WCS Opti-Chem™ Chemical-Injection Safety Valve System

Weatherford's WCS *Opti-Chem* chemical-injection safety valve system is an economical and efficiently installed safety system designed to retrofit a well that requires continuous chemical injection and an operational subsurface safety valve but for which conventional workover methods are too expensive or cannot be completed in a timely manner.

The WCS system consists of Weatherford's innovative Ren Gate™ wellhead-penetration conversion kit, a capillary hanger, a capillary stinger, a wireline-retrievable subsurface safety valve with chemical-injection bypass, and a chemical-injection valve. The system is installed using capillary and slickline equipment. The system accommodates capillary strings from 1/4 in. to 5/8 in.

The capillary string is connected below the safety valve and run to the chemical injection depth. The safety valve assembly with capillary string is installed into either a safety-valve landing nipple or a communicated tubing-mounted safety valve and is operated via the existing hydraulic control system. The upper section of capillary string with capillary stinger connects the subsurface safety valve to the capillary hanger in the wellhead via a wet-mate connector in the safety valve. The capillary hanger lands in the backpressure valve profile in the tubing hanger and provides the fluid connection from the wellhead to the safety valve and beyond. Surface chemical-injection equipment is connected to the *Ren Gate* wellhead-penetration conversion kit.

The **WCS fail-safe-close safety valve**, run and retrieved on wireline, consists of a wireline safety valve, chemical-injection communication pod, a lower-capillary-string connector, and a wireline lock. The valve is rigorously tested to procedural and acceptance criteria exceeding the requirements of American Petroleum Institute (API) specification 14A. The pod provides the wet-mate connection to the separately installed capillary stinger and capillary string to surface. The capillary string is securely attached and sealed to the lower capillary-string connector by a specially designed double-bend connector for mechanical strength and safety-valve hydraulic fitting for pressure integrity. The wireline lock is interchangeable to accommodate most common safety-valve landing-nipple profiles. The valve is available in fail-safe setting depths to 2,000 ft (*610 m*).

The ***Ren Gate* wellhead-penetration conversion kit** provides hydraulic communication through the wellhead and the downhole safety valve. The *Ren Gate* wellhead-penetration conversion kit sets Weatherford's system apart from other offerings through its innovative design that allows retrofitting the

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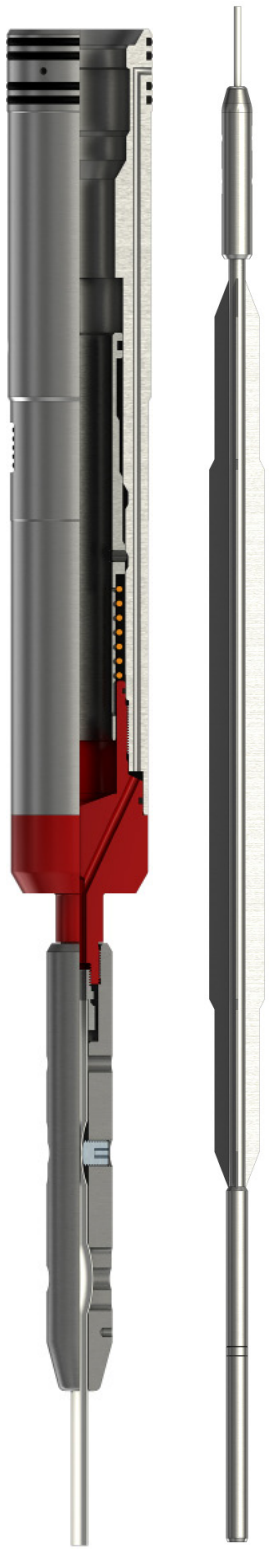

wellhead without removing the wellhead or flowlines. The Ren Gate™ kit is adaptable to virtually all wellheads and does not compromise the integrity of the wellhead. The retrofitted *Ren Gate* kit provides the required two barriers to the wellbore fluid.

The **RQXC hanger (CLH)** is available in both the type H locking-dog version and a premium wireline locking-groove version, providing installation flexibility. With the RQXC hanger, installation of the capillary hanger into the existing type H locking profile simplifies the wellhead retrofit. The capillary hanger is run and retrieved on slickline. If space-out is uncertain, the capillary hanger is available with a length adjustment feature that can be adjusted on location, ensuring proper installation into the tubing hanger. The capillary string is securely attached and sealed to the capillary hanger by a specially designed double-bend connector for mechanical strength and safety-valve hydraulic fitting for pressure integrity.

The **capillary stinger** provides the connection between the hanger and the WCS *Opti-Chem* safety valve. The stinger includes a capillary connector, a centralizer, and a wet-mate connection.

The **downhole chemical-injection valve**, attached at the bottom of the capillary string, prevents chemical siphoning as well as gas flowback. The chemical-injection valve provides precise control of the fluids to prevent excessive use of chemicals. Valve injection pressure is easily adjusted at location, before installation, to accommodate well conditions.

Applications

- Retrofit wells requiring unplanned chemical injection while retaining well control with a subsurface safety valve
- Return-to-service marginal wells with production issues that can be controlled with injection of chemicals and for which standard workover is cost prohibitive
- Replacement with an API-certified fail-safe-close safety barrier
- Continuous injection of foamers for dewatering gas wells while maintaining full safety-valve integrity.
- Continuous injection of water for dissolving salt buildup in the perforations while maintaining full safety-valve integrity
- Continuous injection of chemical treatments to mitigate paraffin, asphaltene, or scale problems while maintaining full safety-valve integrity
- Continuous injection of corrosion inhibitors while maintaining full safety-valve integrity

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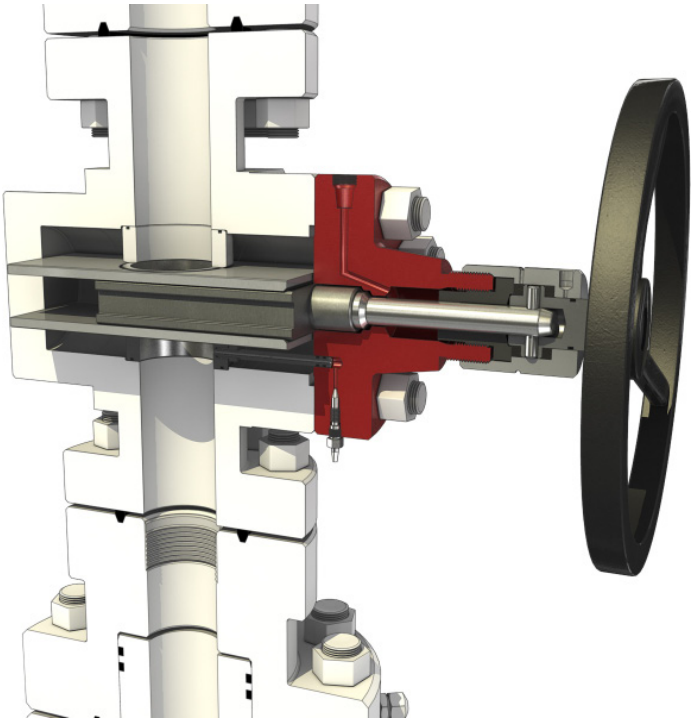
Features, Advantages and Benefits

- The standard design enables the use of standard wireline and cap-string procedures, reducing intervention costs.
- The Ren Gate™ kit allows retrofitting an existing wellhead with a new wellhead penetration without removing the wellhead or flowlines or adding a spool piece, thus eliminating the expense and time of moving flowlines already in place.
- The CLH's overall length can be adjusted on location to accommodate wellhead manufacturing differences, reducing installation time required for hanger customization.
- The installation package is compact in size and suitable to almost any platform or well site and is particularly advantageous where environmental issues or space availability require a minimized footprint.
- Installation requires minimal personnel, making the WCS a cost-effective solution.
- The system allows wells to be returned to service more quickly, using more efficient wireline and masthead truck operations rather than slower tubing workover operations.
- Valve and wellhead equipment are tested and certified to rigorous API standards, ensuring that the equipment provides emergency shutdown protection in the event of an uncontrolled loss.
- The flow area is maximized by design, reducing the pressure loss through the system, preventing choked flow, and thus minimizing production loss.
- The capillary tube system can be sized from 1/4 in. to 5/8 in. to accommodate a wide range of injection fluids and rates to meet specific well requirements.
- The safety valve uses field-proven, metal-to-metal, through-the-flapper equalizing technology for ultimate durability and reliability to protect personnel, property, and the environment.



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Specifications

Surface Equipment: Wellhead and Capillary-String Hanger

API wellhead size (in./*mm*)	**3-1/16** ***78.0***	**4-1/16** ***103.0***	**5-1/8** ***130.18***	**7-1/16** ***179.37***
Nominal H type hanger size (in./*mm*)	3.00 *76.2*	4.00 *101.6*	5.00 *127.0*	7.00 *177.8*
Working pressure	Wellhead dependent			
Working temperature (°F/°*C*)	-40° to 300° *-40° to 149°*			
Capillary string hanger	H type or premium wireline locking-groove profile			
Capillary string sizes (in./*mm*)	1/4 to 5/8 *6.35 to 15.88*			

Downhole Equipment: Safety Valve and Chemical-Injection Valve

Size (in./*mm*)	**3-1/2 × 2.813** ***88.90 × 71.45***	**4-1/2 × 3.813** ***114.30 × 96.85***	**5-1/2 × 4.562** ***139.70 × 115.90***	**7 × 5.962** **177.8 × 151.43**
Nipple profile (in./*mm*)	2.813 *71.45*	3.813 *96.85*	4.562 *115.90*	5.962 *151.43*
Working temperature (°F/°*C*)	30° to 300° *–1° to 149°*			
Working pressure (psi/*kPa*)	5,000 or 10,000 *34,474 to 68,948*			
Fully open operating pressure (psi/*kPa*)	2,000 *13,790*			
Fully closed operating pressure (psi/*kPa*)	1,000 *6,895*			
Fail-safe setting depth (ft/*m*)	1,000 or 2,000 *305 to 610*			

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Specifications (continued)

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 *(68,948-kPa)* 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 *(551,581-kPa)* 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 non-Weatherford lock profiles.

For Internal Use:

Link to Endeca assembly part numbers:

Ren Gate
RQXC Control Line Hanger
WCS Safety Valve
Stinger
Chemical Injection Valve