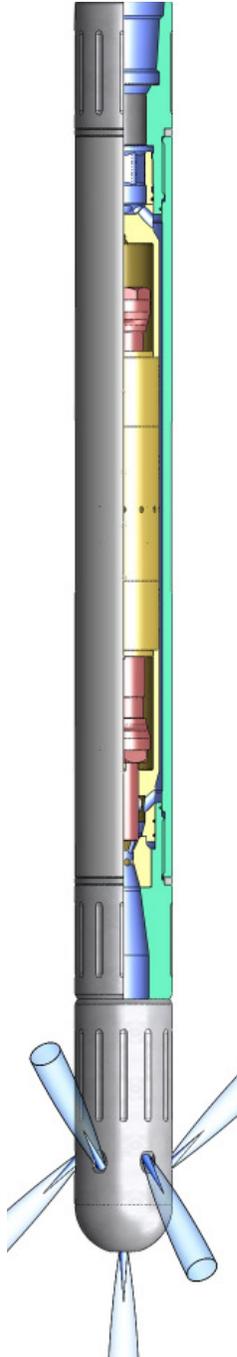


Pulsed Cleanout & Stimulation Tool



The HydroPull® Cleanout & Stimulation tool momentarily interrupts the return flow in the completion annulus to create intense water-hammer pressure pulses that vacuum the wellbore, pulling fines and debris from behind completions and out of the formation. This tool incorporates a nozzle with multiple jets that dislodge fill and scale. Pulsation of the return flow moves sand and debris in the horizontal and inclined sections of the well. The tool also pulls tubing into extreme reach horizontal wells.

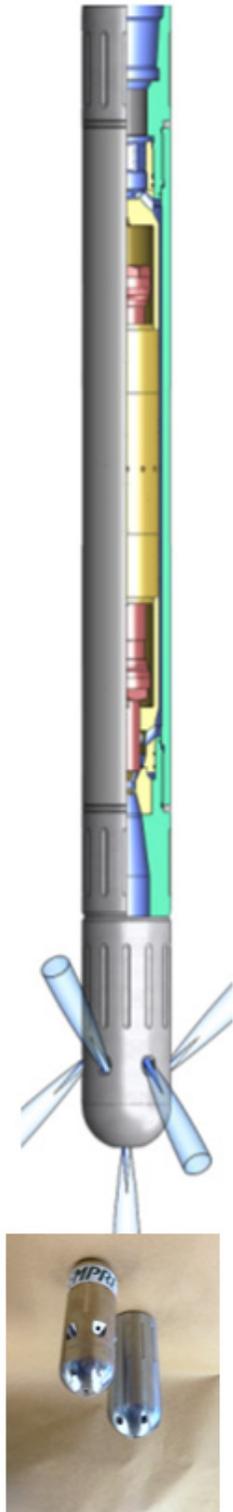
Three nozzle configurations are available, including a carbide coated version to break up obstructions.

When the well is allowed to circulate flow, the tool generates alternating suction and pressurized pulses over a large area of the completion. The induced flow flushes debris out from behind complex screened completions and pulls fines out of the near wellbore formation.

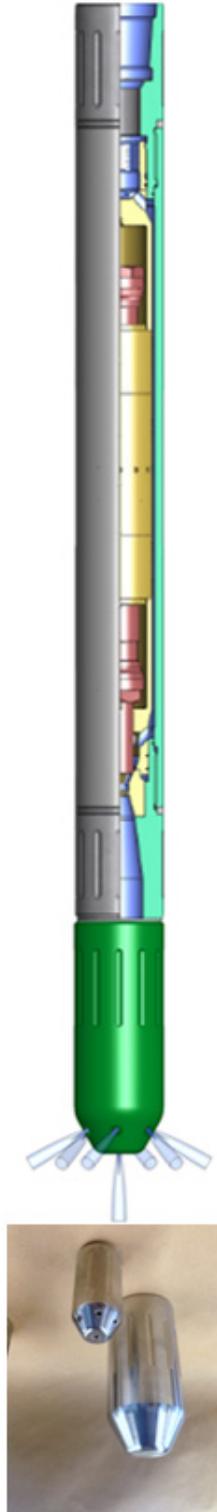
When the well is shut-in, the valve causes the flow of acid or other stimulation fluid to pulsate. Case histories have demonstrated increased production from acid and solvent squeeze treatments.

Feature	Benefit
Intense suction pressure	Removes debris from perforations and behind screens
Flow pulsation	Better sand and cuttings transport at low flow
Low pressure differential	Maximizes flow
Pull action	Pulls tubing into long tortuous wells, 10,000 ft.
Pulsating jets	One-trip cleanout and stimulation Eliminates the need for a motor and mill
High reliability	Multiday extended-reach jobs without tripping

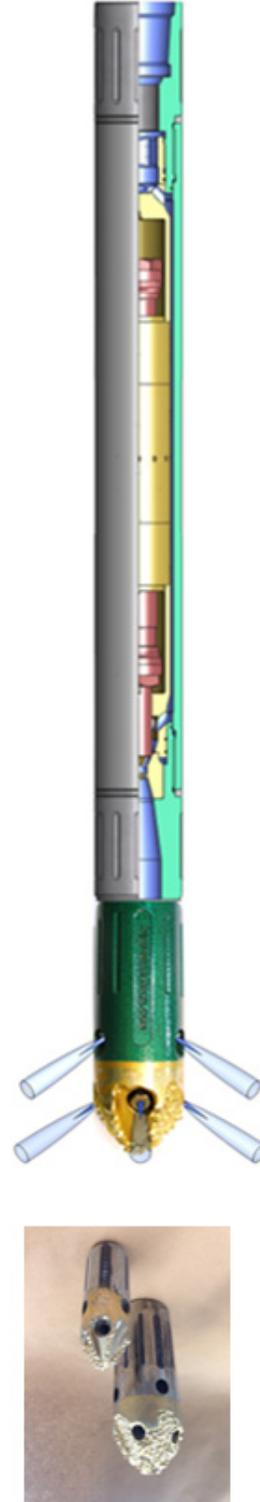
U.S. Patents 8,528,649 &
8,939,217,
International Patents Pending



Jets: Side Firing

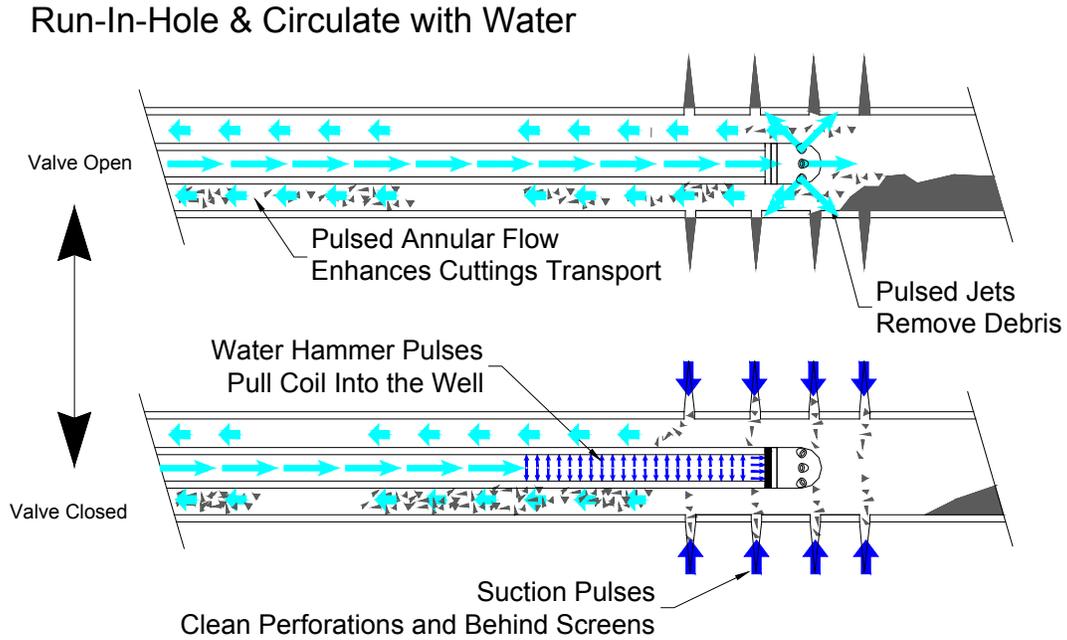


Forward Firing

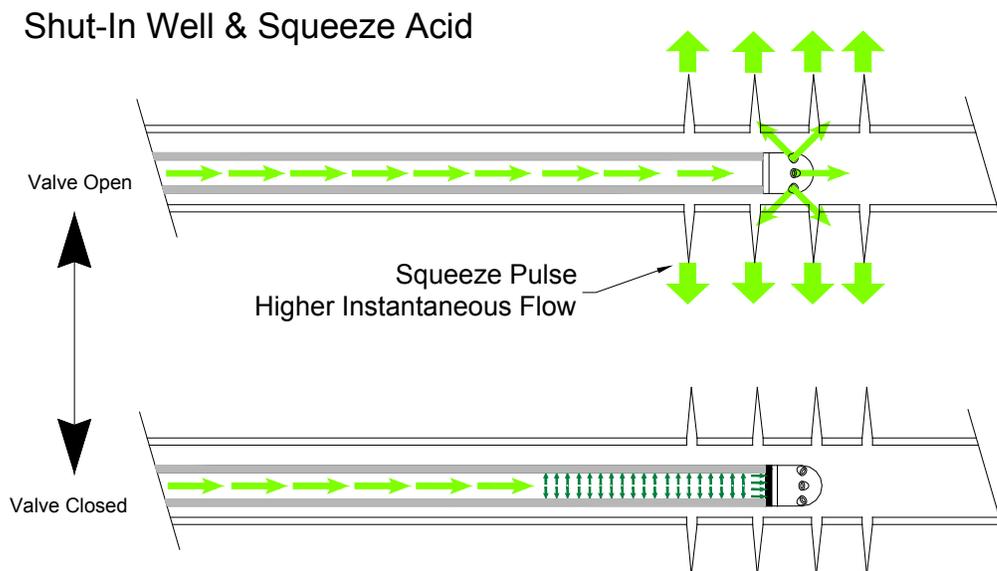


Carbide Coated

Extended-reach well stimulation



One-Trip Cleanout and Stimulation



Specifications

Tool diameter	1.69 in. (43 mm)	2.13 in. (54 mm)	2.38 in. (60 mm)	2.88 in. (73 mm)	
Connected length	22.75 in. (578 mm)	25.25 in. (641 mm)	27.10 in. (688 mm)	SA 36.79 in. (934 mm)	DIN 39.76 in. (1010 mm)
Connected length (with screen sub)	41.00 in. (1041 mm)	48.65 in. (1236 mm)	50.50 in. (1283 mm)	SA 66.14 in. (1680 mm)	DIN 72.08 in. (1831 mm)
Connections	1 in. AMT	1-1/2 in. AMT	1-1/2 in. AMT	2-3/8 in. PAC-DSI (mod)	
Design flow rate	0.9–1.8 bpm (140–290 lpm)	1.2–2.2 bpm (190–350 lpm)	1.2–2.2 bpm (190–350 lpm)	1.8–4.1 bpm (300–650 lpm)	
Average pressure differential*	400–1,500 psid (2.8–10 MPa)	700–2,000 psid (4.8–14 MPa)	700–2,000 psid (4.8–14 MPa)	600–1,700 psid (4.1–12 MPa)	
Annulus suction pulse* (proportional to flow rate)	90–180 psi (0.6–1.3 MPa)	160–260 psi (1.1–1.8 MPa)	160–260 psi (1.1–1.8 MPa)	110–180 psi (0.8–1.3 MPa)	
Traction rate* (proportional to flow rate)	15–25 ft/min (4–8 m/min)	15–30 ft/min (5–9 m/min)	15–30 ft/min (5–9 m/min)	10–20 ft/min (3–6 m/min)	
Pulse cycle rate (proportional to flow rate)	6–12 Hz	8–14 Hz	8–14 Hz	3–7 Hz	
Max. temperature	400°F (200°C)				
Fluid compatibility	Water, brine, weighted mud, bleach, solvents, 1% acid, 3% KCl, polymer gel and scale dissolvers. Acid-capable tools (1.69 & 2.13 in) can handle 28% HCl and mud acid.				
Gas compatibility	Air, carbon dioxide, nitrogen, or multiphase.				

*Values calculated using Tempress Performance Software.

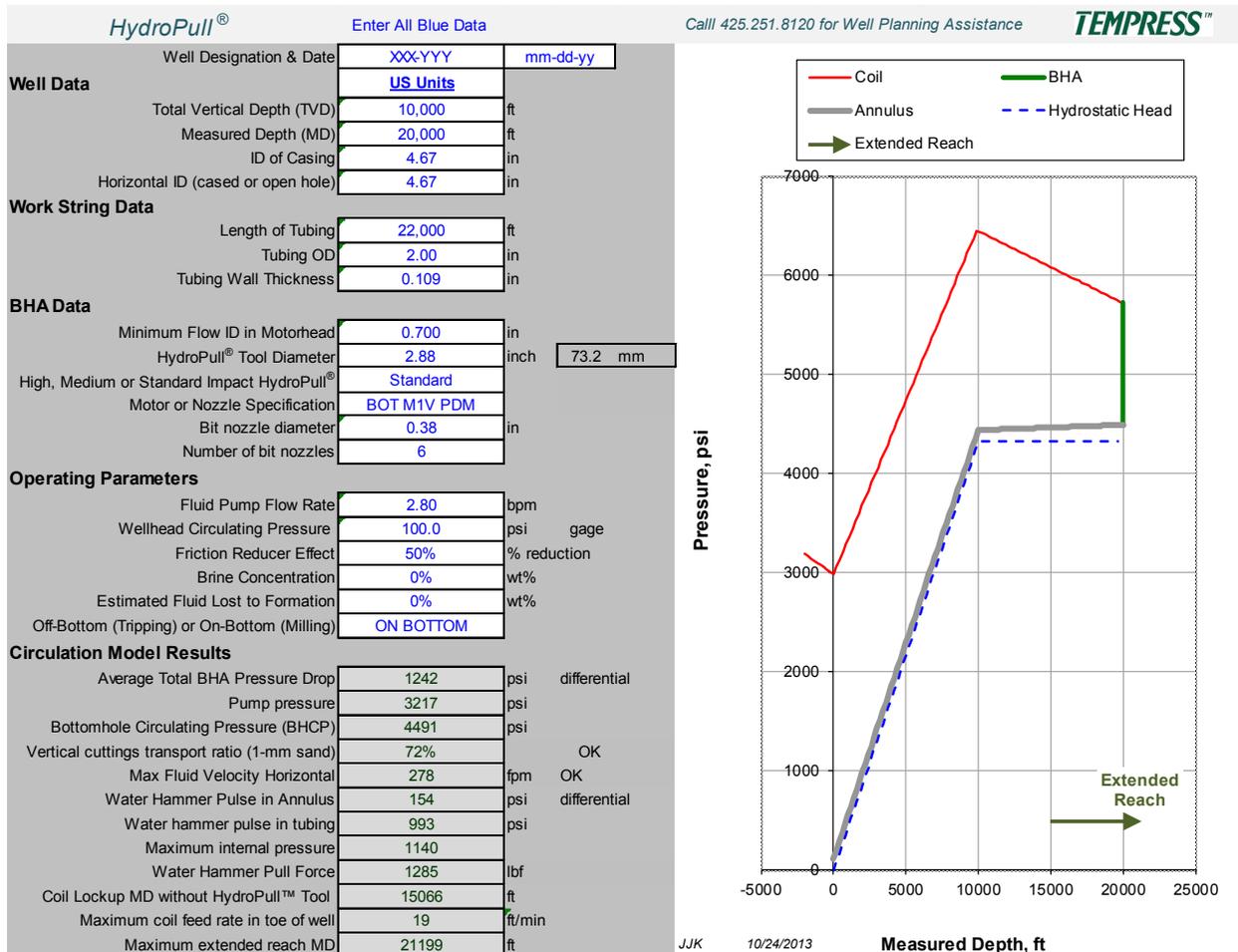
Specifications

Tool diameter	3.13 in. (79 mm)	3.38 in. (86 mm)	3.50 in. (89 mm)
Connected length (with screen sub)	76.10 in. (1633 mm)		
Connections	2-3/8 in. API REG		
Design flow rate	2.5-5.0 bpm (400-800 lpm)		
Average pressure differential*	600-1,700 psid (4.1-12 MPa)		
Annulus suction pulse* (proportional to flow rate)	150-300 psi (1.0-2.0 MPa)		
Traction rate* (proportional to flow rate)	10–20 ft/min (3-6 m/mm)		
Pulse cycle rate (proportional to flow rate)	3-6 Hz		
Maximum temperature	400°F (200°C)		
Fluid compatibility	Water, brine, weighted mud, bleach, solvents, 1% acid, 3% KCl, polymer gel and scale dissolvers		
Gas compatibility	Air, carbon dioxide, nitrogen, or multiphase		

* Values calculated using Tempress Performance Software.

HydroPull® Performance Software

A proprietary software program is available for HydroPull® tool job planning. The software evaluates circulating pressures in the well, BHA, and supply tubing based on job parameters. The program calculates pump pressure requirements, the transport of sand and cuttings in the horizontal and vertical sections of the well, the rate at which the tool will pull tubing into the well, and the pressure pulse amplitude in the completion. A screen shot of the software is provided below.



Case Histories

The HydroPull® tool has been run in thousands of wells in the U.S. and Canada since their introduction in 2010. Runs range from 1 to 9 days of continuous operation. A few case histories are summarized below.

Heavy Oil Well Stimulation (two wells): For the first well, a 1.69-in. (43-mm) HydroPull® tool was operated on 1.5-in. (38 mm) coil to enter a 7-in. (18 mm) slotted liner in a heavy oil horizontal completion. Prior attempts to enter this well were prevented because of asphaltene and sand obstructions between 3100 and 3800 ft (945 and 1158 m). A bullnose nozzle was run. The tool was operated at a flow rate of 1.3 bpm (207 lpm) of produced water plus 15% AS-1 solvent (kerosene and xylene). The tool slowed in the area of the obstructions, but moved through at a feed rate of 8 ft/min (2.4 m/min), then it resumed at a feed rate of 20 ft/min (6 m/min). TD was reached at 4592 ft (1400 m), and the tool was run out of the hole at 33 ft/min (10 m/min). A total of 280 bbl (44,516 l) of fluid was pumped. **Well production increased from 44 to 605 bbl (6996 to 96,187 l) per day with low water cut.**

On the second well, a 1.69-in. (43-mm) HydroPull® tool was used to place 315 bbl (50,081 l) of water with 3% KCl and 2% MudSol. A bullnose with three 0.188-in. (5-mm) forward-facing jet nozzles was run. The flow rate was 0.9 to 1.3 bpm (207 lpm) with a surface pump pressure of 1740 psi (12 MPa). The tool was run in at 10 to 20 ft/min (3 to 6 m/min) through the 5.5-in. (140-mm) horizontal slotted liner to TD at 4920 ft (1500 m) MD, with 1970 ft (600 m) TVD. The tool was pulled back every 300 ft (91 m) to sweep sand fill. **Well production increased from 25 to 44 bbl (3975 to 6996 l) per day with low water cut.**

Extended Reach on 1.5-in. (38-mm) Coil: This job required re-entry into a 6.1-in. (155-mm) diameter horizontal openhole from 4760 to 8070 ft (1451 to 2460 m) MD to place solvent. The horizontal section was 3313 ft (1010 m) long. Prior attempts to enter this well with 1-in. (25 mm) continuous rod failed at 6230 ft (1899 m) MD. The casing was 2.44-in. (62-mm) ID, so a 1.69-in. (43-mm) HydroPull® tool with a four-jet nozzle pattern was run on 1.5-in. (38-mm) coiled tubing. The tool was operated at 1.3 bpm (207 lpm) and at feed rates of 30 to 65 ft/min (9 to 20 m/min). The final 1000 ft (305 m) to TD was entered at 10 ft/min (3 m/min) with snubbing forces well below the coil limits. The solvent was placed at the toe of the well and allowed to soak for 24 hours. The well was re-entered with the HydroPull® tool the following day. Commingled fluid (0.7 bpm [111 lpm] water and 525 scf [14.9 m³] nitrogen) was pumped to lift the solvent from the well. **The HydroPull® Cleanout & Stimulation tool extended the lateral reach of the coil by 20% or 690 ft (210 m) in this well.**

Extreme-Reach Cleanout: This job involved three wells that required sand cleanout in 5.5-in. (140-mm) casing at an extended reach of 6950, 7170 and 8009 ft (2118, 2185 and 2441 m). A 2.88-in. (73-mm) HydroPull® tool with a motor was run in these wells on 2-in. (51-mm) coil at 2.75 bpm (437 lpm). TD was reached on all three wells. A coiled tubing friction lockup model was run for each well trajectory. On the longest well trajectory, shown below, the model predicted coil lockup at a measured depth of 13,060 ft (3981 m), assuming a default value for the coil/casing wall friction coefficient. The HydroPull® tool enabled the coil to reach TD at 15,239 ft (4645 m), which is 3179 ft (969 m) beyond the predicted lockup point. **On the 8009-ft (2441-m) lateral, this represents a minimum 52% increase in lateral reach.**

