

TRFC-HN AP and TRFC-HN LP

Single-line flow control valves

APPLICATIONS

- Multizone intelligent completions
- Comingled-flow completions
- Production and water- or gas-injection wells
- Well environments with scale deposition, severe erosion or high temperature conditions

BENEFITS

- Maximize production by
 - reducing unwanted water and gas production
 - providing better production or injection profile sweep efficiency
 - increasing reservoir understanding through periodic zonal tests
- Minimize costs and risks of well interventions

FEATURES

- Single control line operation that ensures a minimum of control lines deployed
- Simple, reliable J-slot indexer controlling valve movement
- Nine customizable choking positions, plus fully closed and fully open positions
- Compatibility with oil- and water-base control line fluids
- Field-proven gas-spring closure
- Positive closure at true vertical depths greater than 12,000 ft [3,658 m]
- No pressure drops or flow limitations through the system
- Reduced number of control lines required for operation

The TRFC-HN tubing-retrievable flow control valve provides surface-actuated downhole control of reservoir flow in dual-zone or multilateral wells in intelligent completions.

The actuation method, based on proven Camco* gas lift and subsurface safety systems, uses pressure cycles to shift the valve to the selected choking position. The rugged design makes the valves suitable for severe environments with scale deposits, erosion, and other demanding conditions. The valves are manufactured in a variety of materials, all meeting NACE specification MR0175. The use of multiple TRFC-HN valves allows a reservoir to be selectively controlled more reliably.

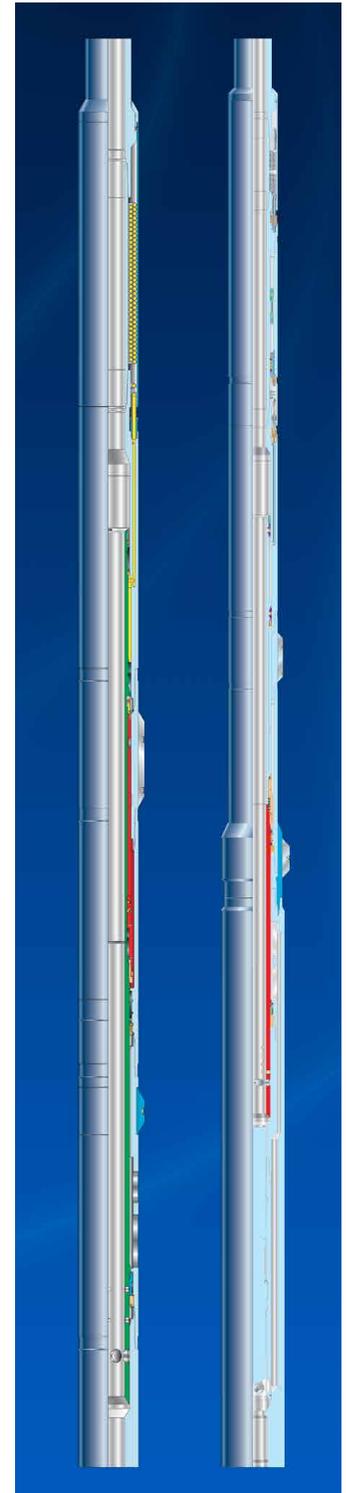
Operation

The TRFC-HN valve uses a single, dedicated hydraulic control line, operated at the surface, to activate the choke section. Applying hydraulic pressure to the control line actuates the valve, and the gas spring returns to the appropriate position when the control line pressure is bled off. The TRFC-HN is the only single control line actuated flow control valve that incorporates a closed hydraulic system that is not affected by and does not communicate with the annulus or tubing. It is insensitive to annulus pressure drops and thus has a larger operating envelope than conventional single line actuated valves.

Two versions of the TRFC-HN valve are available: the annular valve (AP) and the in-line (LP) valve. The annular valve controls flow between the annulus and the tubing. The in-line valve controls flow within the same tubing. This valve has a shroud across the choke section and a retrievable plug installed immediately below the choke section. The flow is directed into the shroud before it re-enters the tubing through the choke.

The TRFC-HN valve uses field-proven control line connections that can be externally pressure tested. The annular valve can bypass 2 x 0.433-in [11-mm] encapsulated control lines and the in-line valve can bypass three encapsulated lines, thereby ensuring a high degree of compatibility with hydraulic and electric systems in any completion design.

The TRFC-HN valve features 11 positions in its standard configuration, including fully open, fully closed, and nine intermediate choking positions. Adapting this valve to specific reservoir needs is easily done because the choke area at each position can be customized and the indexer can be configured for a different number of positions.



TRFC-HN AP and LP single-line flow control valves.

TRFC-HN AP and TRFC-HN LP

The TRFC-HN valve has been supplied in on-off, three-position, and four-position configurations. The main advantage of these configurations is to increase the number of flow control valves dropped from one control line.

The valve uses nozzle design flow ports to ensure well-defined flow characteristics for the various choke positions and minimal erosion at high differential pressures.

The choke position is controlled by a specially designed J-slot indexer that moves the choke through each position, allowing for precise flow regulation and control. The gas spring secures the choke in the desired position even after control line pressure is bled down, ensuring that vibrations do not accidentally move the valve. Both valve types use an integral, selective nipple profile to land plugs or pack-off sleeves to isolate zones as a contingency measure.

Schlumberger WellWatcher* permanent monitoring and communications technology can be used in conjunction with the TRFC-HN valve to monitor downhole pressure and temperature and to allow a clear understanding and precise control of a reservoir in real time.

TRFC-HN Flow Control Valve Specifications

Type	Annular Valve		In-Line Valve	
	2 7/8	3 1/2	2 7/8	3 1/2
Size, in	2 7/8	3 1/2	2 7/8	3 1/2
Max OD, in [mm]	5.125 [130.175]	5.844 [148.438]	5.955 [151.257]	7.215 [183.261]
Min. ID, in [mm]	2.250 [57.150]	2.812 [71.425]	2.250 [57.150]	2.812 [71.425]
Drift ID, in [mm]	2.245 [57.023]	2.797 [71.044]	2.245 [57.023]	2.797 [71.044]
Eccentricity, in [mm]	0.297 [7.544]	0.297 [7.544]	0.350 [8.890]	0.297 [7.544]
Overall length, in [mm]	200 [5,080]	225 [5,715]	256 [6,502]	276 [70,10]
Max. flow rate, bbl/d [m ³ /d]	17,000 [2,703]	40,000 [6,360]	17,000 [2,703]	25,000 [3,975]

TRFC-HN Flow Control System Specifications

Type	Annular Valve	In-Line Valve
Max. number of tool positions	2 7/8 valve: 7 (open, closed, and 5 choking positions); 3 1/2 valve: 11 (open, closed, and 9 choking positions)	
Max. flow area	110% of tubing area	
Actuator principle	Single hydraulic line to surface with mechanical spring counteraction	
Control line bypasses	2 7/8 AP valve: four 0.433-in [11.0-mm] encapsulated control lines; 2 7/8 LP valve: two 0.433-in [11.0-mm] encapsulated control lines; 3 1/2 AP/LP valve: two 0.433-in [11.0-mm] encapsulated control lines	
Control line fitting type	Inverted dual ferrule connector (optional hydraulic dry-mate connector)	
Standard in-line plug type	2 7/8 valve: 2.250 PCE selective; 3 1/2 valve: 2.812 PCE selective	

Materials

Material specifications	NACE MR0175
Seal material	Teflon® Chemraz®
Control line fluid compatibility	Oil- or water-base

Operating Data

Working pressures, psi [kPa]	7,500 [51,710]
Max. equalization differential pressure, psi [kPa]	1,500 [10,342]
Max. flowing differential pressure, psi [kPa]	1,500 [10,342]
Operating temperature rating, degF [degC]	2 7/8 valve: 70–325 [21–162]; 3 1/2 valve: 40–325 [5–162]
Min. installation temperature, degF [degC]	33 [0.5]
Min. storage temperature, degF [degC]	–40 [–40]

Environmental Qualifications

Erosion, psi [kPa]	1,500 [10,342] differential across choke nozzles
Sand concentration by weight, %	6
Valve life, years	10

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