Standard flapper soft seal	Proprietary Viton® seal material to provide a reliable low-pressure seal		
Standard O-ring and packing seal material	Viton material. Specified based on environmental compatibility.		
Metallic materials	As required for environmental considerations with an 80,000-psi (551.6-MPa) minimum yield		

*Contact a Weatherford representative for availability.

Options

- A wide choice of designs and materials are available to ensure fluid compatibility and to configure the valve to specific requirements.
- A spreadsheet program is available to ensure that the correct orifice size and spring and spring-spacer combination are specified for any required closure condition.
- A robust, field-proven, through-the-flapper, self-equalizing subassembly is available to keep flow within the tube. The subassembly has a simple operation.
- The safety valve can be configured to accept any manufacturer's lock.

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Renaissance™ System:
Wireline-Retrievable,
No-Workover
Safety Valves

Renaissance System: Wireline-Retrieveable, No-Workover Safety Valves

A revolutionary approach to wellbore revival, Weatherford's *Renaissance* safety-valve system originated from Weatherford's Optimax™ valve technology—proven to be the toughest valves in the industry. Combining recent advances in valve technology with patent-pending new technology, the new system provides an integrated, single-source approach to renew wells suffering from three types of safety-valve-related problems:

Damaged control lines. When dealing with damaged control lines for subsurface safety valves (SSSVs) offshore, the new *Renaissance* WDCL (Weatherford damaged control line) safety valve can restore safe operation and bring the well back on line without a workover—significantly reducing costs. The WDCL also can be used to retrofit safety valves on wells that currently do not have safety valves.

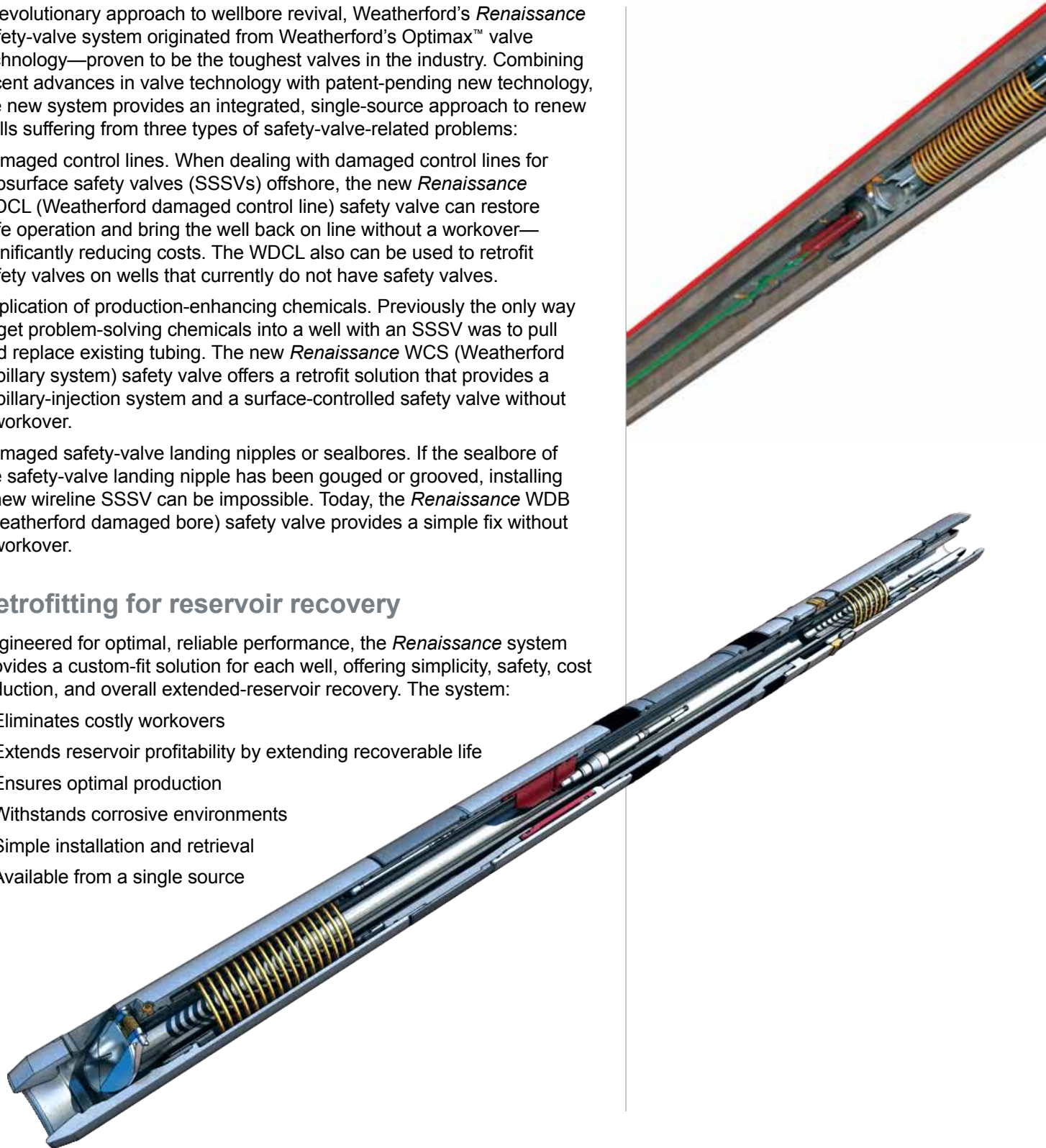
Application of production-enhancing chemicals. Previously the only way to get problem-solving chemicals into a well with an SSSV was to pull and replace existing tubing. The new *Renaissance* WCS (Weatherford capillary system) safety valve offers a retrofit solution that provides a capillary-injection system and a surface-controlled safety valve without a workover.

Damaged safety-valve landing nipples or sealbores. If the sealbore of the safety-valve landing nipple has been gouged or grooved, installing a new wireline SSSV can be impossible. Today, the *Renaissance* WDB (Weatherford damaged bore) safety valve provides a simple fix without a workover.

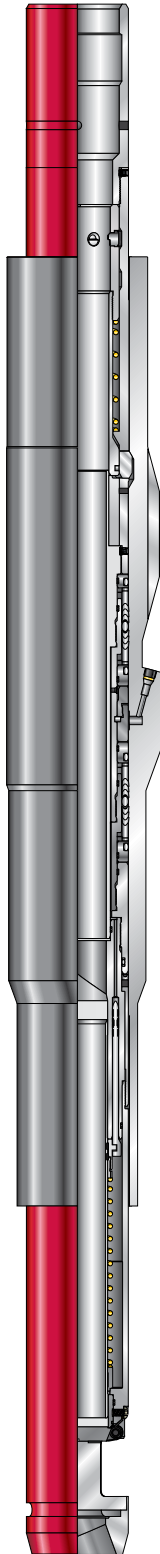
Retrofitting for reservoir recovery

Engineered for optimal, reliable performance, the *Renaissance* system provides a custom-fit solution for each well, offering simplicity, safety, cost reduction, and overall extended-reservoir recovery. The system:

- Eliminates costly workovers
- Extends reservoir profitability by extending recoverable life
- Ensures optimal production
- Withstands corrosive environments
- Simple installation and retrieval
- Available from a single source



Model WDB



Weatherford's Optimax™ WDB wireline-retrievable, subsurface safety valve (WRSSSV) is a standard valve-and-lock assembly featuring a unique modified packing mandrel (patent pending), designed to be set and sealed in damaged landing nipples. Application of force to the packing stacks vastly improves the sealing capabilities of the valve. Floating pistons, activated by tubing pressure from one side and control-line pressure from the other, energize the packing stacks.

Damage to nipple hone bores, such as grooving or gouging, can be caused by operational running of tools through the nipple and operations such as snubbing. Damaged hone bores, debris, or corrosion can prevent conventional wireline and insert valves from functioning properly and result in loss of well control, intermittent service, or possible damage to other insert equipment in the completion. Effective sealing of the WDB in these conditions can eliminate the need for a costly workover.

Like all Weatherford *Optimax* valves, the WDB WRSSSV is rigorously tested to procedural and acceptance criteria that exceed API 14A requirements.

Applications

- Seals in damaged safety-valve landing nipples with grooves or gouges up to 0.039 in. (1 mm)
- Seals in damaged hone bores of tubing-retrievable subsurface safety valves (TRSSSVs) with grooves or gouges up to 0.039 in. (1 mm)
- Seals in conventional tubing-retrievable safety valves (TRSVs) or landing nipples where debris or corrosion on the nipple hone bore prevents sealing of conventional wireline-retrievable or insert valves
- Is suitable for sour- and critical-well applications

Features, Advantages and Benefits

- The WDB WRSSSV seals, to API standard, sealbores with damage to 0.039 in. (1 mm) deep, which eliminates the need for costly workovers.
- The standard design of the WDB safety-valve assembly means standard installation and retrieval procedures can be used, with no additional accessory tools or special procedures required.
- Installation does not reduce ID or restrict flow. Optimal production is maintained with the larger throughbore and flow area.
- The packing stacks do not energize until they are seated in the nipple. This feature simplifies installation and retrieval of the valve, as there is no squeeze on the seals.
- The WDB WRSSSV, like all *Optimax* valves, includes field-proven, metal-to-metal, through-the-flapper equalizing technology for the ultimate in durability and reliability to protect people, property, and the environment.

Model WDB

- The WDB WRSSSV can be designed to fit competitors' lock profiles.
- Dynamic seal system: The rod piston, with proprietary design Viton® elastomeric T-seal and moly-filled Teflon® bearing backup rings, is verified in tests to 10,000-PSI (68.9-MPa) gas differential pressure at 300°F (149°C).
- Flapper soft seal: The proprietary design of the Viton seal material provides a reliable low-pressure seal.

Specifications

Size (in./mm)	2-7/8 × 2.313 73.0 × 58.8	3-1/2 × 2.813 89.9 × 71.5		4-1/2 × 3.437 114.3 × 87.3	4-1/2 × 3.813 114.3 × 96.9			5-1/2 × 4.562 139.7 × 115.9
Nipple profile	X	RRQ	B	DB-6	B	RRQ	DB-6	RRQ
Maximum lock OD (in./mm)	2.281 57.937	2.878 73.101	2.868 72.847	3.488 88.595	3.860 98.044	3.858 97.993	3.860 98.044	4.620 117.348
Minimum flowing ID (in./mm)	1.180 29.972	1.433 36.398	1.433 36.398	1.630 41.402	2.165 54.991	2.165 54.991	2.165 54.991	2.465 62.611
Overall length (in./cm)	48 121	62 158	58 147	55 141	59 150	64 163	59 150	63 159
Working temperature (°F/°C)	30° to 300° -1° to 149°							
Working pressure (psi/MPa)	6,500 44.8	6,000 41.4	6,000 41.4	6,500 44.8	6,500 44.8	5,000 34.5	5,000 34.5	5,000 34.5
Operating pressure full open (psi/MPa)	2,000 13.8							
Operating pressure full closed (psi/MPa)	1,000 6.9							
Test pressure (psi/MPa)	9,750 67.2	9,000 62.1	9,000 62.1	9,750 67.2	9,750 67.2	7,500 51.7	7,500 51.7	7,500 51.7
Failsafe setting depth (ft/m)	2,000 610							
Materials								
Actuation system	Rod piston Viton elastomeric T-seal and moly-filled Teflon bearing backup rings, verified to 10,000 psi (68.9 MPa) gas differential pressure at 300°F (149°C)							
Flapper soft material	Viton Seal							
Lock and majority of safety-valve components	Minimum 13Cr, 80,000-psi (551.6-MPa) minimum yield, heat treated							
Rod piston, flapper, seat	INCOLOY® 925, heat treated							
Power spring, flapper pin, torsion spring	MP35N, heat treated							
Design compliance	API 14A							
Manufacturing compliance	API Q1 and API 14A							
Class of service	3S2							

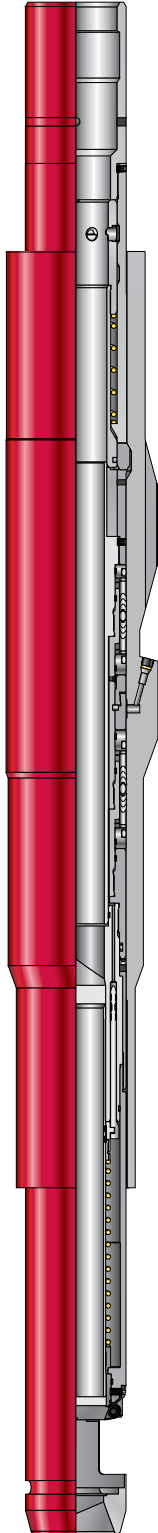
*Contact an authorized Weatherford representative for availability.

Options

- WDB(E) includes a self-equalizing feature through the flapper of the valve.

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Model WDCL



Weatherford's Optimax™ WDCL wireline-retrievable, subsurface safety valve is used in a well with a damaged, blocked or leaking control line. The valve-and-lock assembly is installed in an existing tubing-mounted safety valve, or safety-valve landing nipple with control-line failure, or standard flow control nipple. In an environmentally sensitive area, the fail-safe WDCL valve replaces a standard tubing-mounted or wireline safety valve.

The WDCL valve has a unique, modified packing mandrel (patent pending) and wet connection. The valve is set and sealed in landing nipples and tubing-mounted safety valves with damaged or blocked lines. Then a capillary line is run from the surface on the tubing ID for valve control.

The valve is rigorously tested to procedural and acceptance criteria exceeding the requirements of American Petroleum Institute (API) specification 14A.

Applications

- Seals in safety-valve landing nipples and tubing safety valves in which communication through the control lines is impossible
- Sour- and critical-well applications

Features, Advantages and Benefits

- The standard design enables the use of standard wireline and cap-string procedures.
- The Viton® flapper soft seal material provides excellent heat and chemical resistance for a reliable low-pressure seal.
- The valve uses field-proven, metal-to-metal, through-the-flapper equalizing technology for ultimate durability and reliability to protect persons, property, and the environment.

Model WDCL

Specifications

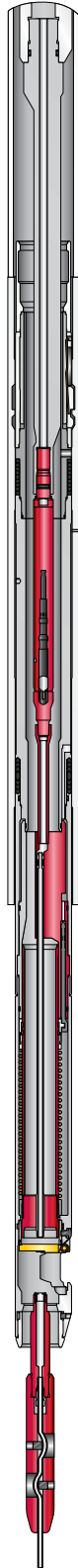
Size (in./mm)	3-1/2 × 2.810 88.90 × 71.37	4-1/2 × 3.810 114.30 × 96.77
Nipple Profile		
Maximum lock no-go OD (in./mm)	2.858 72.593	3.858 97.993
Overall length (in./cm)	64 163	68 173
Working temperature (°F/°C)	30° to 300° -1° to 149°	
Working pressure (psi/MPa)	5,000 34.5	
Operating pressure, full open (psi/MPa)	2,000 13.8	
Operating pressure, full closed (psi/MPa)	1,000 6.9	
Test pressure (psi/MPa)	7,500 51.7	
Fail-safe setting depth (ft/m)	2,000 610	
Materials		
Dynamic seal actuation system	Rod piston Viton® elastomeric T-seal and Teflon® bearing backup rings filled with molybdenum verified to a 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)	
Flapper soft material	Viton seal	
Lock and most safety-valve components	13% minimum chrome; 80,000-psi (551.6-MPa) minimum yield; heat treated	
Piston rod, flapper, and seat	Heat-treated INCOLOY® alloy 925	
Power spring, flapper pin, and torsion spring	Heat-treated MP35N alloy	
Design specification	API 14A	
Manufacturing specification	API Q1 and API 14A	
Service class	3S2	

Options

- The valve can be modified to model WDCL(E) with a self-equalizing feature through the valve flapper.
- The valve can be designed to fit the lock profiles of other companies.

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Model WCS



Weatherford's Optimax™ WCS wireline-retrievable subsurface safety valve (WRSSSV) is a standard valve-and-lock assembly featuring a unique patent pending modified packing mandrel, wet connect, and chemical feed-through designed to be set and sealed in landing nipples and tubing mounted safety valves as part of Weatherford's capillary-string chemical-delivery system. After running and setting the valve, a capillary-control line is run from the surface on the ID of the tubing for chemical delivery. The capillary string is hung from the bottom of the valve assembly to allow delivery of chemicals, such as foaming agents, scale inhibitors, and others.

Wells experiencing liquid loading, scaling, asphaltene deposition, etc., can lead to costly workovers to replace the existing completions in environmentally sensitive areas. By utilizing the *Optimax* WCS these costs can be saved and the wells put back on production in the minimal amount of time at a small percentage of the cost of a workover.

Like all Weatherford *Optimax* valves, the WCS WRSSSV is rigorously tested to procedural and acceptance criteria that exceed API 14A requirements.

Applications

- Seals in existing safety-valve landing nipples and tubing safety valves where chemical injection is a requirement. Suitable for sour and critical well applications.
- The standardized design allows the use of standard wireline and cap string procedures.

Features, Advantages and Benefits

- The WCS WRSSSV, like all *Optimax* valves, includes field-proven, metal-to-metal, through-the-flapper equalizing technology for the ultimate in durability and reliability to protect people, property, and the environment.
- The WCS WRSSSV can be designed to fit competitors' lock profiles.
- Dynamic seal system: The rod piston, with proprietary design Viton® elastomeric T-seal and moly-filled Teflon® bearing backup rings, is verified in tests to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C).
- Flapper soft seal: The proprietary design of the Viton seal material provides a reliable low-pressure seal.

Model WCS

Specifications

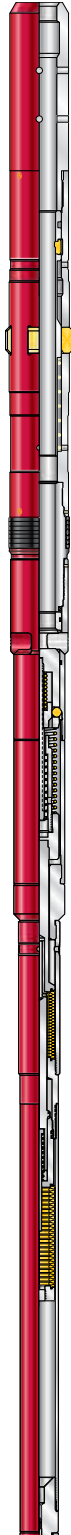
Size (in./mm)	3-1/2 × 2.810 89.9 × 71.4	4-1/2 × 3.810 114.3 × 96.8	4-1/2 × 3.810 114.3 × 96.8	5-1/2 × 4.562 139.7 × 115.9	7 × 5.963 177.8 × 151.5
For nipple profile				—	—
Maximum lock no-go OD (in./mm)	2.868 72.847	3.860 98.044	3.858 97.993	4.622 117.399	6.080 154.432
Overall length (in./mm)	57.70 1,466	59.05 1,500	64.00 1,626	72.00 1,829	84.00 2,134
Working temperature (°F/°C)	30° to 300° -1° to 149°				
Working pressure (psi/kPa)	6,000 41,368.5	6,500 44,815.9	5,000 34,473.8	10,000 68,947.6	
Operating pressure, fully open (psi/kPa)	2,000 13,789.5				
Operating pressure, fully closed (psi/kPa)	1,000 6894.8				
Test pressure (psi/kPa)	9,000 62,052.8	9,750 67,223.9	7,500 51,710.7	15,000 103,421.4	
Failsafe setting depth (ft/m)	2,000 610				
Materials					
Actuation system	Rod piston Viton® elastomeric T-seal and moly-filled Teflon® bearing backup rings, verified to 10,000-psi (68.9-MPa) gas differential pressure at 300°F (149°C)				
Flapper soft material	Viton seal				
Lock and majority of safety valve components	13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield, heat treated				
Piston rod, flapper, and seat	INCOLOY® 925, heat treated				
Power spring, flapper pin, and torsion spring	MP35N, heat treated				
Design compliance	API 14A				
Manufacturing compliance	API Q1 and API 14A				
Class of service	3S2				

Options

- WCS(E) includes a self-equalizing feature through the flapper of the valve.

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Models PB and HP-PB



Weatherford's Model PB and Model HP-PB safety valves are wireline-retrievable, poppet-type, subsurface-controlled subsurface safety valves, available in 3,000 psi (20.6 MPa) and 10,000 psi (68.9 MPa) operating pressure variants. There is no setting depth limitation associated with this design. Each valve model is tubing-pressure sensitive and can be adjusted to close at a pre-set tubing pressure. Weatherford's subsurface-controlled, gas-lift valve technology has been applied to create a Nitrogen dome-charged, bellows-operated safety valve which can be adjusted to close at a predetermined tubing pressure between 50 psi (0.344 MPa) and 10,000 psi (68.9 MPa).

Each valve model is normally open and will remain in this position in the well to allow production to flow to the surface. If well control is compromised, the tubing pressure will fall to a predetermined pressure where the valve is set to close. Following closure, each model is designed to automatically "re-cock" and re-open as soon as equalization is achieved, either by pressuring the tubing string or deploying a wireline equalizing prong. The safety valve is then automatically returned to the *open* position. Each valve model has no setting depth limitation and can be installed in any existing seating nipple or, by utilizing the PB Packer, set in tubing strings with damaged or no pre-existing nipple profiles.

These valve models are particularly suited for installation in tubing-retrievable safety valves that have suffered control-line failure, offering the advantage that communication is not required.

The Model PB valve has an operating range of 50 to 3,000 psi (0.344 to 20.6 MPa); the Model HP-PB valve has an operating range of 100 to 10,000 psi (0.689 MPa to 68.9 MPa). The standard safety-valve lock for the Model PB and Model HP-PB safety valves is the Optimax™ OQXSV lock, which is a large-bore version of the Petroline® QX lock. This ambient pressure safety valve, however, can be configured to accept any manufacturer's lock.

Applications

- Fluid and gas environments
- Production and injection situations where a barrier is needed to flow

Features, Advantages and Benefits

- Design, material manufacturing, assembly, and test documentation retention are in accordance with API Q1 and API 14A quality programs and are certified to OCS/API specifications, ensuring integrity to industry standards.

Models PB and HP-PB

- Several features of the Model PB and Model HP-PB safety valves maximize reliability, safety, and repeatable performance:
 - These valves are wireline installed and retrieved.
 - Each model offers a large flow area with no flow through the internal working parts of the safety valve.
 - Since closing force is transmitted through the liquid-filled bellows, there are no hydraulic seals.
 - The operating bellows protection unit is self-contained.
 - The valve’s snap-action closure avoids valve disc “throttling” in the flow stream.
 - With the appropriate test stand, the safety valve can be field tested and reset.
 - These safety valves can be retrofitted in wells with no existing hydraulic control line or emergency shut down (ESD) system. Since each valve model is subsurface controlled, there is no practical setting-depth limitation.
 - Each valve model can be adapted to any manufacturer’s lock or tubing plug.
 - Re-opening the valve is accomplished in-situ, either by applying pressure down the tubing string or with an “equidapter” sub fitted by a wireline-deployed equalizing probe.

Specifications

PB Technical Data*

Tubing Nominal OD (in./mm)	Maximum Valve OD (in./mm)	Minimum Nipple Required (in./mm)	Minimum Tubing ID around Valve (in./mm)	Seat ID (in./mm)	Minimum Flow Area (in. ² /mm ²)	Operating Pressure (psi/MPa)	Legacy Part Number	JDE PN	API Class
2.375 60.325	1.750 44.450	1.875 47.625	1.845 46.863	0.875 22.225	0.601 15.265	50 to 3,000 0.34 to 20.68	8102-001	90004305	3S
2.875 73.025	2.250 57.150	2.312 58.725	2.358 59.893	1.250 31.750	1.227 31.166	50 to 3,000 0.34 to 20.68	8103-001	90004306	3S
3.500 88.900	2.500 63.500	2.750 69.850	2.878 73.101	1.625 41.275	2.074 52.680	50 to 3,000 0.34 to 20.68	8104-001	90004307	3S
4.500 114.300	3.000 76.200	3.812 96.825	3.606 91.592	2.000 50.800	3.141 79.781	50 to 3,000 0.34 to 20.68	8106-002	340293	non-certified
5.000 127.000	3.718 94.437	4.125 104.775	4.480 113.792	2.718 69.037	5.802 147.370	50 to 3,000 0.34 to 20.68	8108-002	340294	non-certified

PB II Technical Data*

Tubing Nominal OD (in./mm)	Maximum Valve OD (in./mm)	Minimum Nipple Required (in./mm)	Minimum Tubing ID around Valve (in./mm)	Seat ID (in./mm)	Minimum Flow Area (in. ² /mm ²)	Operating Pressure (psi/MPa)	Legacy Part Number	JDE PN	API Class
4.500 114.300	3.000 76.200	3.812 96.825	3.606 91.592	2.000 50.800	3.141 79.781	50 to 3,000 0.34 to 34.79	8106-003	783960	non-certified

HP-PB Technical Data*

Tubing Nominal OD (in./mm)	Maximum Valve OD (in./mm)	Minimum Nipple Required (in./mm)	Minimum Tubing ID around Valve (in./mm)	Seat ID (in./mm)	Minimum Flow Area (in. ² /mm ²)	Operating Pressure (psi/MPa)	Legacy Part Number	JDE PN	API Class
2.063 52.400	1.406 35.712	1.625 41.275	1.454 36.932	0.625 15.785	0.307 7.798	100 to 10,000 0.69 to 68.95	8001-001	90008244	non-certified
2.375 60.325	1.625 41.275	1.710 43.434	1.845 46.863	0.875 22.225	0.601 15.265	100 to 10,000 0.69 to 68.95	8002-001	90004300	3S
2.875 73.025	2.250 57.150	2.312 58.725	2.358 59.893	1.250 31.750	1.227 31.166	100 to 10,000 0.69 to 68.95	8003-001	90004301	3S
3.500 88.900	2.500 63.500	2.562 65.075	2.878 73.101	1.625 41.275	2.074 52.680	100 to 10,000 0.69 to 68.95	8004-001	90008391	3S

*Contact Weatherford for availability.

Safety-Valve Lock and Landing Nipples

Model OQXSV

Weatherford's Optimax™ series OQXSV safety-valve lock is a large-bore variant of Weatherford's successful Uniset® lock mandrel, which has established an outstanding service record in applications worldwide. The model OQXSV safety-valve lock was developed for use with the *Optimax* series wireline retrievable safety valve and is installed and retrieved on slickline. It is designed for compatibility with the Weatherford QN nipple profile and can be designed to also suit third-party nipple profiles.

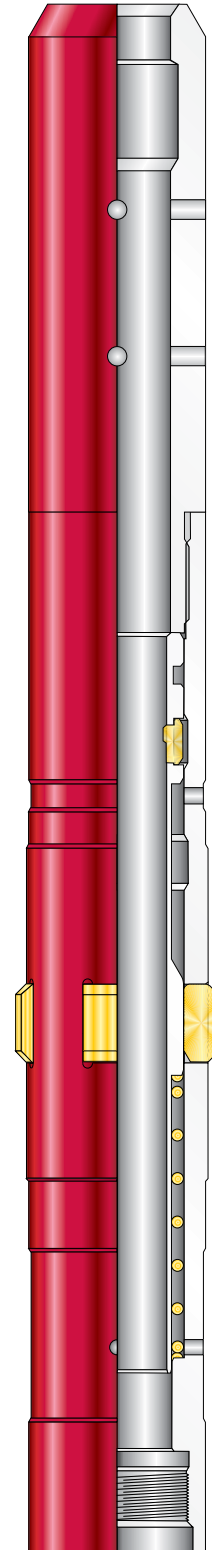
The standard *Optimax* OQXSV safety-valve lock has a maximum temperature rating of 300°F (149°C) and is rated for working pressures of 10,000 psi (68.9 Mpa) from below. Because it is a sit-on, no-go design, there is no pressure rating from above. Special clearance locks can be designed with reduced ODs for applications where running clearance is of particular importance.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- API Q1 and API 14L quality programs ensure design and manufacturing integrity.
- The OQXSV running tool eliminates uncertainty with a 'tell-tale' collet that indicates on retrieval whether the safety-valve lock setting procedure was successful.
- The flush ID inner mandrel enhances reliability by minimizing turbulence and scale adhesion.
- Design procedures and precision component manufacture prevent the entrance of solids to the lock internals in sandy conditions for trouble-free operation.
- The rigid outer mandrel directly transfers maximum jarring force to overcome seal friction when setting and retrieving the valve. Minimal downward jarring is required to set the lock.
- The box connection down connects directly to the SSSV packing mandrel, eliminating a potential leak path to the safety-valve hydraulic control system
- Each basic tubing size is gas-slam tested at a minimum flow velocity of 100 ft/sec, three times the API requirement for maximum reliability.
- Retention of design, material, manufacturing, assembly, and test documentation ensures full conformance to industry standards.
- The movement of the upward lock mandrel eliminates the need for a secondary lock-down mechanism, preventing flow-induced vibration from unseating the lock mandrel.



Model OQXSV

Features, Advantages and Benefits (continued)

- A significant increase in bore size, and therefore flow area, yields a lower pressure drop for any given flow rate.
- Designed for ease of use and, since there are no elastomeric seals, this safety-valve lock optimizes reliability and simplifies redress.
- Minimizing the threaded connections reduces the potential for galling on disassembly.
- A wide choice of materials is available to ensure fluid compatibility.

Specifications

Size (in./mm)	2-3/8 ×		2-7/8 ×		3-1/2 ×		4-1/2 ×		
	1.875 47.625	2.188 55.575	2.313 58.750	2.562 65.074	2.750 69.850	2.813 71.450	3.437 87.299	3.688 93.675	3.813 96.850
Maximum lock OD (in./mm)	1.930 49.022	2.244 56.997	2.368 60.147	2.617 66.471	2.805 71.247	2.868 72.847	3.500 88.900	3.750 95.250	3.873 98.374
Minimum bore ID (in./mm)	0.850 21.590	0.850 21.590	1.291 32.791	1.291 32.791	1.593 40.462	1.732 43.993	1.861 47.269	2.194 55.727	2.460 62.484
Overall length (in./cm)	19.70 50.04	19.70 50.04	20.20 51.31	21.28 54.05		23.30 59.18		22.00 55.88	23.05 58.55
Fishing neck profile (in.)	2.00 GS				3.00 GS		3.50 GS	4.00 GS	
Working pressure—above	No pressure from above								
Working pressure—below (psi/MPa)	10,000 68.9								
Test pressure (psi/MPa)	10,000 68.9								
Rated working temperature (°F/°C)	30° to 300° -1° to 149°								
Lower box thread (in.)	1.400 – 14 Stub Acme	1.740 – 14 Stub Acme	1.850 – 14 Stub Acme	2.225 – 14 Stub Acme	2.265 – 14 Stub Acme	2.874 – 12 Stub Acme	3.125 – 14 Stub Acme	3.250 – 12 Stub Acme	3.250 – 12 Stub Acme
Metallic materials	13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield for all body parts. Elgiloy or MP35N coil springs. All materials are heat treated in accordance with NACE MR 01 75.								
Accessory tools	Weatherford Optimax™ OQXSV running tool Weatherford Optimax OQXSV pinning handle Weatherford Optimax OQXSV pulling probe Otis GS style pulling tool								
Design compliance	API 14L								
Manufacturing compliance	Manufactured in accordance with API Q1 and API 14L								
Class of service	H ₂ S and standard								

Model OQXSV

Size (in./mm)	5-1/2 ×					7.00 ×				9-5/8 ×
	4.412 112.064	4.562 115.875	4.578 116.281	4.688 119.075	4.750 120.650	5.813 147.650	5.875 149.225	5.963 151.460	6.000 152.400	8.410 213.614
Maximum lock OD (in./mm)	4.471 113.563	4.622 117.399	4.638 117.805	4.735 120.269	4.810 122.174	5.894 149.707	5.955 151.257	6.043 153.492	6.080 154.432	8.510 216.179
Minimum bore ID (in./mm)	2.778 70.561	2.952 74.980			4.000 101.600				6.141 155.980	
Overall length (in./cm)	23.10 58.67					22.80 57.91				28.00 71.12
Fishing neck profile (in.)	4.00 GS	5.00 GS			6.00 GS				9.00 GS	
Working pressure—above	No pressure from above									
Working pressure—below (psi/MPa)	10,000 68.9									
Test pressure (psi/MPa)	10,000 68.9									
Rated working temperature (°F/°C)	30° to 300° -1° to 149°									
Lower box thread (in.)	3.820 – 12 Stub Acme	3.940 – 10 Stub Acme			5.200 – 10 Stub Acme		5.354 – 10 Stub Acme	5.200 – 10 Stub Acme	7.70 – 12 Stub Acme	
Metallic materials	13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield for all body parts. Elgiloy or MP35N coil springs. All materials are heat treated in accordance with NACE MR 01 75.									
Accessory tools	Weatherford Optimax™ OQXSV running tool Weatherford Optimax OQXSV pinning handle Weatherford Optimax OQXSV pulling probe Otis GS style pulling tool									
Design compliance	API 14L									
Manufacturing compliance	Manufactured in accordance with API Q1 and API 14L									
Class of service	H ₂ S and standard									

Model OQXSV

Specifications (continued)

Associated Equipment Assembly Numbers

Size (in./mm)	OQXSV Lock	Running Tool	Pinning Handle	Pulling Probe	GS Pulling Tool	Running Prong	Pulling Prong
1.875 47.625	606-1875-000-001	651-1812-000-002	665-2000-03-11	675-1813-01-11	P46.200.00	670-2375-001-410	670-2375-002-410
2.188 55.575	606-2188-000-001	651-1812-000-002	665-2000-03-11	675-1813-01-11	P46.200.00	670-2375-001-410	675-2375-002-410
2.313 58.750	606-2313-000-001	651-2313-000-001	665-2000-03-11	675-2313-000-001	P46.200.00	670-2875-001-410	670-2875-002-410
2.562 65.074	606-2562-000-001	651-2313-000-001	665-200-03-11	675-2313-000-001	P46.200.00	670-2875-001-410	670-2875-002-410
2.750 69.850	606-2750-000-001	651-2812-00-01	665-3000-01-11	675-3510-00-01	P46.300.00	670-3500-001-410	670-3500-002-410
2.813 71.450	606-2813-000-001	650-2813-000-002	665-3000-01-11	675-2813-01-11	P46.300.00	670-3500-001-410	670-3500-002-410
3.437 87.299	606-3437-000-001	650-4010-00-02	665-3500-03-15	675-4010-03-11	3.5 in.		
3.688 93.675	606-3688-000-001	650-4500-00-03	665-4000-01-15	675-4500-00-01	P46.400.00	670-4500-003-410	670-4500-004-410
3.813 96.850	606-3813-000-001	650-5000-000-006	665-4000-01-15	675-5000-00-01	P46.400.00	670-4500-001-410	670-4500-002-410
4.412 112.065	606-4412-000-001	650-5550-00-01	665-4000-01-05	675-5500-00-01	P46.400.00		
4.562 115.875	606-4562-000-001	650-5510-00-02	665-5000-01-15	675-5510-00-01	P46.500.00	670-4500-001-410	670-4500-002-410
4.578 116.281	606-4578-000-001	650-5510-00-02	665-5000-01-15	675-5510-00-01	P46.500.00	670-4500-001-410	670-4500-002-410
4.688 119.075	606-4688-000-001	650-5510-00-02	665-5000-01-15	675-5510-00-01	P46.500.00	670-4500-001-410	670-4500-002-410
4.750 120.650	606-4750-000-001	650-5510-00-02	665-5000-01-15	675-5510-00-01	P46.500.00	670-4500-001-410	670-4500-002-410
5.813 147.650	606-5813-000-001	651-5980-000-002	665-6000-01-15	675-5980-00-01	P46.600.00	670-7000-001-410	670-7000-002-410
5.875 149.225	606-5875-000-001	651-5980-000-002	665-6000-01-15	675-5980-00-01	P46.600.00	670-7000-001-410	670-7000-002-410
5.963 151.460	606-5963-000-001	651-5980-000-002	665-6000-01-15	675-5980-00-01	P46.600.00	670-7000-001-410	670-7000-002-410
6.000 152.400	606-6000-000-001	651-5980-000-002	665-6000-01-15	675-5980-00-01	P46.600.00	670-7000-001-410	670-7000-002-410
8.410 213.615	608-8410-000-001	658-9000-000-001	665-9000-000-001	675-9000-000-001	9-in. 01115377	670-9000-000-001	670-9000-000-001

Options

- Supplied in any sealbore size to suit Weatherford's QN nipple or third-party nipple profiles.
- Special clearance locks can be designed with reduced ODs.
- Contact your Weatherford representative for details.

Model WNI

Weatherford's Optimax™ series model WNI safety-valve landing nipple (SVLN) is an integral part of the tubing string, designed for containing pressure, and is connected by a hydraulic control line to the surface. The model WNI nipple is a one-piece construction, manufactured from bar stock and contains the highly successful, field-proven Petrolite® QN lock profile, along with dual sealbores with a control-line port between the sealbores, and an industry-standard, control-line connection profile. When manufactured from 80,000-psi (551.6-MPa) minimum yield material, the model WNI SVLN is rated for 10,000-psi (68.9-MPa) working pressure, dependent on end connection thread pressure rating.

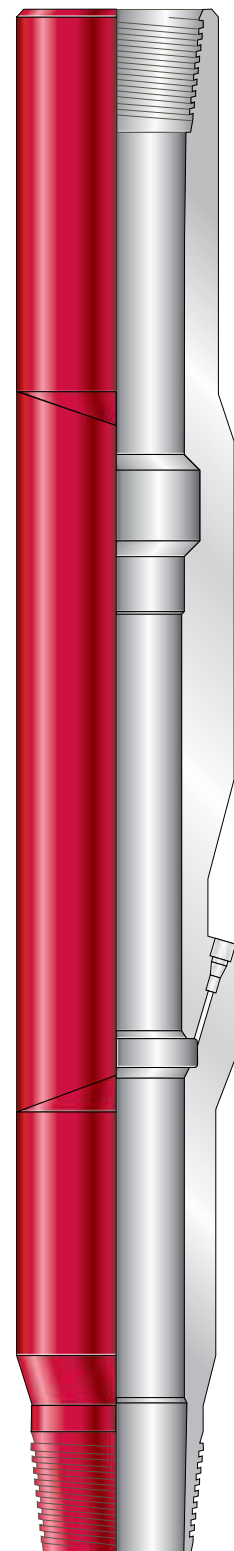
The internal profile accepts Weatherford's *Optimax* model WW(E) wireline-retrievable safety valve, *Optimax* OQXSV safety-valve lock, standard flow-control devices, and capillary string hanger. The lock is on the no-go shoulder on top of the upper sealbore, and the locking dogs are in the QN profile. In this position, the chevron packing seals on the safety valve, flow-control device, or hanger are positioned and sealed in both upper and lower sealbores, straddling the control-line port. The sealed, pressure-containment system enables control of the WW(E) safety valve by manipulation of the control-line fluid pressure.

Applications

- Fluid and gas environments
- Production and injection applications

Features, Advantages and Benefits

- The industry-leading, standard, slim-line design results in the industry's smallest available major diameter, providing increased running clearances.
- The 10,000-psi (68.9-MPa) working pressure with standard materials-9 chrome 1 moly or 13 percent chrome, 80,000-psi (551.6-MPa) minimum yield, as well as other materials available on request ensure application versatility.
- All materials are heat-treated in accordance with NACE MR0175, enabling the nipple's use for sour service.
- The nipple design, material, manufacturing, assembly, and test-document retention is according to API Q1 and API 14A, ensuring industry-standard integrity and conformance.
- The nipple is constructed without welding, providing homogeneous material properties.
- The QN lock profile enables completion optimization without restriction to standard sealbore sizes.



Model WNI

Features, Advantages and Benefits *(continued)*

- The control line can be installed from the surface to the nipple during the initial completion run, saving time during later string operations.
- The machined slot in the eccentric OD above the control-line port protects the line from expensive damage and provides nipple communication with Weatherford’s control-line communication tool.
- The integral control-line fitting is machined to accept an industry-standard, metal-to-metal, seal-compression fitting.
- Compression ferrules in the control-line connection ensure reliable metal-to-metal sealing with simple installation.
- Manufactured from bar stock with an eccentric machine slug containing the control-line connection.

Specifications

Standard size (tubing × sealbore) (in./mm)	2-3/8 × 1.875 60.325 × 47.625	2-7/8 × 2.313 73.025 × 58.750	3-1/2 × 2.75 88.900 × 69.850	3-1/2 × 2.813 88.900 × 71.450
Maximum SVLN OD (in./mm)	3.350 85.090	4.055 102.997	4.528 115.011	4.940 125.476
Minimum bore (sealbore) (in./mm)	1.875 47.625	2.313 58.750	2.750 69.850	2.813 71.450
Length (in./cm)	26.40 67.056	27.56 70.002	28.40 72.136	28.40 72.136
Working pressure* (psi/MPa)	10,000 68.9			
Test pressure* (psi/MPa)	15,000 103.4			
Tensile rating*	Equivalent to tubing size and material			
Rated working temperature (°F/°C)	30° to 300° -1° to 149°			
Metallic materials	Standard 9 Chrome – 1 moly or 13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield. Alternative materials available on request. All materials are heat treated in accordance with NACE MR 01 75.			
End connections	Client-specified			
Control-line connection	7/16-in. (11.1-mm) UNF thread with profile to accept dual-ferrule compression fittings.			

*Dependent on material yield and end-connection configuration

Model WNI

Standard size (tubing × sealbore) (in./mm)	4-1/2 × 3.813 114.300 × 96.850	5-1/2 × 4.562 139.700 × 115.875	7 × 5.963 177.800 × 151.460
Maximum SVLN OD (in./mm)	5.748 146.000	6.777 172.135	8.675 220.345
Minimum bore (sealbore) (in./mm)	3.813 96.850	4.562 115.875	5.963 151.460
Length (in./cm)	29.88 75.895	31.50 80.010	35.55 90.297
Working pressure* (psi/MPa)	10,000 68.9		
Test pressure* (psi/MPa)	15,000 103.4		
Tensile rating*	Equivalent to tubing size and material		
Rated working temperature (°F/°C)	30° to 300° -1° to 149°		
Metallic materials	Standard 9 Chrome – 1 moly or 13% minimum chrome, 80,000-psi (551.6-MPa) minimum yield. Alternative materials available on request. All materials are heat treated in accordance with NACE MR 01 75.		
End connections	Client-specified		
Control-line connection	7/16-in. (11.1-mm) UNF thread with profile to accept dual-ferrule compression fittings.		

*Dependent on material yield and end-connection configuration

Tubing-Retrievable Safety-Valve Functional Specifications Models W(S)(P)(C) and (E)-5, -7.5 NS -10

Safety-Valve Data			
Model name:			
Size:			
Lock profile type and size:			
Working pressure:			
Temperature rating:			
Fail-safe setting depth:			
Metallurgy:			
Seal materials:			
Self-equalizing feature:			
Quality requirements:	API monogrammed:	API traceable:	Standard:
Class of service:			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

Completion Data			
Client:		Country:	
Field:		Reference No:	
Completion type:			
Tubing size, weight and material:			
Tubing threads:			
Casing size and weight at SSSV depth:			
Control line/gauge cable bypass:			
Production or injection:			
Produced or injected fluid/gas composition:			
Produced or injected fluid/gas flow rates:			
Maximum shut-in tubing pressure:			
Corrosion inhibitor type:			
Well environment			
H ₂ S %			
CO ₂ %			
O ₂ %			
H ₂ O %			
Chlorides (ppm)			
Temperature			
Annulus fluid type and gradient:			
Control line fluid type and gradient:			
Surface-control pressure limitation:			
Special requirements:	Add separate sheet(s) to fully describe any special operational requirements the client needs us to comply with.		

Wireline-Retrievable Safety-Valve Functional Specifications Models WVE-5, WVE-10, WVN-5 and WVN-10

Safety-Valve Data			
Model name:			
Size:			
Safety-valve lock:			
Working pressure:			
Temperature rating:			
Fail-safe setting depth:			
Metallurgy:			
Seal materials:			
Self-equalizing feature:			
Quality requirements:	API monogrammed:	API traceable:	Standard:
Class of service:			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

Completion Data			
Client:		Country:	
Field:		Reference No:	
Completion type:			
Tubing size, weight and material:			
Tubing threads:			
Casing size and weight at SSSV depth:			
SVLN profile:			
SVLN sealbore size:			
Production or injection:			
Produced or injected fluid/gas flow composition:			
Produced or injected fluid/gas flow rates:			
Maximum anticipated tubing pressure:			
Corrosion inhibitor type:			
Well environment			
H ₂ S %			
CO ₂ %			
O ₂ %			
H ₂ O %			
Chlorides (ppm)			
Temperature			
Annulus fluid type and gradient:			
Control line fluid type and gradient:			
Surface-control pressure limitation:			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

Safety-Valve Landing Nipple Functional Specifications

Safety-Valve Landing Nipple Model WNI

SVLN Data			
Model name:	WNI		
Tubing size and weight:			
Tubing threads:			
Tubing material:			
Safety-valve lock profile:			
Sealbore size:			
Working pressure:			
Temperature rating:			
Metallurgy:			
Quality requirements:	API monogrammed:	API traceable:	Standard:
Class of service:			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

Completion Data			
Client:		Country:	
Field:		Reference No:	
Completion type:			
Casing size and weight at SSSV depth:			
Tubing threads:			
Casing size and weight at SSSV depth:			
Production or injection:			
Produced or injected fluid/gas flow composition:			
Maximum anticipated tubing pressure:			
Corrosion inhibitor type:			
Well environment			
H ₂ S %			
CO ₂ %			
O ₂ %			
H ₂ O %			
Chlorides (ppm)			
Temperature			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

OQXSV Safety-Valve Lock Functional Specifications Model OQXSV and Retrofit Variants

Safety-Valve Lock Data			
Model name:			
Sealbore size:			
Profile type and manufacturer:			
Top or bottom no-go:			
Standard or special clearance no-go:			
Working pressure:			
No-go pressure rating:	(If known or required)		
Temperature rating:			
Metallurgy:			
Seal materials:	(Only required for retrofit applications with packing mandrel)		
Quality requirements:	API monogrammed:	API traceable:	Standard:
Class of service:			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

Completion Data			
Client:		Country:	
Field:		Reference No:	
Completion type:			
Tubing size, weight and material:			
Tubing threads:			
SVLN material and yield:			
Production or injection:			
Produced or injected fluid/gas composition:			
Produced or injected fluid/gas flow rates:			
Maximum anticipated tubing pressure:			
Corrosion inhibitor type:			
Well environment			
H ₂ S %			
CO ₂ %			
O ₂ %			
H ₂ O %			
Chlorides (ppm)			
Temperature			
Special requirements:	Add separate sheet(s) as required to fully describe any special functional requirements we need to address to comply with client requirements.		

PB Safety-Valve Design Required Production System Information Sheet

COMPANY:		FIELD:		LEASE:		WELL NO.:		
GENERAL WELL DATA	TUBING SIZE: OD: (IN.) ID: (IN.)			CASING SIZE: OD: (IN.) ID: (IN.)				
	SAFETY VALVE DEPTH: TVD: (FT) WLD: (FT)			MID PERFORATIONS: TVD: (FT) ID: (FT)				
	OIL API GRAVITY:		GAS GRAVITY:		WATER GRAVITY:			
	PRODUCTION THROUGH: <input type="checkbox"/> TUBING <input type="checkbox"/> CASING		WELLHEAD TEMPERATURE: <input type="checkbox"/> °F <input type="checkbox"/> °C		BOTTOMHOLE TEMPERATURE: <input type="checkbox"/> °F <input type="checkbox"/> °C		SEPARATOR PRESSURE: (PSI)	
NORMAL FLOWING TEST DATA	PRODUCTION STATUS: <input type="checkbox"/> FLOWING <input type="checkbox"/> GAS		OIL RATE: BOPD		WATER RATE: BWPD			
	GAS RATE: (MSCF/D)			FLOWING WELLHEAD PRESSURE: (PSI)				
RESERVOIR DATA	RESERVOIR PRESSURE: (PSI)		RESERVOIR PERMEABILITY OR PI: (MD)		FORMATION PAY THICKNESS: (FT)			
	RESERVOIR INFORMATION IS NEEDED TO DETERMINE THE PRODUCTIVITY INDEX (PI) OR CONSTRUCT AN INFLOW PERFORMANCE RELATIONSHIP (IPR) CURVE FOR THE RESERVOIR.							
EMERGENCY CONDITIONS	DEFINE EMERGENCY CONDITIONS TO BE DESIGNED FOR (MMS GUIDELINE IS 150% OF NORMAL RATE): DO YOU HAVE TO BRING WELL DOWN TO SEPARATOR PRESSURE TO BRING BACK ON LINE?							
	WHAT IS SHUT-IN TUBING PRESSURE?							
COMMENTS								
SAFETY VALVE DESIGN	SAFETY VALVE DEPTH: TVD: (FT) WLM: (FT)		NIPPLE ID: (IN.)		NIPPLE TYPE:		SAFETY VALVE SIZE: (IN.)	
	FLOWING TEMP. AT VALVE DEPTH: <input type="checkbox"/> °F <input type="checkbox"/> °C		CLOSING PRESSURE AT VALVE DEPTH: (PSI)			TEST RACK CLOSING PRESSURE: (PSI)		
VALVE CLOSING PRESSURE (Pvc) AT 60°F (16°C) TEST RACK TEMPERATURE								
Pft*Ct = Pvc		Where:		Pft = CLOSING PRESSURE AT FLOWING TEMPERATURE Pvc = CLOSING PRESSURE AT TEST RACK TEMPERATURE Ct = TEMPERATURE CORRECTION FACTOR				

Safety Valves



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