

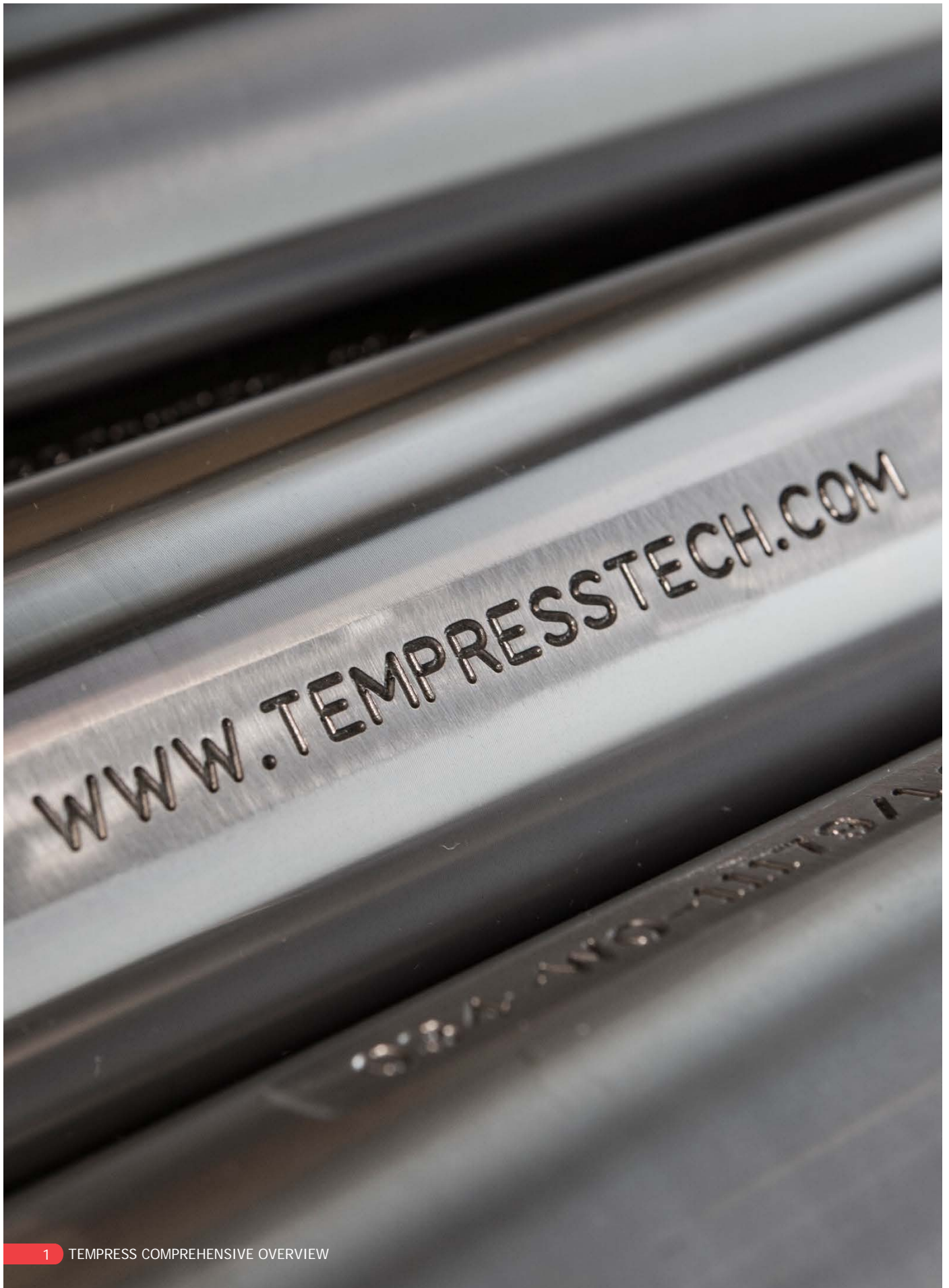


TEMPRESS®

COMPREHENSIVE OVERVIEW

Advanced Rental Tools for Extended-Reach Milling
Well Stimulation, Downhole Phase Separation and Sand Cleanouts

tempresstech.com



Who we are

Tempress®, a division of Oil States Energy Services (OSES), rents tools for extended reach and depleted well service through select global service providers. We focus on serving our clients with support and service equipment throughout the completion and workover phases of the well. We provide a broad range of equipment related to supporting operators and service companies during thru-tubing well site activities.

Tempress tools are renowned for their power and reliability and outperform competitor tools with over 99% reliability. With over 20,000 runs, Tempress is the brand operators rely on to get the job done right, the first time.

OSES mission statement

OSES is totally committed to being the “best in class” by consistently providing our customers with state-of-the-art equipment, highly-trained personnel, and the highest operating efficiency and safety performance within the service and rental segment of the industry. We will continue to be innovative and improve productivity and overall effectiveness through programs and procedures that maximize our overall performance, minimize your risk and exposure, assure financial viability, promote overall growth and ultimately add value and benefit to our customers, employees and investors.

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Quality, Health, Safety, and Environmental Policy Commitment Statement

Oil States Energy Services' Quality, Health, Safety, and Environmental practices support our commitment to achieving our QHS&E initiatives, which align with our overall vision for the company. Our vision defines how we will meet the following objectives:

- We will conduct business in a safe and environmentally responsible manner, striving for zero incidents in everything we do, providing safe and healthy working conditions to prevent injuries and ill health, and minimizing any environmental impact within our overall operations.
- We will use a hierarchy of integrated controls to identify and mitigate risks associated with our processes and procedures.
- We will meet or exceed customer requirements, with service quality and HS&E excellence as our mandate at every level of our organization.
- We will comply with our Business Management System and all statutory, regulatory, and other requirements.
- We will regularly review and set goals and objectives at all levels of our organization, supporting continuous improvement in all areas of QHS&E, with the goal being enhancement to our performance.
- Our employees participate in our Business Management System processes and we will recognize OSES employees with outstanding QHS&E performance.

We are committed to the proactive integration of QHS&E Objectives into our Management Systems at all levels. The commitments in this policy are in addition to our basic obligation to comply with Oil States Energy Services' standards, as well as all applicable laws and regulations where we operate. Compliance with this policy is critical to our business success because it reduces risks and adds value to the services we provide to our customers.

This policy is available by request to any relevant interested parties.





HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

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

Tempress HydroPull™ Tool

The Tempress HydroPull tool is the most powerful friction-breaking tool on the market. This tool incorporates a cycling valve that momentarily interrupts the flow to create water-hammer pressure pulses inside coiled or jointed tubing used in horizontal well interventions. The water-hammer effect generates traction forces that pull the tubing into the well at 20 ft/min (6 m/min) or more. These periodic pulses also vibrate the tubing, which reduces friction drag and extends the lateral reach of the tubing by delaying the onset of helical buckling and lockup.

The HydroPull tool is typically run above a downhole motor for milling applications. The HydroPull tool continues to set and break all existing records for extended reach applications. **The tool is fully tunable for various impact levels and custom applications.**

Applications

- Fishing
- Coiled and Jointed tubing
- Composite bridge plug milling
- Ball seat milling
- Sand cleanout
- Valve shifting
- Extended-reach well service
- Acidizing
- Chemical placement
- Screen and perforation cleaning
- Scale removal
- Depleted well service



Feature	Benefit
Pulling Force	Pulls tubing into long tortuous wells Reduces plug milling time Eliminates the need for friction-reducing beads and chemicals <i>Routine entry of over 11,000 ft horizontals</i>
Flow Pulsation	Better hole cleaning Fewer short trips <i>Mill 48+ plugs per day</i>
Low pressure differential	Effective on various coil sizes or high-pressure wells
High reliability	Multiday extreme-reach jobs without tripping Over 99% downhole success rate <i>Mill 70+ plugs in a single run</i>
Polymer gel compatibility	Effective sweeps minimize short trips
Nitrogen compatibility	Effective on commingled fluid for depleted well service



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Custom Tool Development

Specifications

Tools	1.69-in. Standard Flow	2.12-in. Std Flow 2.38-in. Std Flow	2.12-in. High Flow 2.38-in. High Flow
Design flow rate	0.9-1.8 bpm (140-290 lpm)	1.0-2.0 bpm (160-320 lpm)	1.2-2.4 bpm (190-380 lpm)
Max intermittent (jarring) flow rate	2.3 bpm (370 lpm)	2.6 bpm (410 lpm)	3.1 bpm (490 lpm)
Average pressure differential	230-800 psid (1.6-5.5 MPa)	220-640 psid (1.5-4.4 MPa)	200-600 psid (1.4-4.1 MPa)
Max traction (impact) force at design flow	1,900 lbf (860 daN)	1,900 lbf (860 daN)	1,500 lbf (670 daN)
Pulse cycle rate	7-14 Hz	7-14 Hz	6-13 Hz

Tools	2.88-in. Standard Flow	2.88-in. High Flow	3.12-in. Std/HF 3.38-in. Std/HF 3.50-in. Std/HF
Design flow rate	1.9 – 3.8 bpm (300 – 600 lpm)	2.3 – 4.5 bpm (360 – 710 lpm)	2.5 – 5.5 bpm (400 – 869 lpm)
Max intermittent (jarring) flow rate	4.5 bpm (710 lpm)	5.5 bpm (870 lpm)	6.0 bpm (950 lpm)
Average pressure differential	100 – 550 psid (0.7 – 3.8 MPa)	150 – 590 psid (1.0 – 4.1 MPa)	150 – 560 psid (1.0 – 3.9 MPa)
Max traction (impact) force at design flow	3,200 lbf (1400 daN)	3,900 lbf (1700 daN)	4,400 lbf (2000 daN)
Pulse cycle rate	2 – 6 Hz		



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Custom Tool Development

Case Histories

The HydroPull tool is consistently setting or breaking existing records. Please contact us or visit our website for the most recent HydroPull Case Histories.

Contact Information:

Tempress Technologies Inc.

2200 Lind Avenue SW

Building A, Suite 108

Renton, WA 98057

Phone: 425.251.8120

www.tempresstech.com



Flow Rate Effect

The traction force is linearly proportional to the flow rate in the coil and is magnified by the impact configuration. Several HydroPull tool configurations are available for most applications including Standard Impact, Medium Impact, High Impact, and the Max Impact for the most demanding applications.

Two-Phase Flow

The HydroPull tool is designed to operate on two-phase flow. The presence of nitrogen dampens the pulse. The tool can also be run with a Tempress Motor Gas Separator (MGS™). The HydroPull tool may also be run downhole with straight gas, if required.

Coiled Tubing Connection

A high-quality coiled tubing connection is recommended when the HydroPull tool is operated at the high end of its design flow rate range. Refer to the HydroPull Operation Guide for pressure test and pull test recommendations.

Last Chance Screen



Clean fluid with no sand should be run. A last chance screen is included with each tool to prevent gravel and other debris from blocking the tool and to minimize the chance for premature failure of other bottomhole assembly components. The screen openings are 0.06-in. (1600 microns) to 0.16-in. (3900 microns) depending on tool size and job requirements.

HydroPull Operation Guide

An operation guide is included with the HydroPull tool that provides operating instructions and job reporting requirements. These guides are also located within our Client Login site on our website.



HydroPull™ Extended Reach

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Water Bypass AV Sub (WBS)

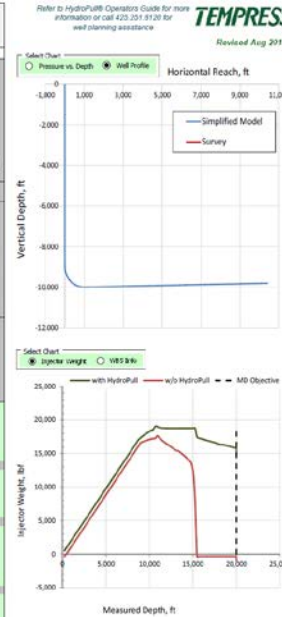
High Pressure Rotary Jet
(JetRotor™)

Engineering Services

Custom Tool Development

HydroPull™ Performance Software

HydroPull® Extended Reach Model- Simplified Well Profile			Enter All Blue Data	©Tempress OSES 2017
Performance Software is designed specifically for use with Tempress® tools only				
Well Designation & Date			Wellname	mm/dd/yr
Well Data	Select units	US Units		
	Kickoff point (TVD)	9,000	ft	
	End of curve/landing point (TVD)	10,000	ft	
	True depth (TVD)	9,800	ft	1.2 deg toe-up
	Measured Depth (MD) Objective	20,000	ft	
	ID of casing in vertical and curve	4.67	in	
	Lateral ID (cased or open hole)	4.67	in	
Working (Separate Tab)	Average dog leg severity in horizontal	1.1	°/100 ft	
	Static friction coefficient	0.24		.21 for pipe-on-pipe friction reducer, with no P.R., .30 if no coil straightener
	Coil OD	2.306	in	Displayed For Reference
	Coil Wall Thickness	0.109	in	
	Minimum flow ID in motorhead	0.70	in	
	HydroPull® tool diameter	2.38	in	
	HydroPull® Configuration (Flow - Impact Rating)	Standard Flow, High Impact		
BHA	# of Nozzle Ports (bit, subnose)	6.375		see Tempress Nozzle Sizes
	Port diameter	0.375	in	
	Tempress® Water Bypass Sub	No		
	No-load motor pressure (see Motor Data Tab)	60	psid	0 if no motor
Operating Parameters	On-off bottom motor pressure differential	750	psid	0 if no motor
	Pump flow rate	3.30	gpm	
	Minimum Weight on Bit	500	lbf	
	Wellhead circulating pressure (choke)	150	psi	gauge
	Fluid friction reducer effect	50%	% reduction	
	Fluid density	8.34	ppg	Spec. Gravity= 1.00
	Est. fluid lost to (-) or gained from (+) formation	0.30	gpm	Default is 0
Results	Total BHA pressure drop	1,300	psi	differential
	Pump pressure (drilling/rolling)	3,490	psi	
	Outshore circulating pressure (BHCP)	4,559	psi	
	Wellhead snubbing force	360	lbf	
	Hydraulic Lift-off force	175	lbf	
	Water hammer pulse in annulus	187	psi	differential
	Water hammer pulse in work string	1026	psi	
	Minimum rupture disk rating	3747	psi	
	Impact force at BHA	3,165	lbf	
	Fluid velocity in horizontal section	219	fpm	OK
	Vertical cuttings transport ratio (1=excellent)	7.6%		OK
	Water Flow to Motor	3.0	gpm	
	Water Bypass (if WBS selected)	-	gpm	
	On-Off Bottom Motor Flow Variation w/WBS	-		
	Maximum coil feed rate at toe of well	17	ft/min	
	Coil lockup MD without HydroPull®	152.65	ft	
	MD with HydroPull®	21998	ft	
	Reach increase due to HydroPull®	6752	ft	



A proprietary software program is available for HydroPull tool job planning. The software evaluates circulating pressures in the well and horizontal reach capabilities based on a set of input parameters. The program also calculates pump pressure requirements, the transport of sand and cuttings in the horizontal and vertical sections of the well, predicted lockup, and the rate at which the tool will pull tubing into the well. This software is located within our Client Login site on our website.



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(JetRotor™)

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Engineering Services

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Custom Tool Development

Competitor Analysis – Friction Breaking Tool

	The Tempress HydroPull™ Tool	Fluidic Flow Modulation Tool	Rotary Valve Pulse Tool with Rotor/Stator
Most powerful friction-breaking tool on the market	✓		
Lowest pressure differential on the market	✓		
Minimal or no elastomeric components	✓	✓	
Compatible with high BHT >400 °F	✓		
Highly effective in extreme, extended reach laterals	✓		
Relatively short length	✓	✓	
Most reliable friction breaking tool on the market	✓		
Nitrogen compatible	✓	✓	
High chemical compatibility	✓	✓	
No moving parts		✓	
Wide operating range	✓	✓	✓
Fully tunable for various impact levels	✓		
Pulls the tubing in the well at >20 ft/min	✓		
Enhances the MWD signal	✓		



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Engineering Services

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Tempress HydroPull™ SC Tool

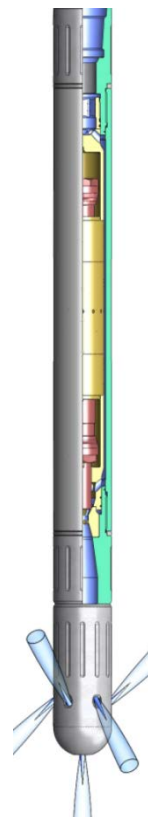
The HydroPull™ SC Stimulation & Cleanout tool momentarily interrupts the return flow in the completion annulus to create intense water-hammer pressure pulses that vacuum the wellbore, pulling fines and debris from behind completions and out of the formation. This tool incorporates a carbide hammer bit or bullnose 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 at 20 ft/min (6 m/min) or more.

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. These pulses penetrate over 100 feet into the formation and can be detected at up to 10,000 ft. Case histories have demonstrated increased production from acid and solvent squeeze treatments. **The tool is fully tunable for various impact levels and custom applications.**

Applications

- Coiled and Jointed tubing
- Sand and fill cleanout
- Scale cleanout
- Cement milling
- Acidizing
- Sand screen flushing
- Perforation cleaning
- Depleted well service



Feature	Benefit
Pulling force	Pulls tubing into long tortuous wells Eliminates the need for friction-reducing beads and chemicals <i>Routine entry of over 11,000 ft horizontals</i>
Flow pulsation	One-trip cleanout and stimulation Eliminates need for a motor and mill Better sand and cuttings transport at low flow Fewer short trips <i>Most powerful pulse pressure available</i>
Low pressure differential	Effective on various coil sizes or high-pressure wells Maximizes flow
Intense suction pressure	Removes debris from perforations and behind sand screens
Nitrogen compatibility	Effective on commingled fluid for depleted well service
High reliability	Multiday extreme-reach jobs without tripping <i>Over 99% downhole success rate</i>



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Engineering Services

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Custom Tool Development

Specifications – HydroPull™ SC Tool

Tools	1.69-in. Standard Flow	2.12-in. Std Flow 2.38-in. Std Flow	2.12-in. High Flow 2.38-in. High Flow
Design flow rate	0.9-1.8 bpm (140-290 lpm)	1.0-2.0 bpm (160-320 lpm)	1.2-2.4 bpm (190-380 lpm)
Max intermittent (jarring) flow rate	2.3 bpm (370 lpm)	2.6 bpm (410 lpm)	3.1 bpm (490 lpm)
Average pressure differential [◇]	230-800 psid (1.6-5.5 MPa)	220-640 psid (1.5-4.4 MPa)	200-600 psid (1.4-4.1 MPa)
Max traction (impact) force at design flow	1,900 lb _r (860 daN)	1,900 lb _r (860 daN)	1,500 lb _r (670 daN)
Pulse cycle rate	7-14 Hz	7-14 Hz	6-13 Hz
Pulse pressure	1,000-2,300 psi [□] (6.9-15.9 MPa)	650-1,350 psi [□] (4.5-9.3 MPa)	500-1,600 psi [□] (3.4-11.0 MPa)

[◇]Based on 1.50-in. coil, 0.156-in. wall

[□]Based on 1.75-in. coil, 0.156-in. wall

Tools	2.88-in. Standard Flow	2.88-in. High Flow	3.12-in. Std/HF 3.38-in. Std/HF 3.50-in. Std/HF
Design flow rate	1.9 – 3.8 bpm (300 – 600 lpm)	2.3 – 4.5 bpm (360 – 710 lpm)	2.5 – 5.5 bpm (400 – 869 lpm)
Max intermittent (jarring) flow rate	4.5 bpm (710 lpm)	5.5 bpm (870 lpm)	6.0 bpm (950 lpm)
Average pressure differential [◇]	100 – 550 psid (0.7 – 3.8 MPa)	150 – 590 psid (1.0 – 4.1 MPa)	150 – 560 psid (1.0 – 3.9 MPa)
Max traction (impact) force at design flow	3,200 lb _r (1400 daN)	3,900 lb _r (1700 daN)	4,400 lb _r (2000 daN)
Pulse cycle rate	2 – 6 Hz		
Pulse pressure [▲]	550-1,300 psi (3.8-9.0 MPa)	600-1,550 psi (4.1-10.7 MPa)	600-1,750 psi (4.1-12.1 MPa)

[◇] Add pressure differential from Hammer Bit or Bullnose for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See nozzle charts below.

[▲] Based on 2.38-in. coil, 0.156-in. wall



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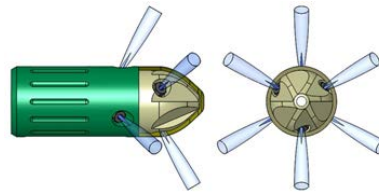
Engineering Services

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Custom Tool Development

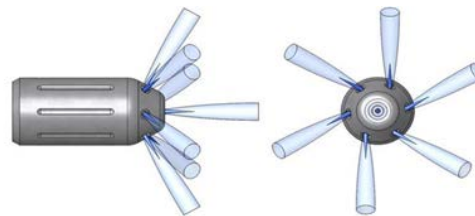
Carbide Hammer Bit

Carbide coated Hammer Bits have an aggressive coating of brazed carbide blocks on the front surfaces ideally suited for aggressive milling and hammering action. This configuration is recommended for applications where hard, consolidated materials may be encountered. The powerful forward movements caused by HydroPull water-hammer cycles create short stroke, hammer-milling action that breaks up scale. Forward firing nozzles at 60° from the tool axis further dislodge scale and clean the inside diameter of the tubing or casing. The nozzles have carbide inserts with good jet quality so the jets are effective at larger standoff (reach) and flow performance remains consistent throughout long jobs.



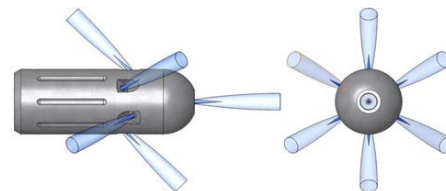
Forward Firing Nozzle Bullnose

The forward firing nozzle configuration has a center nozzle and several nozzles positioned at 60° from the tool axis that exit from the front surface of the tool near the outside diameter. This version is recommended for most sand fill cleanouts and stimulations.



Side Firing Nozzle Bullnose

The side firing nozzle configuration is preferred by some customers. It has a single forward nozzle and several forward and backward facing nozzles at 45° from the tool axis that exit at the outside diameter of the tool.





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Engineering Services

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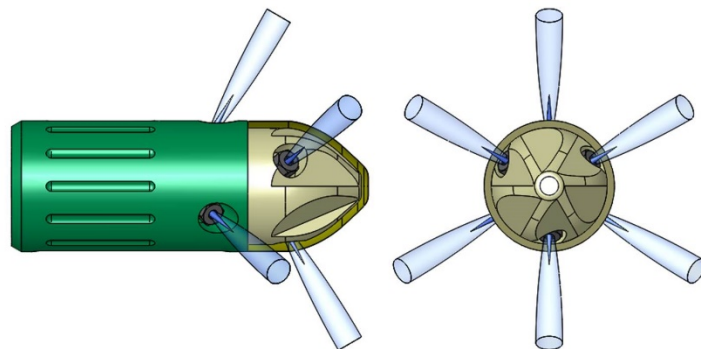
Custom Tool Development

Specifications – Hammer Bit Only 1.69-in. to 2.38-in.

Nozzles on 1.69-in. OD Tools		Low Flow	Medium Flow	High Flow	Max Flow
Average Hammer Bit pressure [†] at suggested flow rate		870 psi @ 1.0 bpm	900 psi @ 1.4 bpm	810 psi @ 1.8 bpm	460 psi @ 1.8 bpm
Total nozzle flow area		.038 in ²	.053 in ²	.074 in ²	.099 in ²
Nozzle Sizes	Qty	6	6	6	6
	Dia.	.090 in.	.106 in.	.125 in.	.145 in.

Nozzles on 2.12-in. & 2.38-in. OD Tools		Low Flow	Medium Flow	High Flow	Max Flow
Average Hammer Bit pressure [†] at suggested flow rate		900 psi @ 1.4 bpm	810 psi @ 1.8 bpm	570 psi @ 2.0 bpm	580 psi @ 2.4 bpm
Total nozzle flow area		.053 in ²	.074 in ²	.099 in ²	.141 in ²
Nozzle Sizes	Qty	6	6	6	6
	Dia.	.106 in.	.125 in.	.145 in.	.173 in.

[†]Add pressure differential from HydroPull to Hammer Bit for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See HydroPull charts above.





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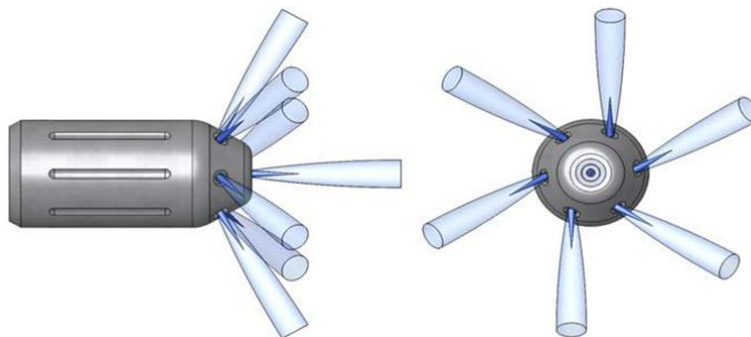
Custom Tool Development

Specifications – Forward Nozzle Bullnose Only 1.69-in. to 2.12-in. Outside Diameter

Nozzles on 1.69-in. Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure▲ at suggested flow rate			890 psi @ 1.2 bpm	830 psi @ 1.7 bpm	480 psi @ 1.8 bpm
Total nozzle flow area			.065 in ²	.096 in ²	.138 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.109 in.	.132 in.	.156 in.
	Front Jets	Qty	1	1	1
		Dia.	.109 in.	.132 in.	.156 in.

Nozzles on 2.12-in. Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure▲ at suggested flow rate			810 psi @ 1.5 bpm	600 psi @ 2.0 bpm	510 psi @ 2.4 bpm
Total nozzle flow area			.086 in ²	.134 in ²	.172 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.125 in.	.156 in.	.177 in.
	Front Jets	Qty	1	1	1
		Dia.	.125 in.	.156 in.	.177 in.

▲Add pressure differential from HydroPull to Forward Nozzle Bullnose for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See HydroPull charts above.





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Engineering Services

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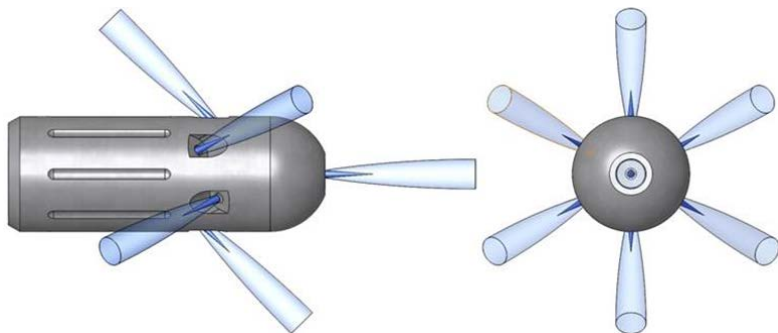
Custom Tool Development

Specifications – Side Firing Nozzle Bullnose Only 1.69-in. to 2.12-in. Outside Diameter

Nozzles on 1.69-in. Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure [△] at suggested flow rate			890 psi @ 1.2 bpm	830 psi @ 1.7 bpm	480 psi @ 1.8 bpm
Total nozzle flow area			.065 in ²	.089 in ²	.133 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.109 in.	.120 in.	.154 in.
	Front Jets	Qty	1	1	1
		Dia.	.109 in.	.163 in.	.163 in.

Nozzles on 2.12-in. Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure [△] at suggested flow rate			810 psi @ 1.5 bpm	600 psi @ 2.0 bpm	510 psi @ 2.4 bpm
Total nozzle flow area			.086 in ²	.132 in ²	.167 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.125 in.	.150 in.	.173 in.
	Front Jets	Qty	1	1	1
		Dia.	.125 in.	.183 in.	.183 in.

[△]Add pressure differential from HydroPull to Side Firing Nozzle Bullnose for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See HydroPull charts above.





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Engineering Services

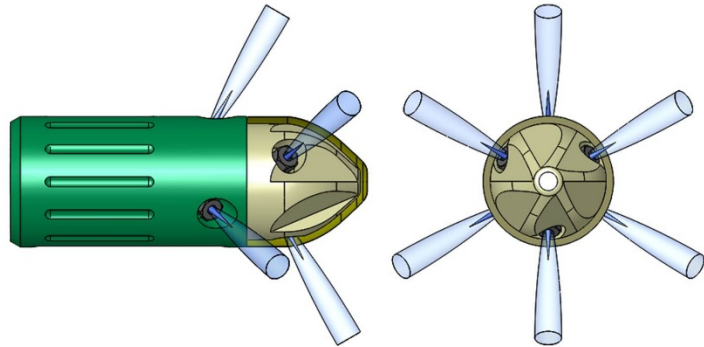
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Custom Tool Development

Specifications – Hammer Bit Only 2.88-in. Outside Diameter

Nozzles on 2.88-in. Tools		Low Flow	Medium Flow	High Flow
Average Hammer Bit pressure [†] at suggested flow rate		800 psi @ 2.4 bpm	820 psi @ 3.2 bpm	820 psi @ 3.8 bpm
Total nozzle flow area		.098 in ²	.132 in ²	.188 in ²
Nozzle sizes	Qty	8	8	8
	Dia.	.125 in.	.145 in.	.173 in.

[†]Add pressure differential from HydroPull to Hammer Bit for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See HydroPull charts above.





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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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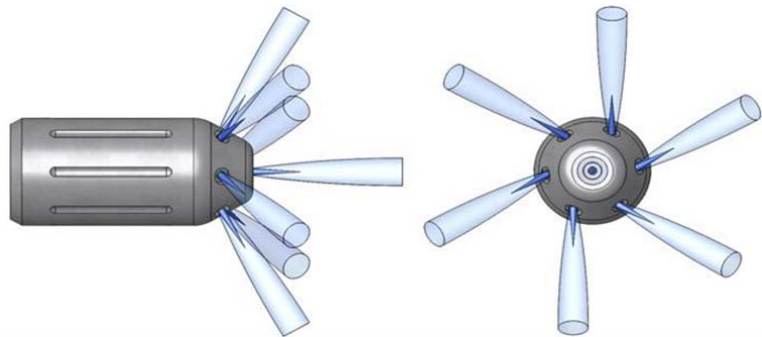
Custom Tool Development

Specifications – Forward Nozzle Bullnose Only 2.88-in. to 3.50-in. Outside Diameter

Nozzles on 2.88" Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure▲ at suggested flow rate			860 psi @ 2.4 bpm	630 psi @ 3.6 bpm	520 psi @ 4.3 bpm
Total nozzle flow area			.134 in ²	.233 in ²	.306 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.156 in.	.206 in.	.236 in.
	Front Jets	Qty	1	1	1
		Dia.	.156 in.	.206 in.	.236 in.

Nozzles on 3.12-in., 3.38-in., 3.50-in. Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure▲ at suggested flow rate			810 psi @ 3.4 bpm	690 psi @ 4.6 bpm	440 psi @ 5.0 bpm
Total nozzle flow area			.194 in ²	.286 in ²	.389 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.188 in.	.228 in.	.266 in.
	Front Jets	Qty	1	1	1
		Dia.	.188 in.	.228 in.	.266 in.

▲Add pressure differential from HydroPull to Forward Nozzle Bullnose for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See HydroPull charts above.





HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

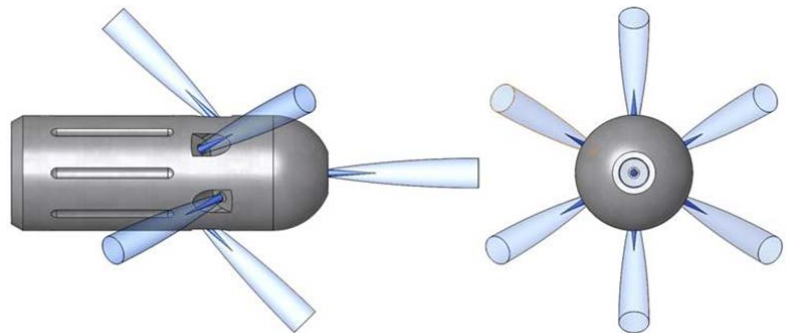
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Custom Tool Development

Specifications – Side Firing Nozzle Bullnose Only 2.88-in. Outside Diameter

Nozzles on 2.88-in. Tools			Low Flow	Medium Flow	High Flow
Average Bullnose pressure [△] at suggested flow rate			860 psi @ 2.4 bpm	630 psi @ 3.6 bpm	520 psi @ 4.3 bpm
Total nozzle flow area			.134 in ²	.233 in ²	.306 in ²
Nozzle Sizes	Side Jets	Qty	6	6	6
		Dia.	.156 in.	.206 in.	.236 in.
	Front Jets	Qty	1	1	1
		Dia.	.156 in.	.206 in.	.236 in.

[△]Add pressure differential from HydroPull to Side Firing Nozzle Bullnose for total differential pressure through HydroPull SC Stimulation and Cleanout Tool. See HydroPull charts above.





HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

Case Histories

The HydroPull SC tool is consistently setting or breaking existing records. Please contact us or visit our website for the most recent HydroPull SC Case Histories.

Contact Information:

Tempress Technologies Inc.
2200 Lind Avenue SW
Building A, Suite 108
Renton, WA 98057
Phone: 425.251.8120
www.tempresstech.com



Flow Rate Effect

The traction force is linearly proportional to the flow rate in the coil and is magnified by the impact configuration. Several HydroPull SC tool configurations are available for most applications including Standard Impact, Medium Impact, High Impact, and the Max Impact for the most demanding applications.

Two-Phase Flow

The HydroPull SC tool is designed to operate on two-phase flow. The presence of nitrogen dampens the pulse. The tool can also be run with a Tempress Motor Gas Separator (MGS™). The HydroPull SC tool may also be run downhole with straight gas, if required.

Coiled Tubing Connection

A high-quality coiled tubing connection is recommended when the HydroPull SC tool is operated at the high end of its design flow rate range. Refer to the HydroPull SC Operation Guide for pressure test and pull test recommendations.

Last Chance Screen



Clean fluid with no sand should be run. A last chance screen is included with each tool to prevent gravel and other debris from blocking the tool and to minimize the chance for premature failure of other bottomhole assembly components. The screen openings are 0.06 in. (1600 microns) to 0.16 in. (3900 microns) depending on tool size and job requirements.

HydroPull SC Operation Guide

An operation guide is included with the HydroPull tool that provides operating instructions and job reporting requirements. These guides are also located within our Client Login site on our website.



HydroPull™ Extended Reach

• Motor Gas Separator (MGS™)

• HydroPull™ SC Tool
(Stimulation and Cleanout)

• Water Bypass AV Sub (WBS)

• High Pressure Rotary Jet
(JetRotor™)

• Engineering Services

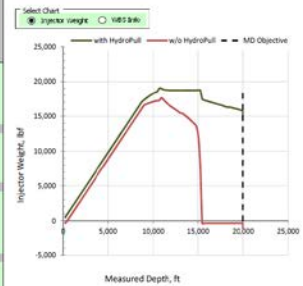
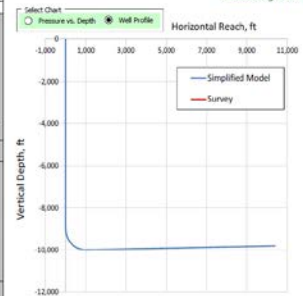
• Custom Tool Development

HydroPull Performance Software

HydroPull® Extended Reach Model- Simplified Well Profile		Enter All Blue Data	©Tempress OSES 2017
Performance Software is designed specifically for use with Tempress® tools only.			
Well Designation & Data		Wellname	mm/dd/yy
Well Data	Select units	US Units	
	Kickoff point (TVD)	9,000	ft
	End of curvetanding point (TVD)	10,000	ft
	True depth (TVD)	9,000	ft
	Measured Depth (MD) Objective	20,000	ft
	ID of casing in vertical and curve	4.67	in
	Lateral ID (cased or open hole)	4.67	in
	Average dog leg severity in horizontal	1	°/100 ft
Working (Separate Tab)	Static friction coefficient	0.24	21 for pipe-on-pipe friction reducer, with no FR, 30 if no coil straightener
	Coil OD	2,800	in
	Coil Wall Thickness	0.109	in
	Minimum flow ID in motorhead	0.70	in
BHA	HydroPull® tool diameter	2.35	in
	HydroPull® Configuration (Flow, Impact Rating)	Standard Flow, High Impact	
	# of Nozzle Ports (at, ballrun)	5	see Tempress Nozzle Sizes
	Port diameter	0.375	in
	Tempress® Water Bypass Sub	No	
	No-load motor pressure (see Motor Data Tab)	50	psid C if no motor
Operating Parameters	On-off bottom motor pressure differential	750	psid C if no motor
	Pump flow rate	3.00	lpm
	Minimum Weight on Bit	500	lbf
	Wellhead circulating pressure (choke)	100	psi
Results	Fluid friction reducer effect	50%	% reduction
	Fluid density	8.34	ppg Spec. Gravity: 1.00
	Est. fluid lost to (-) or gained from (+) formation	0.00	ppg Default is 0
	Total BHA pressure drop	1300	psi differential
	Pump pressure (drilling/milling)	3490	psi
	Bottomhole circulating pressure (BHCP)	4359	psi
	Wellhead snubbing force	360	lbf
	Hydraulic Lift-off force	175	lbf
	Water hammer pulse in annulus	187	psi differential
	Water hammer pulse in work string	1036	psi
	Minimum rupture disk rating	3747	psi
	Impact force at BHA	3166	lbf
	Fluid velocity in horizontal section	219	lpm OK
	Vertical cuttings transport ratio (1 min sand)	74%	OK
	Water Flow to Motor	3.0	lpm
	Water Bypass (if WBS selected)	-	lpm
	On-Off Bottom Motor Flow Variation w/WBS	-	
	Maximum coil feed rate at toe of well	17	ft/min
	Coil lockup MD without HydroPull®	15246	ft
	MD with HydroPull®	21998	ft
	Reach increase due to HydroPull®	6752	ft

Refer to HydroPull® Operators Guide for more information or call 425.251.8120 for well planning assistance

TEMPRESS®
Revised Aug 2017 DF



A proprietary software program is available for HydroPull SC Stimulation and Cleanout tool job planning. The software evaluates circulating pressures in the well, BHA pressure drop, and horizontal reach capabilities based on a set of input parameters. The program calculates pump pressure requirements, the transport of sand and cuttings in the horizontal and vertical sections of the well, and the rate at which the tool will pull tubing into the well. This software is located within our Client Login site on our website.



HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

U.S. Patents
7,677,308

Tempress Motor Gas Separator (MGS™) Tool

The Tempress Motor Gas Separator (MGS™) is the most effective downhole phase separator in the industry and is used to ensure good circulation in depleted wells. This tool incorporates a rotary drum separator that removes the gas from the commingled flow allowing the fluid to operate the downhole motor at the designed flow rate.

The MGS tool incorporates a gas orifice size that can be customized as needed to suit your well profile. This tool is commonly run in tandem with the Tempress HydroPull™ to accommodate a wide range of applications. **The tool reduces or eliminates damage to the motor stator during commingled operations.**

Applications

- Fishing
- Coiled and Jointed tubing
- Composite bridge plug milling
- Ball seat milling
- Sand cleanout
- Valve shifting
- Extended-reach well service
- Acidizing
- Chemical placement
- Screen and perforation cleaning
- Scale removal
- Depleted well service



Feature	Benefit
High-efficiency gas separation	Removes free nitrogen from the commingled flow through the motor for depleted well service Reduces or eliminates nitrogen damage to stators Prevents motor over-speed <i>Extends motor life</i>
Compact length	Simplifies make-up of the bottom hole assembly
Wellbore adaptability	Accommodates severe doglegs and multilateral completions Compatible with common well service fluids Sour gas compatible
High reliability	Multiday extreme-reach jobs without tripping <i>Over 99% downhole success rate</i>



HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

Specifications

Tool diameter	1.69-in. (42.9 mm)	2.12-in. (54.0 mm)	2.88-in. (73.0 mm)	3.12-in. (79.3 mm) 3.38-in. (85.7 mm)
Flow capacity (max commingled flow equivalent)	2.1 bpm (340 lpm)	2.1 bpm (340 lpm)	6.0 bpm (950 lpm)	6.0 bpm (950 lpm)
Water Flow Capacity	1.8 bpm (290 lpm)	1.8 bpm (290 lpm)	5.0 bpm (790 lpm)	5.0 bpm (790 lpm)
Maximum operating pressure	5300 psi (37 MPa)	10,000 psi (67 MPa)	4,000 psi (28 MPa)	5,100 psi (28 MPa)
Maximum particle size	.125" (3.2 mm)	.125" (3.2 mm)	.156" (4.0 mm)	.156" (4.0 mm)
Typical Pressure loss through tool at max water flow	< 160 psi (<1.1 MPa) @ 1.8 bpm		≈300 psi (2.1 MPa) @ 5.0 bpm	
Temperature (maximum)	400 °F (200 °C)			
Max gas fraction at inlet	80%			
Typical gas cut at outlet	0.5%			



Motor Gas Separator (MGSTTM)

HydroPull™ SC Tool (Stimulation and Cleanout)

Water Bypass AV Sub (WBS)

High Pressure Rotary Jet (JetRotor™)

Engineering Services

Custom Tool Development

The MGS tool is consistently displacing the competition in depleted well service. Please contact us or visit our website for the most recent MGS Case Histories.

Contact Information:

Tempress Technologies Inc.
2200 Lind Avenue SW
Building A, Suite 108
Renton, WA 98057
Phone: 425.251.8120
www.tempresstech.com

Two-Phase Flow

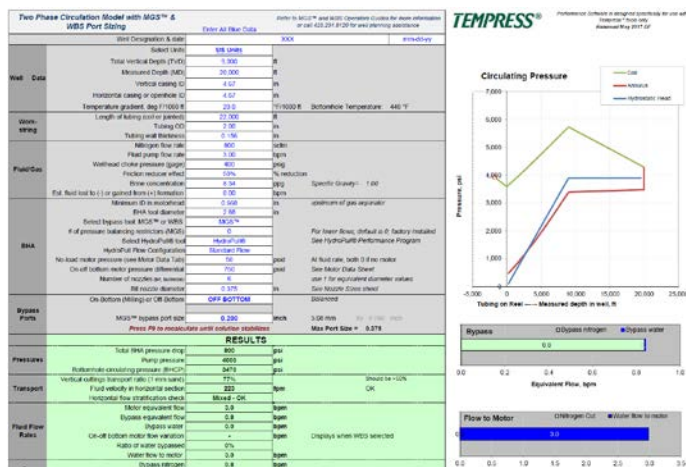
The Motor Gas Separator (MGS™) tool is commonly run with a Tempress HydroPull™ tool. The HydroPull tool may also be run downhole with straight gas, if required. The HydroPull tool is designed to operate on two-phase flow. The presence of nitrogen dampens the pulse.

MGST™ Operation Guide

An operation guide is included with the MGS tool that provides operating instructions and job reporting requirements. These guides are also located within our Client Login site on our website.

MGST™ Performance Software

A proprietary software program is available for MGS tool job planning. The software evaluates the best separator performance range for the job. The software outputs circulating pressures in the well, the transport of sand and cuttings in the horizontal and vertical sections of the well, equivalent fluid flow rates, and the amount of gas separation based on a set of input parameters. This software is located within our Client Login site on our website.





HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

U.S. Patents
7,201,238

Tempress JetRotor™ Tool

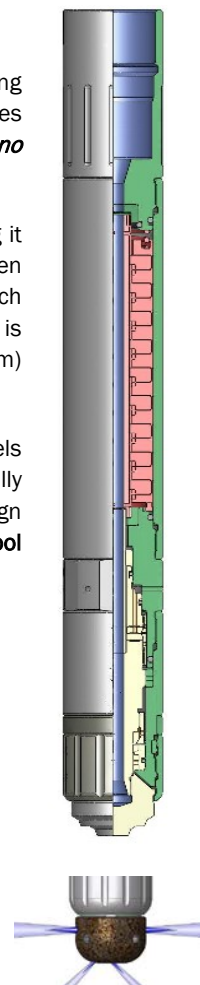
JetRotor™ is a tool equipped with a Mechanically Assisted jet-Drilling (MAD) nozzle creating a high-pressure rotary jetting tool that removes mineral scale safely and quickly and stimulates well completions with ***no risk of damage to production tubing or downhole equipment.***

The JetRotor™ tool is compatible with a broad range of fluids making it applicable in almost all coiled tubing well service jobs, including nitrogen and carbon dioxide energized fluids. The design is highly compact, which greatly simplifies transport, BHA setup, and job execution. The tool is available in several sizes including 1.69-in. (43 mm), 2.06-in. (52 mm) and 2.12-in. (54 mm)

The JetRotor tool operates at the highest power and pressure levels available in the industry. The patented open-flow seal design virtually eliminates power losses due to leakage and friction. This seal design ensures that maximum hydraulic power is delivered to the jets. **The tool is fully tunable for various applications.**

Applications

- Coiled and Jointed tubing
- Sand and fill cleanout
- Scale cleanout
- Cement removal
- Openhole stimulation
- Acidizing
- Sand screen flushing
- Perforation cleaning
- Depleted well service
- Commingled flow



Feature	Benefit
High-pressure, High-power jets	One-trip cleanout and stimulation Eliminates need for a motor and mill Better sand and cuttings transport at low flow <i>Most powerful jetting pressure available</i>
Fluid compatibility	Water, nitrogen, carbon dioxide, polymers, solvents, brine, surfactants, foam, acid
Severe service	Fully acid capable and routinely run in the most severe high-temperature (400 °F/200 °C) and sour gas environments
Easy make-up	Short and compact length, 14.6-in. long
Field tunable	Field-changeable nozzle heads & nozzles for specific applications
High reliability	Multiday extreme-reach jobs without tripping <i>Over 99% downhole success rate</i>



HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

Case Histories

The JetRotor tool is consistently the most sought after high-pressure jetting tool available. Please contact us or visit our website for the most recent JetRotor Case Histories.

Contact Information:

Tempress Technologies Inc.
2200 Lind Avenue SW
Building A, Suite 108
Renton, WA 98057
Phone: 425.251.8120
www.tempresstech.com



Last Chance Screen



Clean fluid with no sand should be run. A last chance screen is available for each tool to prevent gravel and other debris from interfering with the operation of the tool and to minimize the chance for premature failure of other bottomhole assembly components. The screen openings are available in range of sizes depending on tool size and job requirements.

JetRotor Operation Guide

An operation guide is included with the JetRotor tool that provides operating instructions and job reporting requirements. These guides are also located within our Client Login site on our website.



HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

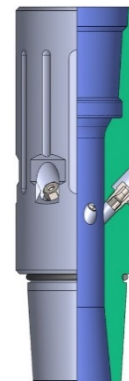
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Custom Tool Development

Tempress Water Bypass Sub (WBS)

The WBS has two to six ports that bypass fluid to the annulus of the BHA. This allows pumping flow rates that are higher than the allowable ratings for motors or other bottomhole assembly components connected below.

A proprietary analysis program for the Water Bypass Sub allows the operator to select the correct port sizes for the job. Integrated into the MGS™ and WBS Performance Software, all pertinent parameters of the job are entered, and the program allows the user to select the appropriate orifice sizes by calculating and displaying key performance characteristics. Bypass orifices have special carbide inserts for consistent performance on extended reach runs. These inserts have been proven to survive weighted fluids or abrasive additives. Available in a range of sizes from 1.69-in. to 3.50-in., **the tool is fully tunable for various applications by using the Water Bypass Sub Performance Model Software.**



Applications

- Coiled and Jointed tubing
- Sand and fill cleanout
- Scale cleanout
- Cement removal
- Acidizing
- Wellbore jetting
- Depleted well service
- Commingled flow

Feature	Benefit
Higher flow	Better cleaning of large wellbores and horizontals Multi-port design promotes wellbore jet cleaning Better sand and cuttings transport <i>Most robust annular velocity tool available</i>
Fluid compatibility	Water, nitrogen, carbon dioxide, polymers, solvents, brine, surfactants, foam, acid
Severe service	Acid capable and routinely run in the most severe high-temperature (570 °F/300 °C) and sour gas environments
Easy make-up	Short and compact length, 3.55-in. to 6.00-in. long
Field tunable	Field-changeable nozzles for specific applications
High reliability	Multiday extreme-reach jobs without tripping <i>Over 99% downhole success rate</i>



HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

•

HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

•

Custom Tool Development

Case Histories

Because of its robust design and predictable performance, the Water Bypass Sub (WBS) is consistently the most sought after annular velocity sub available. Please contact us or visit our website for the most recent WBS Case Histories.

Contact Information:

Tempress Technologies Inc.
2200 Lind Avenue SW
Building A, Suite 108
Renton, WA 98057
Phone: 425.251.8120
www.tempresstech.com



Use with Motors and the HydroPull™

The Water Bypass Sub nozzles are always open, so motors will be more prone to stalling if pump flow rates are reduced. Motor stalls will still produce a noticeable pressure signal on surface. During a stall, more of the pumped fluid will discharge through the bypass nozzles.

When running a Tempress HydroPull™ tool, the Water Bypass Sub should be placed above the HydroPull. If pumping gas while running a downhole motor is necessary, use a Tempress Motor Gas Separator (MGS™).

Nozzle Configuration

Bypass nozzle size and quantity should be selected so that motor performance is maximized while avoiding motor overspeed at the maximum required pump flow rate. Use the Motor Gas Separator - Water Bypass Sub Performance model Software to select the appropriate nozzle configuration.

Each Water Bypass Sub requires two to six nozzles, depending on the design. It is generally best to match nozzle sizes, but specific performance can be achieved by employing other nozzle combinations.

If the pumped fluid is not screened or is not relatively free from abrasives, nozzle washout can occur, especially in extended runs.

Last Chance Screen



Clean fluid with no sand should be run to prevent nozzle washout on extended reach runs. A last chance screen is available for each tool to prevent gravel and other debris from interfering with the operation of the tool and to minimize the chance for premature failure of other bottomhole assembly components. The screen openings are available in a range of sizes depending on tool size and job



HydroPull™ Extended Reach

Motor Gas Separator (MGS™)

HydroPull™ SC Tool
(Stimulation and Cleanout)

Water Bypass AV Sub (WBS)

High Pressure Rotary Jet
(JetRotor™)

Engineering Services

Custom Tool Development

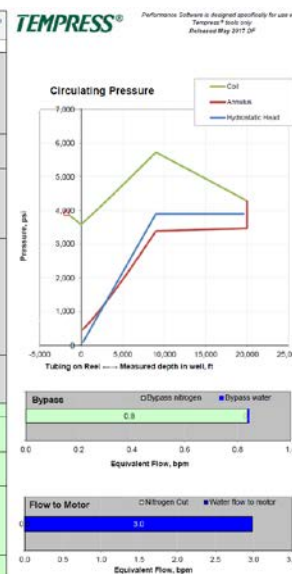
Water Bypass Sub (WBS) Operation Guide

An operation guide is included with the WBS tool that provides operating instructions and job reporting requirements. These guides are also located within our Client Login site on our website.

Motor Gas Separator (MGS™) and Water Bypass Sub (WBS) Performance Software

A proprietary software program is available for MGS and WBS tool job planning. The software evaluates the best bypass performance for the job. The software outputs circulating pressures in the well, the transport of sand and cuttings in the horizontal and vertical sections of the well, equivalent fluid flow rates, and the amount of water flow to the motor based on a set of input parameters. This software is located within our Client Login site on our website.

Two Phase Circulation Model with MGS™ & WBS Port Sizing		Enter All Blue Data		XXX	mm-dd-yy
Well Data	Selected Units	US Units			
	Total Vertical Depth (TVD)	5,000	ft		
	Measured Depth (MD)	20,000	ft		
	Vertical casing ID	4.67	in		
	Horizontal casing ID or opening ID	4.67	in		
Work-string	Temperature gradient, deg F/1000 ft	20.0	F/1000 ft		
	Length of tubing (cool or cement)	22,000	ft		
	Tubing OD	2.00	in		
	Tubing wall thickness	0.155	in		
	Fluid pump flow rate	3.00	gpm		
Fluid/Gas	Wellhead choke pressure (gage)	400	psig		
	Friction reducer effect	50%	% reduction		
	Drill concentration	0.54	ppm		
	Est. fluid lost to (-) or gained from (+) formation	0.00	bpm		
	Minimum ID in motorhead	0.555	in		
B-HA	B-HA tool diameter	2.50	in		
	Select bypass tool: MGS™ or WBS	MGS™			
	# of pressure balancing restrictors (BARS)	0			
	Select HydroPull tool	HydroPull			
	No-load motor pressure (see Motor Data Tab)	50	psid		
Bypass Ports	On-off bottom motor pressure differential	750	psid		
	Number of nozzles in wellhead	0			
	Bit nozzle diameter	0.375	in		
	On-Off Bottom (Milling) or Off-Bottom	OFF BOTTOM			
	MGS™ bypass port size	0.200	inches		
<p>Press F9 to recalculate until solution stabilizes</p> <p>For later flow, default is 0; factory installed See HydroPull Performance Program</p> <p>At fluid rate, both 0 if no motor See Motor Data Sheet</p> <p>Use 1 for equivalent diameter values See Nozzle Size sheet</p> <p>Balance</p>					
<p>RESULTS</p> <p>Total RHA pressure drop: 800 psi</p> <p>Pump pressure: 4000 psi</p> <p>Bottomhole circulating pressure (BHP): 3470 psi</p> <p>Vertical cuttings transport ratio (1=mm sand): 77% (Should be >50%)</p> <p>Fluid velocity in horizontal section: 223 fpm (OK)</p> <p>Horizontal flow stratification check: Mixed - OK</p> <p>Motor equivalent flow: 0.8 bpm</p> <p>Bypass equivalent flow: 0.8 bpm</p> <p>Flow to motor: 0.8 bpm</p> <p>On-off bottom motor flow variation: 0% (Displays when WBS selected)</p> <p>Ratio of water bypassed: 0%</p> <p>Water flow to motor: 0.8 bpm</p> <p>Bypass nitrogen: 0.8 bpm</p> <p>Nitrogen out in motor: 0.8 bpm</p> <p>Nitrogen rate in motor: 0%</p>					





HydroPull™ Extended Reach

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Motor Gas Separator (MGS™)

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HydroPull™ SC Tool
(Stimulation and Cleanout)

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Water Bypass AV Sub (WBS)

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High Pressure Rotary Jet
(JetRotor™)

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Engineering Services

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Custom Tool Development

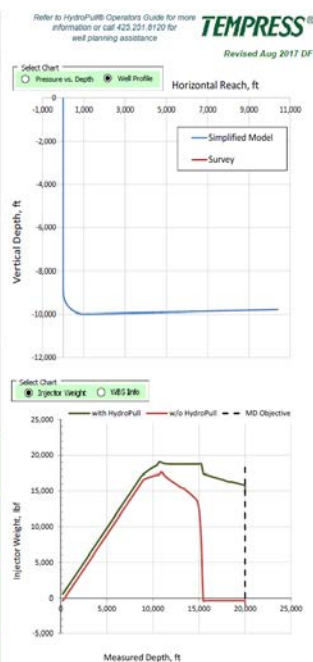
Tempress Job Planning Performance Software Suite

The performance of Tempress Well Intervention tools are enhanced through the use of our proprietary Job Planning Performance Software Suite. The Software is available to predict the performance and configuration of the HydroPull™ tool, the Motor Gas Separator (MGS™) tool and the Water Bypass AV Sub (WBS).

The Tempress Job Planning Performance Software is a critical component in the Front-End Engineering and Design (FEED) required of extended reach and depleted well operations. The Software plays a vital role in Tempress equipment consistently setting or breaking industry records. The Software is located within our Client Login site on our website and training is available at no cost to our clients.

HydroPull™ Performance Software

HydroPull™ Extended Reach Model- Simplified Well Profile		Enter All Blue Data	©Tempress OSES 2017
Performance Software is designed specifically for use with Tempress™ tools only			
Well Designation & Data		Wellname	mm/dd/yy
Well Data	Select units	US Units	
	Kickoff point (TVD)	9,000	ft
	End of curvelanding point (TVD)	10,000	ft
	Toe depth (TVD)	9,800	ft
	Measured Depth (MD) Objective	20,000	ft
	ID of casing in vertical and curve	4.67	in
	Lateral ID (cased or open hole)	4.67	in
	Average dog leg severity in horizontal	1	1/100 ft
	Static friction coefficient	0.24	.21 for pipe-on-pipe friction reducer, .24 with no FR, .30 if no coil straightener
Working (Separate Tab)		Coil OD	2.000 in
		Coil Wall Thickness	0.109 in
		Minimum flow ID in motorhead	0.70 in
		HydroPull™ tool diameter	2.88 in
		HydroPull™ Configuration (Flow, Impact Rating)	Standard Flow, High Impact
		# of Nozzle Ports (bit, bit/noise)	6 see Tempress Nozzle Sizes
		Port diameter	0.375 in
		Tempress® Water Bypass Sub	No
		No-load motor pressure (see Motor Data Tab)	50 psid 0 if no motor
		On-off bottom motor pressure differential	750 psid 0 if no motor
Operating Parameters		Pump flow rate	3.00 gpm
		Minimum Weight on Bit	500 lbf
		Wellhead circulating pressure (choke)	100 psi gage
		Fluid friction reducer effect	50% % reduction
		Fluid density	8.34 gpg Spnc Gravity= 1.00
		Est. fluid lost to (-) or gained from (+) formation	0.00 gpm Default is 0
		Total BHA pressure drop	1300 psi differential
		Pump pressure (drilling/milling)	3490 psi
		Bottomhole circulating pressure (BHCP)	4359 psi
		Wellhead snubbing force	360 lbf
		Hydraulic Lift-off force	175 lbf
Results		Water hammer pulse in annulus	187 psi differential
		Water hammer pulse in work string	1036 psi
		Minimum rupture disk rating	3747 psi
		Impact force at BHA	3166 lbf
		Fluid velocity in horizontal section	219 fpm OK
		Vertical cuttings transport ratio (1-mm sand)	74% OK
		Water Flow to Motor	3.0 gpm
		Water Bypass (if WBS selected)	- gpm
		On-Off Bottom Motor Flow Variation w/WBS	-
		Maximum coil feed rate at toe of well	17 ft/min
		Coil lockup MD without HydroPull™	15246 ft
		MD with HydroPull™	21998 ft
		Reach increase due to HydroPull™	6752 ft



A proprietary software program is available for HydroPull tool job planning. The software evaluates circulating pressures in the well and horizontal reach capabilities based on a set of input parameters. The program also calculates pump pressure requirements, the transport of sand and cuttings in the horizontal and vertical sections of the well, predicted lockup, and the rate at which the tool will pull tubing into the well.



HydroPull™ Extended Reach

Motor Gas Separator (MGST™)

HydroPull™ SC Tool
(Stimulation and Cleanout)

Water Bypass AV Sub (WBS)

High Pressure Rotary Jet
(JetRotor™)

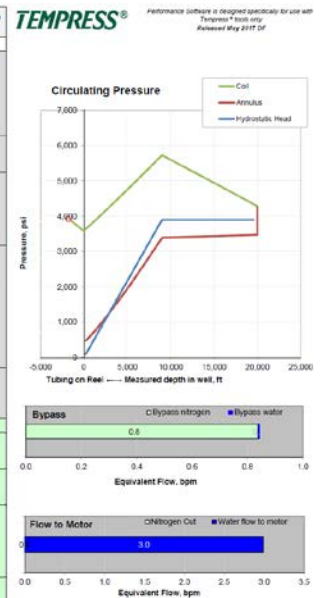
Engineering Services

Custom Tool Development

Motor Gas Separator (MGST™) and Water Bypass Sub (WBS) Performance Software

A proprietary software program is available for MGS and WBS tool job planning. The software evaluates the best separator and fluid bypass performance range for the job. The software outputs circulating pressures in the well, the transport of sand and cuttings in the horizontal and vertical sections of the well, equivalent fluid flow rates, amount of water flow to the motor, and the amount of gas separation based on a set of input parameters.

Two Phase Circulation Model with MGST™ & WBS Port Sizing			
Well Description & data		Enter All Blue Data	XXX
Select Units		US Units	mm-60-yy
Well Data	Total Vertical Depth (TVD)	5,000	ft
	Measured Depth (MD)	20,000	ft
	Vertical casing ID	4.57	in
	Horizontal casing or openhole ID	4.57	in
Work-string	Temperature gradient, deg F/1000 ft	20.0	°F/1000 ft
	Length of casing (casing or jointed)	22,000	ft
	Tubing OD	2.30	in
	Tubing wall thickness	0.195	in
Fluid/Gas	Nitrogen flow rate	800	scfm
	Fluid pump flow rate	3.30	gpm
	Wellhead choke pressure (gpg)	400	gpg
	Friction reducer effect	50%	% reduction
BHA	Drill concentration	0.34	ppg
	Est. fluid loss to (c) or gained from (v) formation	0.20	gpm
	Minimum ID in motorhead	0.690	in
	BHA tool diameter	2.59	in
Bypass Ports	Select bypass tool: MGST™ or WBS	MGST™	
	# of pressure balancing restrictions (BACS)	0	
	Select HydroPull™ tool	HydroPull™	
	HydroPull™ Flow Configuration	Standard Flow	
Pressures	No-load motor pressure (see Motor Data Table)	50	psid
	On-off bottom motor pressure differential	750	psid
	Number of nozzles or screens	6	
	Bit nozzle diameter	0.375	in
Transport	On-bottom (Milling) or Off-bottom	OFF BOTTOM	
	MGST™ bypass port size	0.200	inch
	Press P# to recalculate until solution stabilizes		
RESULTS			
Pressures	Total BHA pressure drop	896	psi
	Pump pressure	4000	psi
	Bottomhole circulating pressure (BSCP)	2479	psi
	Vertical cuttings transport ratio (1 mm sand)	77%	Should be >50%
Fluid Flow Rates	Fluid velocity in horizontal section	222	fpm
	Horizontal flow classification check	Mixed - OK	OK
	Motor equivalent flow	3.0	gpm
	Bypass equivalent flow	0.9	gpm
Gas Separation	Bypass water	0.0	gpm
	On-off bottom motor flow variation	-	
	Rate of water ingested	0%	
	Water flow to motor	3.0	gpm
Gas Separation	bypass nitrogen	0.8	gpm
	Nitrogen cut in motor	0.0	gpm
	Nitrogen rate in motor	0%	



Case Histories

Please contact us or visit our website for the most recent Case Histories.

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