



Chemical-Injection Equipment

Chemical-Injection Equipment

Introduction

Chemical injection is the process of injecting fluid chemicals into the production stream of a well to control corrosion and harmful deposits in the tubing and tubing accessories during production.

In a typical chemical-injection installation, a chemical-injection mandrel with a chemical-injection valve is installed as part of the production-tubing string. A chemical-injection line may be run from the chemical-injection mandrel to the surface to act as a conduit for the injection fluid. In other installations, the injection chemical is pumped down the tubing/casing annulus and into a port in the chemical-injection mandrel. Reverse-flow check valves are installed at the point of injection to prevent flow from the production tubing from entering the injection-flow path. A high-pressure pump, capable of overcoming tubing pressure, is installed on the surface to pump the chemical-injection fluid into the downhole point of injection in the production stream.

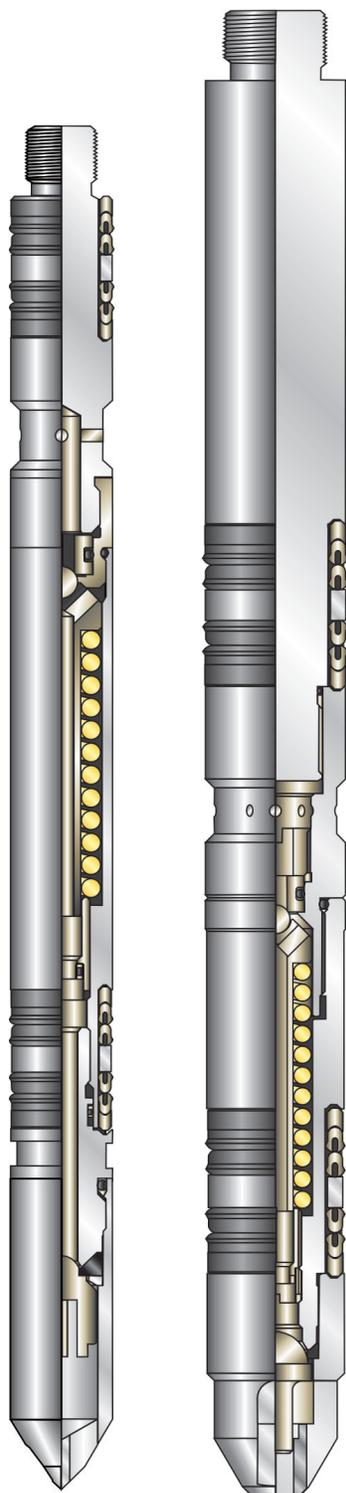
Applications

- Extending the life span of the production tubing by minimizing internal corrosion in hostile well environments with hydrogen sulfid (H_2S) and/or carbon dioxide (CO_2)
- Reducing completion costs by allowing the installation of less-expensive grades of production tubing in some applications
- Minimizing or eliminating the buildup of deposits such as salts, paraffin, and scale that reduce the tubing inside diameter (ID) and lead to lower production rates

Benefits

- Minimizes maintenance and operating costs
- Reduces initial installation cost in many installations
- Can be installed in almost any wellbore configuration
- Maximizes the time between costly workovers on completions in hostile well environments

Chemical-Injection Equipment



RCI-1A Valve
(1-in. OD)

RCI-2A Valve
(1.5-in. OD)

RCI Series Wireline-Retrieval, Chemical-Injection Valves

Weatherford's McMurry-Macco® RCI series wireline-retrievable chemical-injection valves are used to control the injection of chemicals for treatment of harmful deposits and corrosion in tubing and around downhole tools. These valves are installed in chemical-injection side-pocket mandrels using a kickover tool and standard wireline techniques.

The valves' injection rate is controlled by the size of the port, the tension adjustment of the internal INCONEL® power spring before installation, and pump-in rate. The valves are in a normally closed position as a result of the combined force of the preset spring tension and the tubing pressure on the valve stem. A chemical pump at the surface injects chemicals down the casing annulus or through a separate injection line attached to the mandrel. From the casing annulus or injection line, the chemical enters the injection valve port. The valve opens when the chemical-injection pressure (the surface chemical-pump pressure plus the hydrostatic pressure of the chemical) exceeds the spring force and tubing pressure, allowing chemicals to flow into the tubing string. An integral reverse-flow check valve prevents backflow into the casing annulus or injection line.

Applications

- RCI series valves are used in wells that require the continuous or intermittent injection, via the casing annulus or the injection-control line, of corrosion inhibitors or other chemicals to treat corrosion or harmful deposits in the tubing and around downhole tools.

Features, Advantages and Benefits

- INCONEL power spring withstands corrosive and high-temperature conditions, delivering reliable performance and extending the life of the valve.
- The power spring is available in a wide range of sizes to fit low- and high-set-pressure requirements so that set pressure is maintained, ensuring consistent operation.
- Tungsten-carbide ball and insert seat (standard) offer the highest abrasion and impact resistance available, providing a robust and stable injection system.
- Design excludes crossover seats to decrease the likelihood of valve Plugging, increasing the flow efficiency of the valve.
- Integral reverse-flow check valve prevents tubing-to-casing annulus communication during operation, prolonging the valve's life cycle.
- Check-valve spring is made from durable MP35N alloy material, ensuring that production fluids do not enter the injection conduit.
- Wireline-retrievable design allows valve to be pulled, serviced, and reinstalled without pulling the tubing, reducing maintenance and repair costs.
- Setting tool facilitates adjustment of valve injection pressure, ensuring consistent operation.

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Chemical-Injection Equipment

Specifications

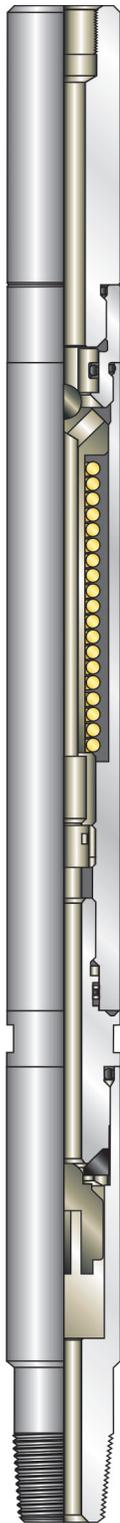
Set Pressure Guide						
Valve Model	Valve Model Number	Latch Type	Valve OD (in./mm)	Port Size (in./mm)	Spring Part Number and Wire Diameter	
					99641183 (0.145 in., 3.68 mm)	
					Set Pressure	
					Minimum (psi/bar)	Maximum (psi/bar)
RCI-1A	0109-XXX	BK-2	1.0 25.4	1/8 3.175	1,000 68.9	9,800 675.0
				3/16 4.763	1,000 68.9	6,500 448.0
				1/4 6.350	1,000 68.9	4,300 296.0
RCI-2A	0208-XXX	RK	1.5 38.1	1/8 3.175	1,000 68.9	14,400 447.9
				3/16 4.763	1,000 68.9	8,100 199.8
				1/4 6.350	1,000 68.9	4,850 133.7

Different spring designs for special set pressures are available upon request.
Set pressures based on standard Monel 400 valve material. Higher pressures can be obtained with stronger valve material.

Options

- RCI series injection valves are available in stainless steel, MONEL®, or INCONEL materials.
- Tungsten-carbide ports are standard and are available in 1/8-, 3/16-, and 1/4-in. sizes.
- Standard moly-filled Teflon® packing-element system enhances performance and extends the service life.

Chemical-Injection Equipment



CCI-1A Valve

CCI Series Tubing-Retrievable, Chemical-Injection Valve

Weatherford's CCI-1 valve is a spring-loaded chemical-injection valve designed to control the injection of chemicals, fluids, and water for treating corrosion and harmful paraffin, salt, and hydrate deposits inside tubing and around downhole tools.

The valve is installed on a tubing-retrievable chemical-injection mandrel. Before installation, the injection rate of the valve is adjusted by the port size and tension of the internal INCONEL® power spring. The preset spring tension maintains the valve in a normally closed position.

A chemical pump at the surface injects chemicals down the casing annulus or through a separate injection line attached to the CCI-1 valve. From the casing annulus or injection line, the chemical enters the injection valve port. The valve is primarily controlled by the differential between the injection pressure and the tubing pressure. The valve opens when the pressure differential across the stem and seat exceeds the preset spring tension, allowing chemicals to flow into the tubing string. An integral, reverse-flow check valve prevents backflow into the casing annulus or injection line.

Applications

- The CCI-1 valve is used for downhole injection of corrosion inhibitors and various chemicals to treat, intermittently or continuously, harmful deposits and corrosion in the tubing or around downhole tools.
- This valve is useful in both annular and injection control-line applications.

Features, Advantages and Benefits

- INCONEL power spring and check-valve spring withstand corrosive and high-temperature conditions, delivering reliable performance and extending the life of the valve.
- Spring-loaded operation allows accurate functioning of the CCI-1 valve, regardless of well temperature, providing consistent operation.
- Integral reverse-flow check valve prevents tubing-to-casing annulus communication during operation.
- Valve design excludes crossover seats, decreasing the likelihood of valve plugging and increasing the flow efficiency of the valve.
- Setting tool allows easy adjustment of valve injection pressure.
- Tungsten-carbide ball and insert seat (standard) offer the highest abrasion and impact resistance available, providing a robust and stable injection system.

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Chemical-Injection Equipment

Specifications

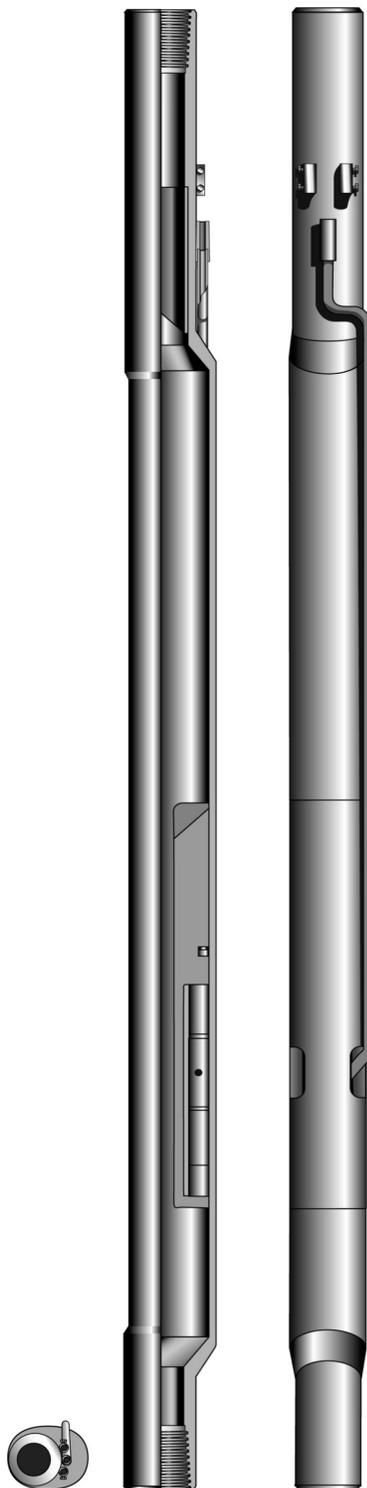
Valve Model	Valve Model Number	Valve OD (in./mm)	Port Size (in./mm)	Maximum Set Pressure (psi/bar)
CCI-1A	3604-XXX	1.00 25.40	1/8 3.18	8,400 578.8
			3/16 4.76	
			1/4 6.35	
CCI-1B		1.19 30.20	1/8 3.18	8,400 578.8
			3/16 4.76	
			1/4 6.35	

Options

- The CCI-1 valve is constructed of 316 stainless steel and is also available in premium materials, such as MONEL[®] and INCONEL, for corrosion resistance in wells with high concentrations of hydrogen sulfide (H₂S) or carbon dioxide (CO₂).
- A wide variety of standard, chemical-resistant, and high-temperature elastomers is available as well.
- Special erosion-resistant coatings for flow-wetted parts are available.

Chemical-Injection Equipment

Chemical-Injection Equipment



SFO-CI Series
Side-Pocket Mandrel

SFO-CI and SMO-CI Series Side-Pocket Mandrels, Oval-Body, Forged and Machined

Weatherford's McMurry-Macco® SFO-CI and SMO-CI series chemical-injection side-pocket mandrels feature an oval cross-sectional profile and threaded connections for installation in the tubing string. Attached to the mandrel pocket for the chemical-injection valve is an integral injection tube, which is connected to the capillary-injection line that is used to pump chemicals from the surface to the mandrel downhole. The side pocket is offset from the bore of the tubing, allowing full tubing drift through the mandrel for well-servicing operations without restriction.

The side pocket encompasses profiles and sealbores to land chemical-injection devices. The SIF and SIM series mandrels have integrally forged swages.

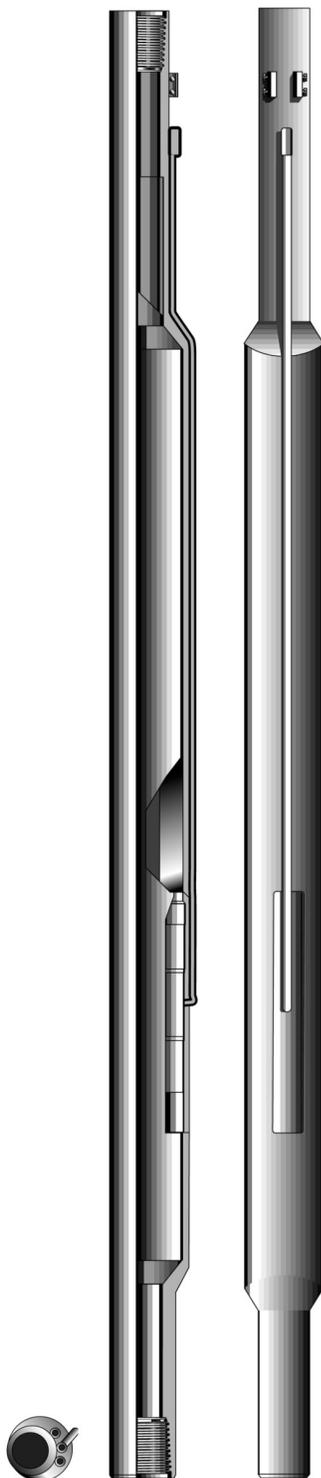
Chemical-injection devices are installed in the side pocket using a kickover tool, which is run into the well, using standard wireline techniques. SFO-CI and SMO-CI mandrels include an integral orienting sleeve, which aligns the kickover tool and injection device with the side pocket for precise installation in straight and deviated wellbores. SFO-CI and SIFO-CI series mandrels have a one-piece forged pocket/deflector that guides the chemical-injection device into the pocket and deflects tools larger than the pulling/running tool back into the tubing bore of the mandrel. SMO-CI and SIMO-CI series mandrels have a machined pocket and tool guard that perform the same function.

The chemical-injection system for both series of mandrels includes a chemical pump that injects chemicals through the wellhead and down an injection line to the chemical-injection valve in the mandrel side pocket. When the chemical-injection valve opens, the chemicals flow into the production string. A reverse-flow check valve prevents wellbore fluids from flowing back into the injection line.

Applications

- Oval-body mandrel design reduces overall running clearances and is ideal for dual-completion applications.
- SFO-CI and SMO-CI series mandrels are used in single or dual completions as receivers for wireline-retrievable chemical-injection valves to enhance production and remediate corrosion, paraffin, salt, and scale formation, ultimately prolonging production life.
- The SFO-CI series mandrels feature an oval body with a one-piece forged pocket/deflector, a side pocket with an injection-line connection, and an integral orienting sleeve for injection-device installation in straight and deviated wellbores.
- The SMO-CI series mandrels feature an oval body with a machined tool guard, a side pocket with an injection-line connection, and an integral orienting sleeve for injection-device installation in straight and deviated wellbores.

Chemical-Injection Equipment



SMOR-CI Series
Side-Pocket Mandrel

SMOR-CI Series Side-Pocket Mandrels, Round-Body, Machined

Weatherford's McMurry-Macco® SMOR-CI series side-pocket mandrels feature a round cross-sectional profile with machined swages, pocket, and tool guard. The mandrels have threaded connections for installation in the tubing string. The robust design enables installation of the mandrels in applications in which premium alloy, special dimensional requirements, and/or increased pressure capabilities are required.

The SMOR-1CI mandrel has a 1-in. inside diameter (ID) side pocket, and the SMOR-2CI mandrel has a 1 1/2-in. ID side pocket. The side pocket is offset from the bore of the tubing, allowing full tubing drift for well-servicing operations through the mandrel without restriction. The side pocket encompasses profiles and sealbores to land chemical-injection devices.

Chemical-injection devices are installed in the side pocket using a kickover tool, which is run into the well using standard wireline techniques. The SMOR-CI series mandrels include an integral orienting sleeve that aligns the kickover tool and injection device above the pocket for precise installation in straight and deviated wellbores. The mandrels feature a tool guard at the top of the pocket to deflect tools larger than the pulling/running tool back into the tubing bore of the mandrel to prevent damage to the valve latch.

Applications

- SMOR-CI series mandrels are used as internal receivers for chemical-injection valves and related equipment in standard, high-pressure, and corrosive service, primarily in single completions.
- These mandrels can be installed in straight and deviated wellbores.

Features, Advantages and Benefits

- High-pressure design allows mandrels to be used in deep applications requiring high burst- and collapse-pressure ratings and high tensile ratings.
- Side pocket is offset from the tubing bore, maximizing the flow area and allowing full tubing drift for well servicing operations through the mandrel without restriction.
- Side pocket avoids having to pull and rerun the tubing string to install or replace a chemical-injection device, reducing costly workover operations.
- Slotted orienting sleeve enables precise installation and retrieval of chemical-injection equipment in straight and deviated wellbores.
- Machined pocket and tool guard protect chemical-injection equipment by preventing tools larger than the pulling/running tool from damaging the valve latch.
- Mandrel material is fully heat-treated to provide the best combination of strength and corrosion resistance for its intended use.
- The injection lug is tucked under the upper swage for additional protection of injection-line termination.

Chemical-Injection Equipment

CI Series Tubing-Retrievable Mandrels

Weatherford's McMurry-Macco® CI series chemical-injection mandrels are equipped with an external lug to receive tubing-retrievable chemical-injection valves and check valves. This series consists of two sub-series: CS-CI and CM-CI.

CS-CI series mandrels are machined from solid bar stock. This design eliminates all welds, providing an extremely strong mandrel for the most demanding environments. In addition, CS-CI mandrel designs are available with external protection for bypass cables and control lines. External guards are machined onto the outside diameter (OD) of the mandrel to protect the chemical-injection line and valve during tubular running and pulling operations.

CM-CI series mandrels are equipped with a welded external lug to receive tubing-retrievable chemical-injection valves and check valves. CM-CI series mandrels are also equipped with welded guards that house the chemical-injection device, protecting it and the injection line from damage during running and pulling operations. CM-CI mandrels offer economical choices for less-demanding downhole-injection applications.

CI series mandrels are available in a variety of sizes and materials and can be custom-designed for service in high-pressure, high-temperature, and highly corrosive environments. Weatherford's experienced engineering and technical support staff can assist in the selection of the proper materials for the application.

Applications

- CI series mandrels are installed as part of the tubing string to allow injection of chemicals into the tubing string by capillary-injection line or casing annulus.
- These mandrels are also used to inject water to inhibit salt formation in the tubing string.
- CI series mandrels can also serve as sensing points for downhole pressure determination.
- CS-CI series mandrels are designed for the most demanding environments.
- CM-CI mandrels offer economical choices for less-demanding applications.

Features, Advantages and Benefits

- The tubing-retrievable configuration accommodates larger, more robust valve designs, providing maximum functionality and increasing system reliability.

Chemical-Injection Equipment

CI Series Tubing-Retrievable Mandrels

Specifications

CM-CI series

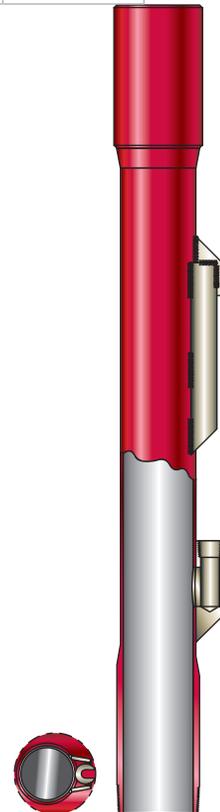
Mandrel Model	Model Number	Tubing Size (in.)	Mandrel Lug ID (in./mm)	Dimension OD ^{1,2}	Mandrel OD (in./mm)	Drift ID (in./mm)	Mandrel Length (ft/m)
CM-1CI	471X-XXX	2-3/8	1.00 25.40	A	3.783 96.09	1.901 48.29	4.25 1.30
				B	3.706 94.13		
		2-7/8		A	4.335 110.11	2.347 59.61	
				B	4.231 107.47		
		3-1/2		A	5.063 128.60	2.867 72.82	
				B	4.903 124.54		

¹A—Mandrel maximum running OD, standard collar

²B—Mandrel maximum running OD, special-clearance collar

Options

- Lug thread is available in numerous high-pressure connection designs.
- Dual-injection valve capability is available for increased chemical-injection volume.
- Internal lock profiles can be incorporated for additional functionality.
- Mandrels are available in a variety of alloys to meet stringent operating conditions in corrosive, high-pressure, and high-temperature environments.



CM-1CI
Mandrel



Chemical-Injection Equipment

SBRO-CI Series Side-Pocket Mandrels, Solid-Body

Weatherford's premium SBRO-CI series side-pocket mandrels feature a round cross-sectional profile, an integral orienting sleeve, and a unique bat-wing tool guard for the installation of 1-in. and 1 1/2-in. outside diameter (OD) chemical-injection devices. The mandrels have a pocket and deflector section that is machined from solid-bar stock. This design eliminates all longitudinal welds, providing an extremely strong mandrel for the most demanding environments. Internal profiles, including the bat-wing tool guard, are designed and tested to provide smooth wireline-tool passage in highly deviated wellbores, ensuring trouble-free operation throughout the life of the well.

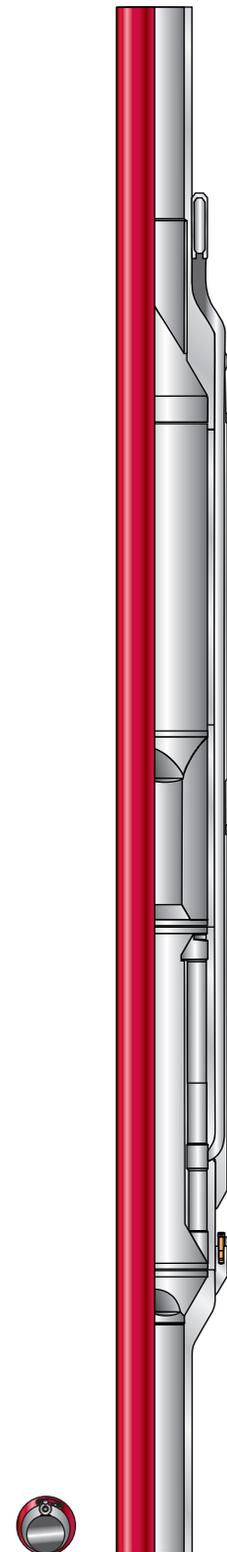
The SBRO-CI series mandrels are ideal for applications in which superior strength and increased pressure capabilities are required. Chemical-injection devices are installed in the side pocket using a kickover tool, which is run into the well using standard wireline techniques. The upper swage section contains an orienting sleeve that aligns the kickover tool with the side pocket for precise installation of chemical-injection devices in straight and deviated wellbores. The special bat-wing tool guard at the top of the pocket captures and guides the chemical-injection device into the pocket and deflects tools larger than the pulling/running tool back into the tubing bore of the mandrel.

These side-pocket mandrels also feature an integral injection tube attached to the mandrel pocket. The injection tube is connected to the capillary-injection line, which is used to transport chemicals from the surface to the mandrel downhole.

Because of their totally machined design, the SBRO-CI series mandrels are available in a number of configurations and materials.

Applications

- Used as internal receivers for the installation and retrieval of chemical-injection devices, primarily in single-string completions
- Can be installed in deviated and straight wellbores



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