

NEXT GENERATION MILLING TECHNOLOGY
2021 PRODUCT CATALOG



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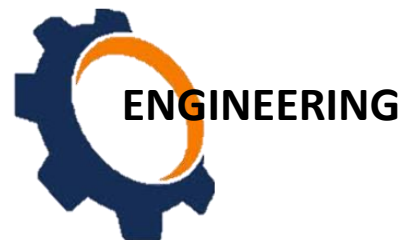


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**OVER 230
COMBINED YEARS
OF THRU TUBING
EXPERIENCE**



Thruster Energy Corporation is a Thru-Tubing Company comprised of seasoned, experienced professionals with extensive knowledge & expertise, aligning ourselves with industry-leading, cutting edge, technical downhole tools such as the Tempress HydroPull™ friction-breaking tool & Motor Gas Separator (MGS™), as well as the innovative and unique Universal Jet Thruster (UJT).

The TEC Team have worked together for over a decade developing solutions to downhole challenges for customers specializing in long, tortuous horizontal milling with high stage counts and casing deformation milling.

The Universal Jet Thruster (UJT) uses hydraulic advancements to increase milling efficiency and maximizes hole-cleaning. Our extreme Milling BHA the “Hell And Back System” (H.A.B.S.) incorporates the Tempress HydroPull™ & UJT as well as the hardest and most durable mill on the planet, the BRAMA Reaper Mill, driven by our powerful & high rate PREDATOR & BRUTE FORCE Motors, Thruster Energy Corp can achieve deeper depths faster than any other milling BHA in the world. By incorporating the TENAX HydraShock™ Run-in-Place Sub in our H.A.B.S. BHA to assist coil getting unimpeded from debris/ fill above the BHA, the HABSystem is also by far the safest.

Utilizing the latest innovations and techniques for success, TEC is committed to providing our customers with the high level of service & results they’ve come to expect from us, each and every time!



IF WE CAN'T GET THERE, YOU'RE NOT GETTING THERE!

Thruster Energy Corp's principles of working safely in an environmentally responsible manner are fully integrated into our Quality Management System that define our company's operations.

QUALITY ASSURANCE

TEC's products and services are designed and manufactured to conform with API specifications, proprietary licensors, or other specifications of our clients and meeting their needs and expectations the first time, every time.

It is TEC's policy that only the highest quality products and services, that meet all specification requirements, are provided to customers. TEC's Quality Management System seamlessly integrates through all of our geographical footprints.

HEALTH, SAFETY & ENVIRONMENT

TEC is committed to a standard of safety for its employees, customers, suppliers and the public that are of the highest standards. An integral part of TEC's business plan is that we consciously operate in a manner that is respectful to all environmental matters.

TEC strives for zero accidents, zero harm to people and zero damage to the environment.



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THRUSTER ENERGY CORP.

CASE STUDIES

NEXT GENERATION MILLING TECHNOLOGY



Case Study

BRAMA Reaper Mill

Strongest Gauge Integrity on the Market

TEC was presented with a challenging fish left in the hole. Due to the nature of the fish's dimensions, it was concluded that the most economical means to deal with the fish was to mill it out instead of multiple, costly fishing runs. TEC's Reaper Mill was just the tool necessary!



Component from Wireline Setting Tool- P-110 Material

Milled Out Fish in 4 Hours, Then Milled the Remaining 26 Plugs & TD'd Well!



Post Run Mill Pics- only wore down 1.1mm (0.043")!!

Case Study

TEC's Hell And Back System- Duvernay 2019

The H.A.B.System Proving it's Mettle in the Duvernay

**55 Plugs Milled Out in 54.5 Hours-
Single Trip/ NO Motor Stalls/ NO MMFR!!**

Pre-Run Bit Pics 114.3mm



Post Run Bit Pic



Debris Pics



Case Study H.A.B.S. Obliterates Records

TEC's Unique Hell And Back System (H.A.B.S.) Does the Seemingly Impossible by Milling Out an Unprecedented **(59) 10K Composite Plugs in a 12 Hour Shift!**

During the milling operation, the Universal Jet Thruster (UJT) was monitored by a Smart Coil sub, and proved a quantifiable value of **575 daNs (1,288lbf) Axial Force (Pull Force)**. This meant that the string was under additional tension from the UJT which assists in ROP by combatting hydraulic forces. The end result was a well with **67 total 10 K composite plugs milled in 18 hours, without a single wiper trip** while returning wave after wave of small plug debris and the BRAMA Reaper Mill maintaining 99.1% of original gauge OD.



**(59) 10k
Composite
Plugs in 12
Hours!**

**(67) Total
10K
Composite
Plugs in 18
Hours!**

Example of Debris Captured in the Junk Catcher



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Case Study

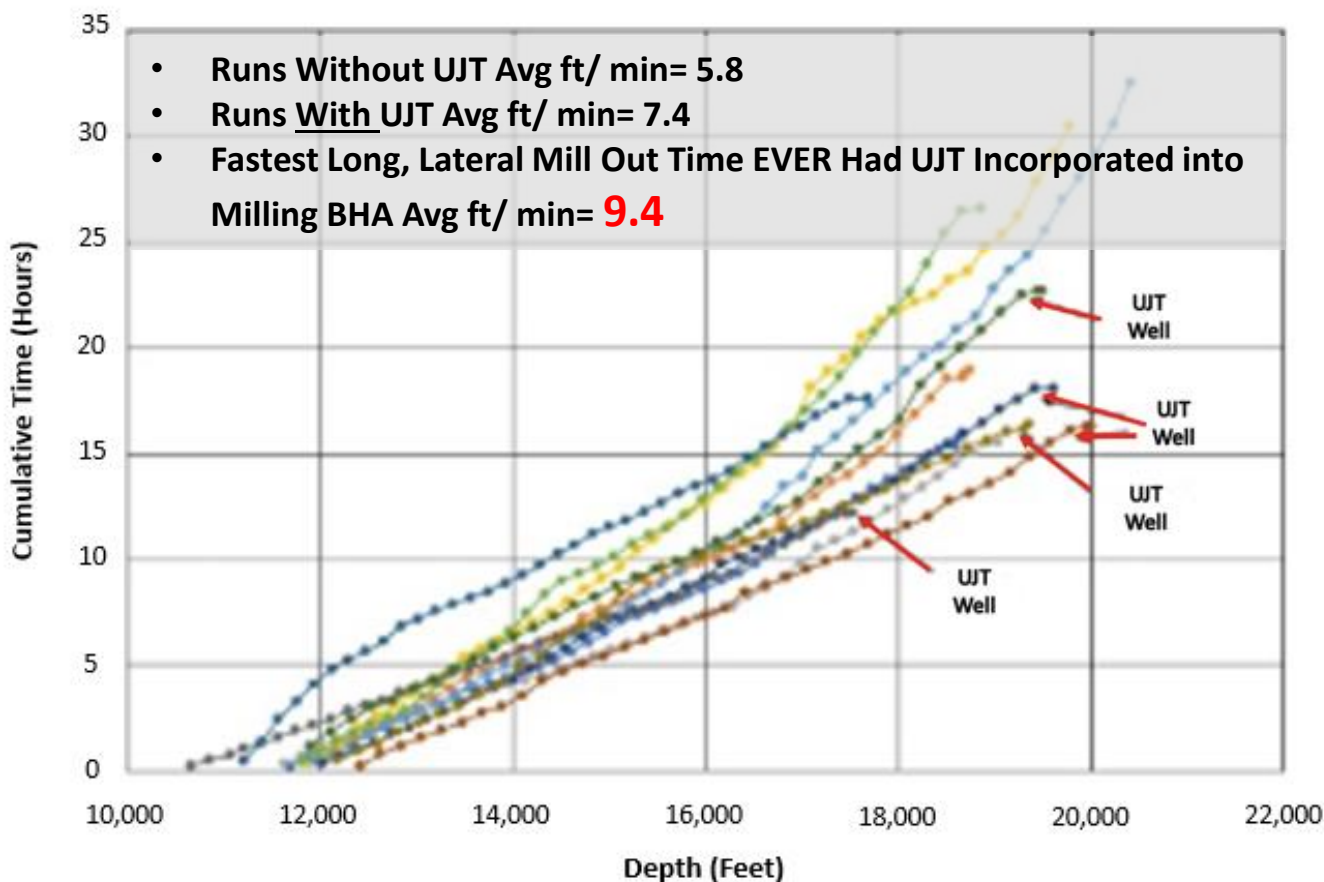
Universal Jet Thruster (UJT) in Permian

UJT in Permian Success

“Running the Universal Jet Thruster on all our Milling BHAs is a no-brainer!”- Top Executive of Major American Producer in the Permian.

Every well where the Universal Jet Thruster (UJT) was incorporated into the milling BHA was faster completing the plug milling than BHAs without it. Fastest long, lateral mill out time EVER for Top American Producer had the UJT in the Milling BHA!

Drill-out Time for Long Laterals in Permian- New Well Design



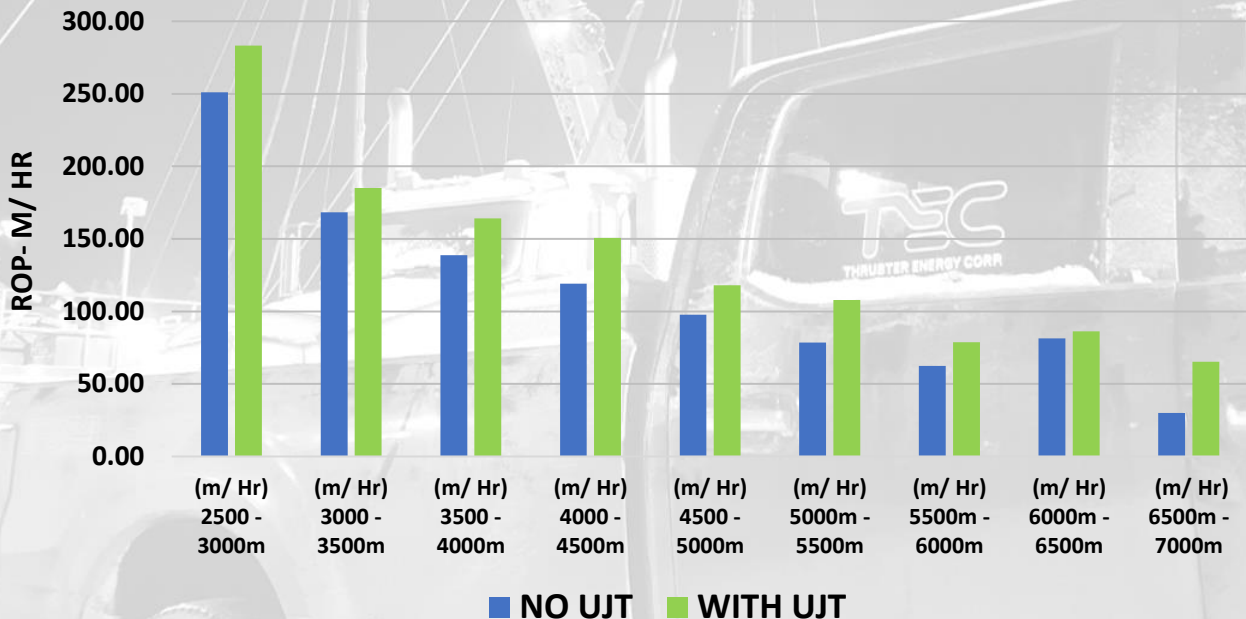
Case Study

Universal Jet Thruster Performance in Canada

Consistent ROP Improvement with UJT in TEC's H.A.B.S. (Hell And Back System)
Milling BHA

Over and over again, TEC's unique & patented Universal Jet Thruster (UJT) is proving why it is a MUST in today's Milling BHA. The graphs below, taken from over 650 runs, illustrates the ROP speed (measured in Meters/ Hr), regardless of the geographical area and TVD depth! Consistently the results are better with the assistance of the UJT!

Comparing ROP With or Without UJT in Milling BHA



Majority of Runs Where the UJT is in the BHA,
ZERO MMFR IS REQUIRED!!

Average ROP when Running the UJT in the Milling
BHA **15-20% Faster!**

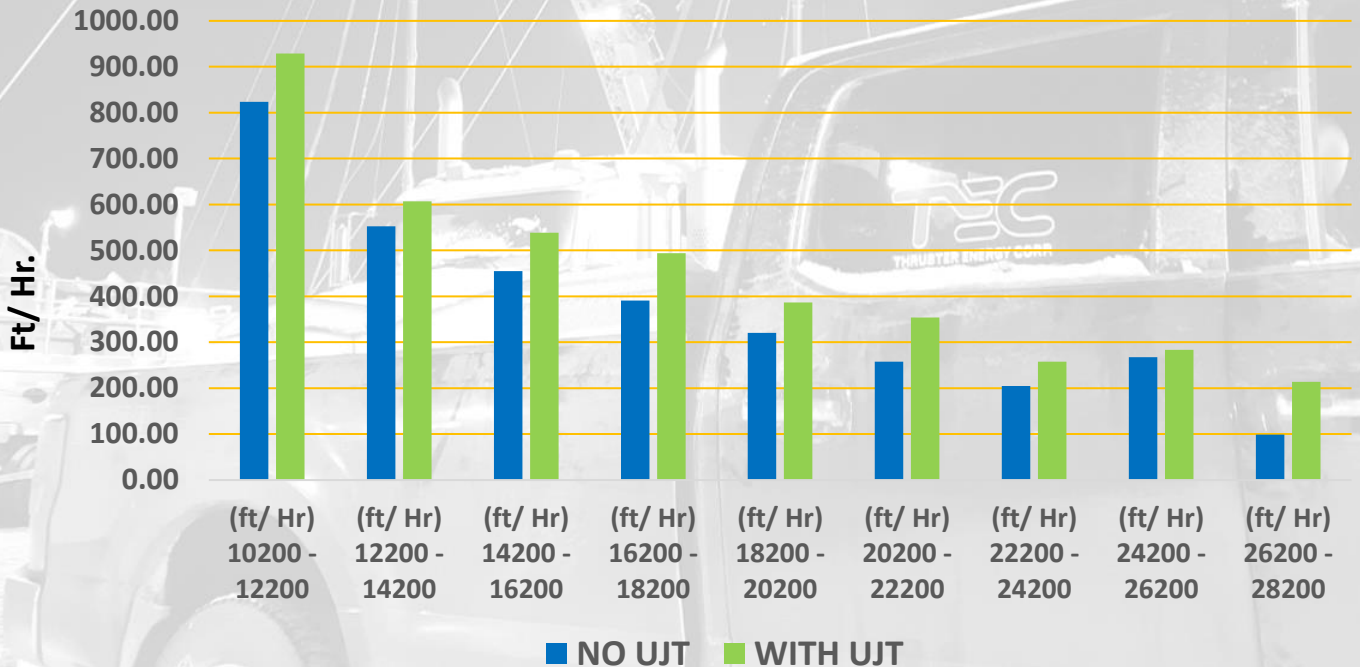
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Universal Jet Thruster Performance

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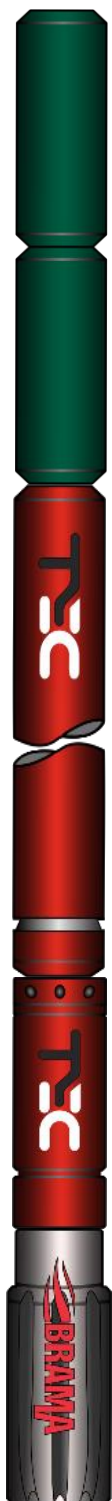
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ZERO MMFR IS REQUIRED!!

Average ROP when Running the UJT in the Milling
BHA **15-20% Faster!**

HELL AND BACK SYSTEM (H.A.B.S.)



TEC uses the **H.A.B. System (Hell & Back System)** to maximize the success of a single-trip mill out of a high-stage plug count well with a long, tortuous horizontal well. Like an orchestra, each component of the Milling BHA compliments one another. The combined result of these tools running in conjunction with one another means smaller debris to manage and circulate out of the well, greater ROP, and of course savings in time & money.

The **Tempress HydroPull™** is the most powerful friction-breaking tool on the market, consistently breaking Industry records for extended-reach applications. This hard-hitting tool pulls the coil string along, agitating debris & sand up from under the coiled tubing to not only clean the well, but to overcome tubular friction and assist the work string in reaching extreme lateral depths.

The **TEC Predator & Brute Force Series Motors** have the power you need while maintaining a power section that's hydrocarbon-resistant as well as the endurance to last with high-stage count wells. Both platforms also have **EV (Extreme Velocity)** high-rate options, the **PREDATOR EV (800 LPM/ 5 Bbl/ Min)** and **Brute Force EV (950 LPM/ 6 Bbl/ Min)** respectively.

The **Universal Jet Thruster (UJT)** is the most exciting technology on the market for extreme milling in years. Elegant in its simplicity, the **Universal Jet Thruster (UJT)** is placed below the motor between the bit/ mill and the motor's bit box (can also be used with wash nozzles, spinning wash tools & Venturi Tools) with flow opening multiple 45° up-hole facing ports to the annulus while isolating flow through the mill face. With only 180# of WOB applied, the **UJT** seamlessly & automatically switches from "Thruster Mode" back to "Milling Mode".

The **UJT** assists Friction-Breaking Tools with ROP, overcoming the hydraulic-effect while in "Thruster Mode". Hole cleaning, debris recovery & debris management has never been greater!

The **BRAMA Reaper Mill** is the hardest mill in the industry, period. The hard-coating applied to the gauge area/ OD (Outside Diameter) of the mill maintains its size & integrity in high-stage count wells, thus keeping the debris small & manageable. The next few slides go into greater detail of each of these components. When ran in conjunction together, the **Hell And Back System (H.A.B.S.)** will get you to the end of your wells consistently. If TEC isn't getting you there, you aren't getting there.

HELL AND BACK SYSTEM (H.A.B.S.)- LOWEST BACK PRESSURE OF ANY MILLING BHA ON THE MARKET

Hell And Back System Unique **ONLY** to Thruster Energy Corp.

Universal Jet Thruster: 200 PSI Back Pressure- Only while there is no WOB, all flow is diverted through the UJT's 45° up-hole facing jets. With only 180# of set down force applied on bit, the back pressure drops back to zero, and flow is diverted once again through the mill face and isolates flow to the annulus.



Universal Jet Thruster Venturi/ Hydraulic-Affect

When the UJT is in “Thrust” mode, it creates a pressure drop/ Venturi-Effect which draws residual debris away from the front of the mill face, sucking in the remaining portion of the plug just previously milled, milling it off by the time you get to the next plug. This suction overcomes the Hydraulic-Effect typically created from the flow path exiting a mill/ bit and increases ROP. The UJT allows the operator to use hydraulic jet force instead of fighting hydraulic jet force to achieve longer, tortuous wellbores and reaching target depths faster than ever before. Once the end of the well has been reached, the UJT's “Thrust” mode cleans up all debris as it is circulated behind the BHA while tripping out of hole leaving your wellbore squeaky clean. The illustration below shows how the Venturi-Effect is working.

****Chevron U.S. & Shell U.S.-** The fastest mill outs EVER for both companies was while using the Universal Jet Thruster in their BHA string (Sample size over 2400 runs). Chevron U.S. has since gone back and evaluated every well where the UJT was ran, and they discovered that those wells were by far the cleanest whereas other wells were still flowing back debris.

<http://www.thrusterenergy.com/videos/>

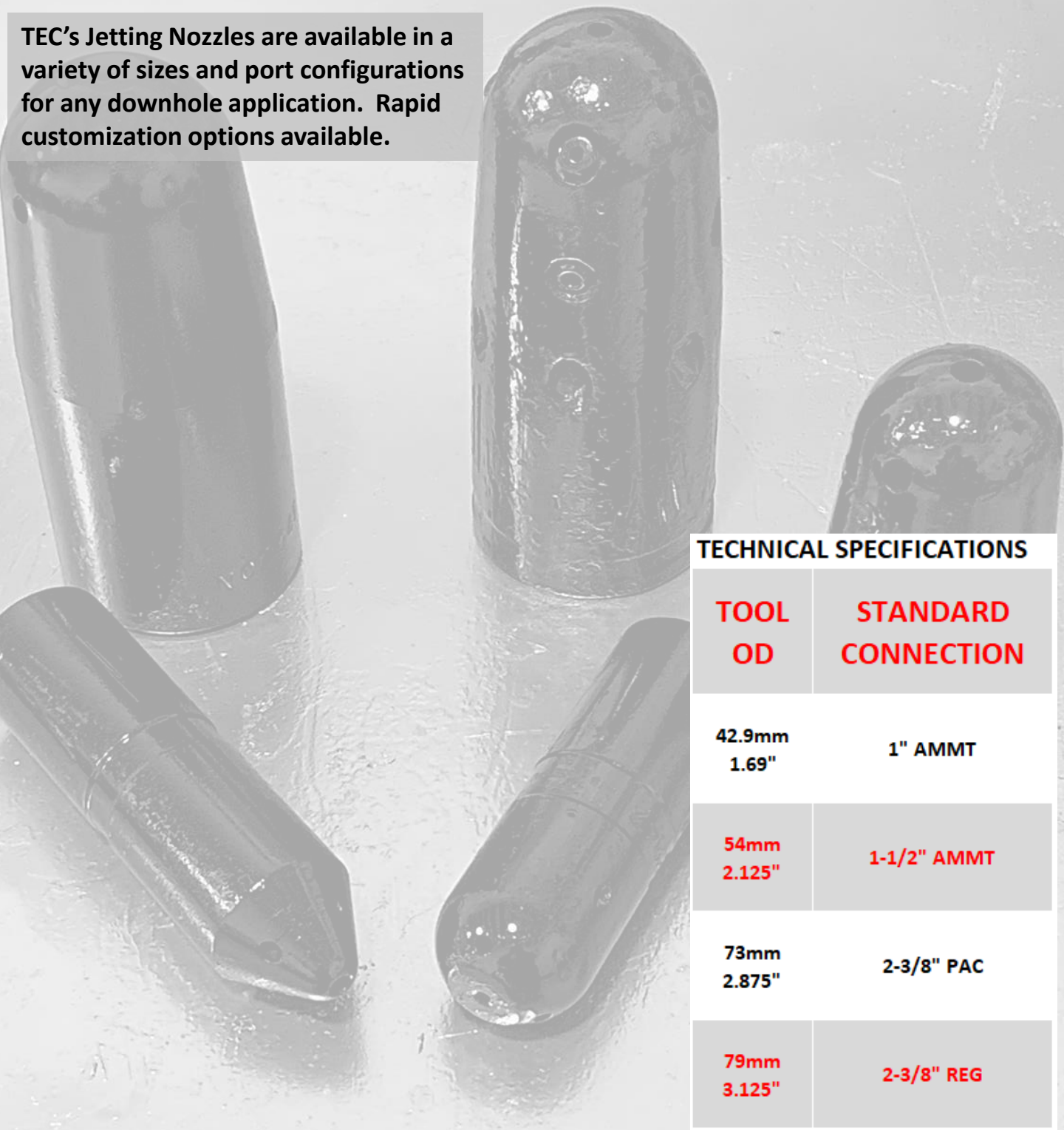




JETTING & CLEANING TOOLS

NEXT GENERATION MILLING TECHNOLOGY

TEC’s Jetting Nozzles are available in a variety of sizes and port configurations for any downhole application. Rapid customization options available.



TECHNICAL SPECIFICATIONS

TOOL OD	STANDARD CONNECTION
42.9mm 1.69"	1" AMMT
54mm 2.125"	1-1/2" AMMT
73mm 2.875"	2-3/8" PAC
79mm 3.125"	2-3/8" REG

The Selectable Jetting Nozzle has 12 threaded ports that can be either plugged off with a blank set screw, or with a nozzle that can come in a wide range of orifice sizes, and with the aid of software TEC can give you the desired jetting action in the configuration you need. A 13th hole is on the bottom of the nozzle.



TECHNICAL SPECIFICATIONS		
TOOL OD	STANDARD CONNECTION	TENSILE YIELD
73mm 2.875"	2-3/8" PAC	63,392 daNs 142,000 lbf



UNIVERSAL JET THRUSTER (UJT)

NEXT GENERATION MILLING TECHNOLOGY

The Universal Jet Thruster (UJT) Smart-Jet Sub is placed below a motor between the bit and the motor’s bit box (can also be used with wash nozzles, spinning wash tools & Venturi Tools), with flow opening multiple, 45° up-hole facing ports to the annulus while isolating flow through the mill face. With only 180# of WOB applied, the UJT seamlessly & automatically switches back and forth from “Thruster Mode” back to “Milling mode”.

The UJT assists Friction-Breaking Tools with ROP, overcoming the hydraulic-effect while in “Thruster Mode”. Hole cleaning, debris recovery & debris management has never been greater!

Design Features:

- Reduces the Need for Wiper Trips
- Reduces Chemical Use to Achieve Target Depths
- Interchangeable Thread Connections (Thread “Up”)
- Torsional Yield 7,500 ft-lbs.
- Tensile Yield 71,428 daNs (160,000#)
- UJT Automatically Sequences From “Milling Mode” to “Thruster Mode” Seamlessly & Automatically, NO DROP BALLS REQUIRED
- Pressure Drop in “Thruster Mode” (Venturi Effect) Eliminates Hydraulic Forces & Increases ROP
- Compatible with Water, KCl, N2, Acid, Light Mud, Friction Reducer, Lost Circulation Material (LCM)
- Greater Debris Recovery
- Next Generation Milling Efficiency

TECHNICAL SPECIFICATIONS

TOOL OD	PIN-UP CONNECTION	BOX-DOWN CONNECTION	TENSILE YIELD	TORSIONAL YIELD	MAX FLOW RATE	TEMP RATING
73.0mm/ 2.875"	2-3/8" PAC	2-3/8" PAC	71,428 daNs 160,000 lbf	7,500 ft-lbs	1 m³/ min 6.29 bbl/ Min	Unlimited- (O-Ring Dependent)
79.4mm/ 3.125"	2-3/8" REG	2-3/8" REG	71,428 daNs 160,000 lbf	7,500 ft-lbs	1 m³/ min 6.29 bbl/ Min	Unlimited- (O-Ring Dependent)
79.4mm/ 3.125"	2-3/8" REG	2-3/8" REG	71,428 daNs 160,000 lbf	7,500 ft-lbs	1 m³/ min 6.29 bbl/ Min	Unlimited- (O-Ring Dependent)

HydroPull™
Certified



VENTURI JUNK BASKET

NEXT GENERATION MILLING TECHNOLOGY

The Venturi Junk Basked is used to remove debris from the wellbore. Using the “Venturi” Principle this tool functions similar to a vacuum cleaner and allows solids to be stored in an integral debris chamber and transported to surface for safe disposal.

Internally there are uni-directional “Finger Catches” that prevent debris from falling out, and “Flutter Cages” to catch finder sedimentary debris. Can be ran in conjunction with wash over shoes, mud motors and Fishing Tools.

- Design Features:**
- Interchangeable Nozzles Allows for Various Flow Rates & Suction Pressures
 - Debris Chamber Capacity can be Enlarged by Adding Wash Pipe Extensions
 - Can be Operated by Pumping Fluid, Gas or a Combination of Both
 - Can be Used in Conjunction with Mud Motors
 - Finger Catch Sub Available as a Stand-Alone Item

TOOL OD	MINIMUM YIELD POINT & LOAD TO YIELD	TORSIONAL WEAK & ft-lbs TO YIELD	RECOMMENDED MAKE-UP-TORQUE (ft-lbs)
57.15mm 2.250"	Pin Connection on Venturi Section PN-TT0320-206-A-006; Load to Yield: 38,787 daNs/ 86,883 lbs	2-1/16" CWP Connections Torsional: 1,067 ft-lbs, 2-1/4" CWP Connections Torsional: 1,308 ft-lbs	1st Connection: 2-1/16" CWP- 267 ft-lbs 2nd Connection: 2-1/4" CWP- 327 ft-lbs
52.4mm 2.063"	Pin Connection on Venturi Section PN-TT0320-206-A-006; Load to Yield: 38,787 daNs/ 86,883 lbs	2-1/16" CWP Connections Torsional: 1,067 ft-lbs	1st Connection: 2-1/16" CWP- 267 ft-lbs
79.4mm 3.125"	3-1/8" CWP Box Connection at 62982 daNs/ 141,080 lbf (Top connection of tool is not taken into consideration, since the top connections varies as per customer request)	CWP Connections at 4,825 ft-lbs	1st Connection: Top Sub & Venturi Section CWP Connection- 1,206 ft-lbs 2nd Connection: Venturi Section & Screen Housing CWP Connections- 1,206 ft-lbs 3rd Connection: Screen Housing & Cage Housing CWP Connection- 1,206 ft-lbs
*3.125" OD BURST POINT & BURST PRESSURE:		Top Sub and Nozzle Carrier Rotational Connection- 116.74 MPa/ 16,933 PSI, 3-1/8" CWP Connection- 35.1 MPa/ 5,091 PSI	

TEC’s Typhoon Flow Diverter allows the operator to divert flow to the annulus and back through the Bottom Hole Assembly as often as required by manipulating flow fluid to the tool. Housing an internal multi-cycle circulating valve, the Typhoon Flow Diverter has the ability for unlimited sequencing without the need to circulate any balls down the Coiled Tubing.

Valve position indication is seen on surface through pump pressure. A lower pressure reading is indicative of the flow being isolated through the rest of the tools below the Typhoon Flow Diverter, and diverted to the annulus above.

- Design Benefits:**
- 100% Flow Diversion
 - 100% Flow Isolation to the Tools Below
 - Acid Compatibility
 - NO DROP BALLS to Function
 - Unlimited Sequencing Between Flow to the Annulus and BHA
 - Increased Annular Velocity
 - LCM/ Diversion Agent Compatible



TECHNICAL SPECIFICATIONS

TOOL OD	CONNECTION	TENSILE YIELD	TORSIONAL YIELD	MAX CLOSED FLOW	MAX OPEN FLOW	WORKING PRESSURE
2.875" 73mm	2-3/8" PAC	175,000 lbf 78,125 daNs	3,100 ft-lbs	4.7 BPM 750 LPM	7.6 BPM 1,200 LPM	34.5 MPa 5,000 PSI

A DURABLE, CONTROLLED ROTATION SOLUTION FOR WELL INTERVENTION

A viscous fluid governor controls rotation speed to maximize jet power delivered to the tubing/ casing walls. By using only a few rotating jets, each jet is bigger to convey hard-hitting power. Replaceable jets are efficient and clean recesses and irregular surfaces without damaging the well pipe. SpinCat™ set the standard for rotary nozzle performance and durability.

TECHNICAL SPECIFICATIONS

MODEL	SC-168TM	SC-212-TM	SC-250TM	SC-287TM
MAX PRESSURE	5,000 PSI 34.5 MPa	5,000 PSI 34.5 MPa	5,000 PSI 34.5 MPa	5,000 PSI 34.5 MPa
TENSILE (PULL)	SAFE LOAD TO 8,500LBF/ 3,794 daNs	SAFE LOAD TO 15,00LBF/ 6,696 daNs	SAFE LOAD TO 20,00LBF/ 8,928 daNs	SAFE LOAD TO 20,00LBF/ 8,928 daNs
COMPRESSION (SET DOWN)	SAFE LOAD TO 12,000 LBF/ 5,357 daNs	SAFE LOAD TO 21,000 LBF/ 9,375 daNs	SAFE LOAD TO 25,000 LBF/ 11,160 daNs	SAFE LOAD TO 25,000 LBF/ 11,160 daNs
FLOW RANGE	0.7 - 1.3 BPM 111 - 207 LPM	**1.3 - 3.2 BPM **200 - 510 LPM	0.7 - 3.0 BPM 111 - 318 LPM	1.0 - 3.0 BPM 159 - 477 LPM
FLOW RATING	2.3 Cv	4.6 Cv	7.5 Cv	7.5 Cv
OUTSIDE DIAMETER	1.690"/ 43mm	2.125"/ 54mm	2.500"/ 64mm	2.875"/ 73mm
OVERALL LENGTH	9.8"/ 0.25m	12.3"/ 0.31m	16"/ 0.40m	15.6"/ 0.39m
BOX CONNECTION	1" AMMT	1-1/2" AMMT	1-1/2" AMMT	2-3/8" PAC
ROTATION SPEED	150 - 200 RPM	150 - 200 RPM	80 - 150 RPM	80 - 150 RPM
PSI LOSS @ 1 BPM	330 PSI	83 PSI	31 PSI	31 PSI
MAX TEMP	390°F 200° C	390°F 200° C	390°F 200° C	390°F 200° C

**Custom Nozzle Sizes

DYNOMAX REGULATOR™

Today’s milling applications are becoming more challenging with deeper, longer and more complex wells being milled out faster than ever before. One challenge is keeping the hole clean while milling, which is achieved with higher flow rates. These flow rates are limited by the power sections on the motor.

The Regulator employs a variable size exit orifice to actively moderate the flow that goes through the motor continuously- extra fluid is vented to the annulus. The exit orifice is controlled by a valve that measures the flow entering the motor. The valve mechanism responds in milliseconds so that flow to the motor is always regulated.

Features

- Reduce Stator Failures Due to Over-Pumping
- Utilize Optimal Performance of the Power Section in Motors
- NO DROP BALLS or Darts Required for Activation
- Motor Stalls are Still Visible at Surface
- Different Orifice Sizes Available to Customize Flow Diversion

Specifications



	2-1/8" (54 mm)
TOOL OD	2.125 in (54 mm)
OVERALL LENGTH	43.5 in (1105 mm)
PIN ID	1 in (25 mm)
MOTOR FLOW RATE SETTING RATE (MIN/MAX)	30 gpm / 100 gpm (115 / 380 lpm)
MAX. PUMP RATE	100 gpm (0.4 m³/min)
MAX. OVERPULL	150,000 lbs (66,720 daN)
MAX. TORQUE	1,700 ft-lbs (2,305 Nm)
CONNECTION	1-1/2 MT

	2-7/8" (73 mm)
TOOL OD	2.875 in (73 mm)
OVERALL LENGTH	35.0 in (889 mm)
PIN ID	1.13 in (29 mm)
MOTOR FLOW RATE SETTING RATE (MIN/MAX)	21 / 158 gpm (80 / 600 lpm)
MAX. PUMP RATE	315 gpm (1.2 m³/min)
MAX. OVERPULL	150,000 lbs (66,720 daN)
MAX. TORQUE	2,000 ft-lbs (2,712 Nm)
CONNECTION	2-3/8 PAC



TEMPRESS HYDROPULL™

NEXT GENERATION MILLING TECHNOLOGY



HydroPull™ Extended Reach

•
Motor Gas Separator
(MGS™)

•
HydroPull™ SC Tool
(Stimulation and Cleanout)

•
Water Bypass AV Sub (WBS)

•
High Pressure Rotary Jet
(JetRotor™)

•
Job Planning Software

•
Engineering Services

•
Custom Tool Development

Tempress HydroPull™ Tool

The Tempress HydroPull 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 (6m/ 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 lock up.

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	<ul style="list-style-type: none">• Pulls Tubing into Long, Tortuous Wells• Reduces Plug Milling Time• Eliminates the Need for Friction-Reducing Beads & Chemicals• Routing Entry of Over 11,000 ft (3,333m) Horizontals
Flow Pulsation	<ul style="list-style-type: none">• Better Hole Cleaning• Fewer Short Trips• Mill 48+ Plugs Per Day
Low Pressure Differential	<ul style="list-style-type: none">• Effective on Various Coil Sizes or High-Pressure Wells
High Reliability	<ul style="list-style-type: none">• Multi-Day Extreme-Reach Jobs Without Tripping• Over 99% Downhole Success Rate• Mill 70+ Plugs in a Single Run
Polymer Gel Compatibility	<ul style="list-style-type: none">• Effective Sweeps Minimize Short Trips
Nitrogen Compatibility	<ul style="list-style-type: none">• Effective on Commingled Fluid for Depleted Well Service



HydroPull™ Extended Reach

- Motor Gas Separator (MGS™)

HydroPull™ SC Tool (Stimulation and Cleanout)

Water Bypass AV Sub (WBS)

- High Pressure Rotary Jet (JetRotor™)

Job Planning Software

Engineering Services

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 (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. High Flow 3.38-in. High Flow 3.50-in. High Flow
Design flow rate	1.9 - 3.8 bpm (300 - 600 lpm)	2.3 - 4.5 bpm (360 - 710 lpm)	2.5 - 5.0 bpm (400 - 790 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 - 3.7 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 (1,400 daN)	3,900 lbf (1,700 daN)	4,400 lbf (2,000 daN)
Pulse cycle rate	2 - 6 Hz		



HydroPull™ Extended Reach



Motor Gas Separator
(MGS™)



HydroPull™ SC Tool
(Stimulation and Cleanout)

Water Bypass AV Sub (WBS)



High Pressure Rotary Jet
(JetRotor™)



Job Planning Software



Engineering Services



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.

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

www.thrusterenergy.com

1.877.698.3570

HydroPull™ Performance Software



HydroPull™ Extended Reach



Motor Gas Separator
(MGST™)



HydroPull™ SC Tool
(Stimulation and Cleanout)



Water Bypass AV Sub (WBS)



High Pressure Rotary Jet
(JetRotor™)



Job Planning Software

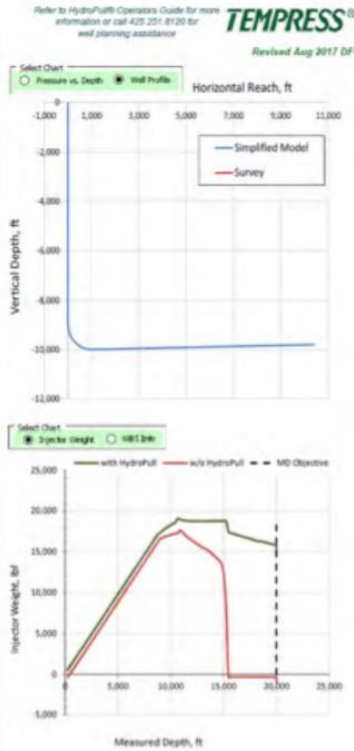


Engineering Services



Custom Tool Development

HydroPull® Extended Reach Model- Simplified Well Profile		Enter All Blue Data	©Tempress OSES 2017
Well Designation & Date		Wellname	msv001r
Select units		US Units	
Well Data	Kickoff point (TVD)	9,000	ft
	End of curve/landing 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	°/100 ft
Static friction coefficient		0.24	21 for pipe-on-pipe friction reducer, with no FR .30 if no coil straightener
Working (Separate Tab)	Coil OD	2,000	in
	Coil Wall Thickness	0.199	in
	Minimum flow ID in motorhead	0.70	in
BHA	HydroPull® ID diameter	2.88	in
	HydroPull® Configuration (Flow, Impact Rating)	Standard Flow, High Impact	
	# of Nozzle Ports (bit, bit/nose)	6	see Tempress Nozzle Sizes
	Port diameter	0.375	in
	Tempress® Water Bypass Sub	No	
Operating Parameters	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
	Pump flow rate	3.00	gpm
Results	Minimum Weight on Bit	500	lbf
	Wellhead circulating pressure (choke)	100	psi gauge
	Fluid friction reducer effect	10%	% reduction
	Fluid density	8.34	ppg Spec. Gravity= 1.00
	Est. fluid lost to (-) or gained from (+) formation	0.00	gpm Default is 0
Results	Total BHA pressure drop	1,300	psi differential
	Pump pressure (drilling/riding)	3400	psi
	Bottomhole circulating pressure (BHCP)	4300	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	fpm OK
Results	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
Results	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 lock-up, 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



Motor Gas Separator
(MGS™)



HydroPull™ SC Tool
(Stimulation and Cleanout)

Water Bypass AV Sub (WBS)



High Pressure Rotary Jet
(JetRotor™)



Job Planning Software



Engineering Services



Custom Tool Development

Competitor Analysis- Friction Breaking Tool

	The Tempress HydroPull™ Tool	Fluid 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	✓		



TEMPRESS MOTOR GAS SEPARATOR (MGS™)

NEXT GENERATION MILLING TECHNOLOGY



HydroPull™ Extended Reach



Motor Gas Separator
(MGS™)



HydroPull™ SC Tool
(Stimulation and Cleanout)



Water Bypass AV Sub (WBS)



High Pressure Rotary Jet
(JetRotor™)



Job Planning Software



Engineering Services

Custom Tool Development

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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Simplifies make-up of the bottom hole assembly
Wellbore adaptability	<ul style="list-style-type: none">• Accommodates severe doglegs and multilateral completions• Compatible with common well service fluids• Sour gas compatible
High reliability	<ul style="list-style-type: none">• Multiday extreme-reach jobs without tripping• <i>Over 99% downhole success rate</i>

NEW Technology- Tempress® MGS™ Tool Motor Gas Separator



HydroPull™ Extended Reach

●
Motor Gas Separator
(MGS™)

●
HydroPull™ SC Tool
(Stimulation and Cleanout)

Water Bypass AV Sub (WBS)

●
High Pressure Rotary Jet
(JetRotor™)

●
Job Planning Software

●
Engineering Services

●
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	5,300 psi (37 MPa)	10,000 psi (67 MPa)	4,000 psi (28 MPa)	5,100 psi (28 MPa)
Maximum particle size	.125-in. (3.2 mm)	.125-in. (3.2 mm)	.156-in. (4.0 mm)	.156-in. (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%			

NEW Technology- Tempress® MGS™ Tool Motor Gas Separator



HydroPull™ Extended Reach

Motor Gas Separator
(MGS™)

HydroPull™ SC Tool
(Stimulation and Cleanout)

Water Bypass AV Sub (WBS)

High Pressure Rotary Jet
(JetRotor™)

Job Planning Software

Engineering Services

Custom Tool Development

Case Histories

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.

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.

MGS™ 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.

MGS™ 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.





TENAX HYDRASHOCK™

NEXT GENERATION MILLING TECHNOLOGY



The HydraShock represents an evolution in conventional jarring technology. The HydraShock uses the entire string as a jar, to find and remove a stuck point.

During a mill out, sand and plug debris can settle and can cause the tubing to become stuck. Due to the limitations of Coiled Tubing's cycling fatigue, few attempts can be made to free the stuck pipe. This is the reason the HydraShock system was invented. Without moving the tubing at surface we can create a dynamic event in the wellbore to free the tubing. This eliminates excessive costs and risks due to cycling fatigue. The 2.88" HydraShock is capable of firing up to 50 jarring events. How does it work?



Run in Place Tool- Below Hydraulic Disconnect/ Circ Sub

Ideally, the "Run in Place Tool" should be ran as part of every Milling BHA. This is what will allow the Delta 'N' balls to seat against, pressure up and then pressure release. The

Run in Place Tool also houses the spent Delta 'N' balls. Conversely, if the Run in Place

Tool was not ran initially as part of the Milling BHA, the TENAX Rescue Tool can be deployed from surface, and land on top of the internal coil connector. Once seated on top of the internal connector, Delta 'N' balls can be deployed and landed there.

Excellent Option for Low Bottom Hole Pressure Wells!

A pre-determined PSI Value Delta 'N' ball is deployed through the Coiled Tubing...

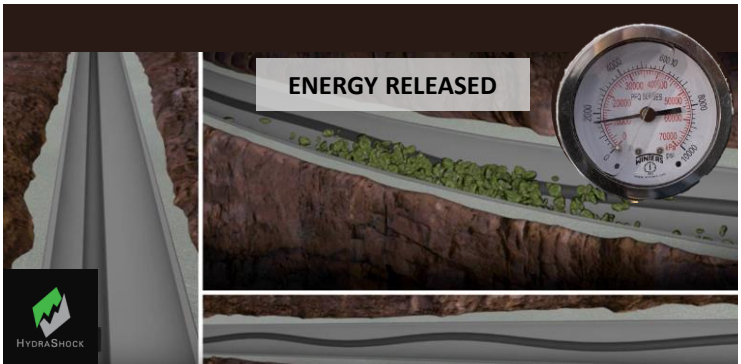
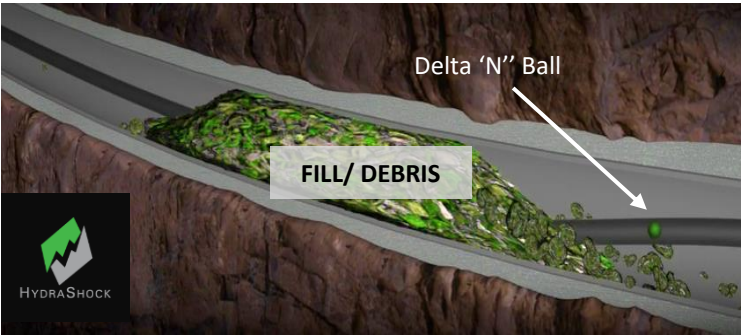
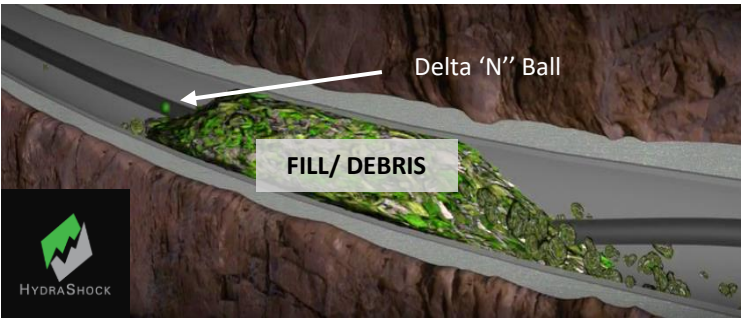
...and makes its way down passed the stuck point above the BHA onto the Run-in-Place Tool or conversely the TENAX Rescue Tool.

The Delta 'N' Ball lands on the seat in the Run in Place Tool, creating differential pressure. Depending on the value of the Delta 'N' Ball selected, the pressure will increase until the value of the Delta 'N' Ball is exceeded. During this process, the tubing above the stuck point transitions from being in tension...

...to compression, straightening out the Coiled Tubing. The tubing below the stuck point goes from being in a natural helix to a state of charged elongation.

Once the HydraShock™ fires, a dynamic event occurs that utilizes the energy stored in both the fluid and the tubing. The mix of fluid propulsion and spring force acts on both sides of the stuck point, breaking free at the weakest part of the fill.

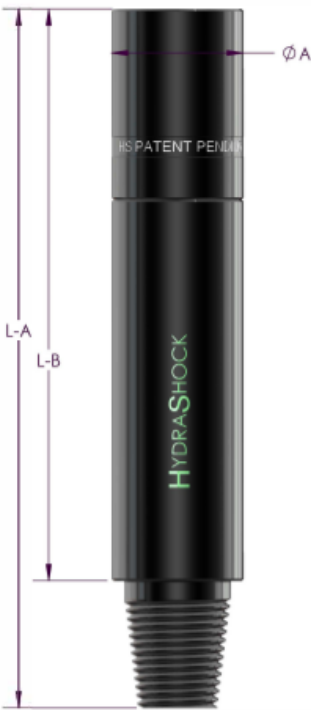
This process can be repeated up to 50 times, or until tubing is free.



15,000+
HydraShock™
Runs

407 Jarring
Events
83% Success!

“Run-in-Place
Sub only
14.25”/
0.36m in
Length!



All dimensions are inches

Size	1.69	2.13	2.88	3.13
ØA	1.69	2.13	2.88	3.13
Øa	0.35	0.35	0.50	0.50
L-A	14.88	15.96	16.5	16.5
L-B	13.38	13.96	14.25	13.5
Box	1 MT	1.5 MT	2.375 PAC	2.375 Regular
Pin	1 MT	1.5 MT	2.375 PAC	2.375 Regular
Make-up Torque lb-ft	500	950	3000	3700
Tensile Strength Lbs	68,100	127,100	269,400	375,500
Ball Capacity	50	50	50	30

Minimum Material Properties	120KPSI Tensile Strength
Operating Temperature and Pressure	350F at 15KPSI
Material Options	Tools for super corrosive environment available upon request

Call Thruster Energy Corp. Today!

1.877.698-3570

To see the HydraShock™ in
Action, Click on the Link Below:

<http://tenaxenergy.com/tenax-hydra-shock>



COILED TUBING CONNECTORS

NEXT GENERATION MILLING TECHNOLOGY

Internal Dimple Connectors are essential to make-up Coiled Tubing with downhole Bottom Hole Assemblies (BHAs). During installation, a hydraulic Dimpling Yoke & Jig apply thousands of pounds of force to dimpling buttons that line up with the dimples on the upper section (Shank) of the Connector. This process creates a strong, intimate fit that transmits the tensile as well as the torsional forces applied.

Design Features

- Robust One-Piece Design
- High Torsional & Tensile Strength
- Ideal for Jarring & Milling Applications
- Simple to Install
- Dual Elastomeric Seals
- Available for All Sizes of Coiled Tubing
- Customization Options Available

TECHNICAL SPECIFICATIONS

TOOL OD	COIL OD/ WT	TENSILE YIELD	TORSIONAL YIELD (ft-lbs)	STANDARD CONNECTION
73mm/ 2.875"	50.8mm (2.000") x 3.96mm (0.156" WT)	30,858 daNs 69,122 (lbf)	2,789	2-3/8" PAC
73mm/ 2.875"	50.8mm (2.000") x 4.45mm (0.175" WT)	31,218 daNs 69,930 lbf	2,691	2-3/8" PAC
73mm/ 2.875"	50.8mm (2.000") x 4.83mm (0.190" WT)	32,100 daNs 71,902 lbf	2,632	2-3/8" PAC
73mm/ 2.875"	73.0mm (2.375") x 3.96mm (0.156" WT)	47,366 daNs 106,100 lbf	4,871	2-3/8" PAC
73mm/ 2.875"	73.0mm (2.375") x 4.45mm (0.175" WT)	43,044 daNs 96,420 lbf	4,487	2-3/8" PAC
73mm/ 2.875"	73.0mm (2.375") x 4.83mm (0.190" WT)	42,483 daNs 95,162 lbf	4,434	2-3/8" PAC

HydroPull™
Certified

INTERNAL DIMPLE CONNECTOR- SPECIFICATIONS

TECHNICAL SPECIFICATIONS

COIL OD	WALL THICKNESS	STANDARD ID	FLOW AREA (sq inch)	O-RING	TENSILE YIELD	TORSIONAL YIELD (ft-lbs)	INTERNAL YIELD PRESSURE
31.80mm (1.25")	2.77mm (0.109")	15.09mm (0.594")	0.277	210	11,229 daNs 25,154 lbf	694	68.9 MPa 10,000 PSI
31.80mm (1.25")	2.99mm (0.118")	14.30mm (0.563")	0.249	210	10,509 daN 23,542 lbf	670	68.9 MPa 10,000 PSI
31.80mm (1.25")	3.18mm (0.125")	12.70mm (0.500")	0.196	210	11,628 daNs 26,048 lbf	668	68.9 MPa 10,000 PSI
31.80mm (1.25")	3.96mm (0.156")	11.09mm (0.437")	0.15	209	9,795 daNs 21,941 lbf	557	68.9 MPa 10,000 PSI

38.1mm/ 1.500"

38.10mm (1.500")	2.77mm (0.109")	20.65mm (0.813")	0.519	214	17,257 daNs 38,657 lbf	1,262	68.9 MPa 10,000 PSI
38.10mm (1.500")	2.99mm (0.118")	19.81mm (0.78")	0.478	214	17,473 daNs 39,140 lbf	1,235	68.9 MPa 10,000 PSI
38.10mm (1.500")	3.18mm (0.125")	19.81mm (0.78")	0.478	214	16,499 daNs 36,959 lbf	1,184	68.9 MPa 10,000 PSI
38.10mm (1.500")	3.40mm (0.134")	19.05mm (0.75")	0.442	213	16,559 daNs 37,093 lbf	1,153	68.9 MPa 10,000 PSI
38.10mm (1.500")	3.68mm (0.145")	16.66mm (0.656")	0.338	213	16,591 daNs 37,166 lbf	1,162	68.9 MPa 10,000 PSI
38.10mm (1.500")	3.96mm (0.156")	14.30mm (0.563")	0.249	213	20,095 daNs 45,015 lbf	1,162	68.9 MPa 10,000 PSI

INTERNAL DIMPLE CONNECTOR- SPECIFICATIONS

COIL OD	WALL THICKNESS	STANDARD ID	FLOW AREA (sq inch)	O-RING	TENSILE YIELD	TORSIONAL YIELD (ft-lbs)	INTERNAL YIELD PRESSURE
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TECHNICAL SPECIFICATIONS

44.45mm (1.75")	2.77mm (0.109")	26.92mm (1.06")	0.882	218	23,706 daNs 53,102 lbf	1,986	62.05 MPa 9,000 PSI
44.45mm (1.75")	3.18mm (0.125")	26.19mm (1.031")	0.835	218	22,724 daNs 50,903 lbf	1,878	62.05 MPa 9,000 PSI
44.45mm (1.75")	3.40mm (0.134")	26.3mm (1.035")	0.841	217	21,003 daNs 47,047 lbf	1,773	51.7 MPa 7,500 PSI
44.45mm (1.75")	3.68mm (0.145")	23.88mm (0.94")	0.694	217	22,909 daNs 51,317 lbf	1,853	68.9 MPa 10,000 PSI
44.45mm (1.75")	3.96mm (0.156")	23.88mm (0.94")	0.694	217	21,141 daNs 47,358 lbf	1,744	62.05 MPa 9,000 PSI
44.45mm (1.75")	4.46mm (0.175")	19.05mm (0.750")	0.442	216	27,213 daNs 60,958 lbf	1,822	68.9 MPa 10,000 PSI

50.80mm/ 2.00"

50.80mm (2.00")	3.18mm (0.125")	31.75mm (1.250")	1.227	222	30,209 daNs 67,669 lbf	2,852	63.4 MPa 10,000 PSI
50.80mm (2.00")	3.40mm (0.134")	30.18mm (1.188")	1.108	222	37,725 daNs 73,306 lbf	2,920	68.9 MPa 10,000 PSI
50.80mm (2.00")	3.68mm (0.145")	30.18mm (1.188")	1.108	222	30,622 daNs 68,595 lbf	2,763	68.9 MPa 10,000 PSI
50.80mm (2.00")	3.96mm (0.156")	28.58mm (1.125")	0.994	221	30,858 daNs 69,122 lbf	2,789	68.9 MPa 10,000 PSI
50.80mm (2.00")	4.46mm (0.175")	26.97mm (1.062")	0.886	220	31,218 daNs 69,930 lbf	2,691	68.9 MPa 10,000 PSI
50.80mm (2.00")	4.76mm (0.188")	25.40mm (1.000")	0.785	220	32,099 daNs 71,902 lbf	2,632	68.9 MPa 10,000 PSI

INTERNAL DIMPLE CONNECTOR- SPECIFICATIONS

COIL OD	WALL THICKNESS	STANDARD ID	FLOW AREA (sq inch)	O-RING	TENSILE YIELD	TORSIONAL YIELD (ft-lbs)	INTERNAL YIELD PRESSURE
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TECHNICAL SPECIFICATIONS

60.3mm (2.38")	3.40mm (0.134")	38.1mm (1.500")	1.767	225	48,903 daNs 109,543 lbf	5,023	68.9 MPa 10,000 PSI
60.3mm (2.38")	3.68mm (0.145")	38.1mm (1.500")	1.767	224	44,777 daNs 100,302 lbf	4,809	66.8 MPa 9,700 PSI
60.3mm (2.38")	3.96mm (0.156")	36.53mm (1.438")	1.624	224	47,366 daNs/ 106,100 lbf	4,871	68.9 MPa 10,000 PSI
60.3mm (2.38")	4.46mm (0.175")	36.53mm (1.438")	1.624	224	43,044 daNs 96,420 lbf	4,487	68.9 MPa 10,000 PSI
60.3mm (2.38")	4.76mm (0.188")	34.9mm (1.375")	1.785	224	42,483 daNs 95,162 lbf	4,434	68.9 MPa 10,000 PSI

The Slip Connector is designed to attach the BHA to the end of the coil and transfer the axial load using slips.

The Slip Connector is comprised of a Top sub, Slip, Brass Ring, and a Bottom Sub with desired connection. The dressed coil is stabbed into the connector and the bottom sub is rotated to start the tightening process. An overpull is then used to set the slips further and retightening the bottom sub then ensures no more movement.

Design Features

- Torque and vibration compatible
- High Torsional & Tensile Strength
- Versatile use for milling, drilling, fracturing
- Multiple Sizes available
- Connections to suit BHA Requirements

TECHNICAL SPECIFICATIONS

COIL SIZE	TOOL OD	CONNECTIONS	TENSILE YIELD	TORSIONAL YIELD ft-lbs	ID	WORKING PRESSURE
31.8mm (1.250")	42.9mm (1.690")	1.00" AMMT	14,285 daNs 32,000 lbf	615	19.05mm (0.750")	68.9 MPa 10,000 PSI
38.1mm (1.500")	54mm (2.125")	1-1/2" AMMT	24,553 daNs 55,000 lbf	1,710	22.65mm (0.892")	68.9 MPa 10,000 PSI
44.45mm (1.750")	57.2mm (2.250")	1-1/2" AMMT	24,553 daNs 55,000 lbf	1,710	22.65mm (0.892")	68.9 MPa 10,000 PSI
50.80mm (2.00")	73mm (2.875")	2-3/8" PAC	42,410 daNs 95,000 lbf	4,000	34.92mm (1.375")	68.9 MPa 10,000 PSI
60.3mm (2.375")	79.4mm (3.125")	2-3/8" PAC	48,930 daNs 111,000 lbf	4,000	34.92mm (1.375")	68.9 MPa 10,000 PSI
60.3mm (2.375")	79.4mm (3.125")	2-3/8" EUE	48,930 daNs 111,000 lbf	4,000	48.26mm (1.900")	68.9 MPa 10,000 PSI
60.3mm (2.375")	79.4mm (3.125")	2-3/8" REG	64,700 daNs 145,500 lbf	4,430	24.6mm (0.900")	68.9 MPa 10,000 PSI

SPOOLABLE DIMPLE CONNECTOR

Spoolable Dimple Connectors are essential in Pipe recovery operations as an emergency splice between two lengths of coiled tubing, one on surface and the other in the wellbore. The central part of the connector has a smooth thru-bore and notched exterior profile. The notches allow a plastic bending modulus equal to the coiled tubing while preserving the OD so that the connector can be passed through the injector chains and the stuffing box.

Design Features

- Robust One-Piece Design
- High Torsional & Tensile Strength
- Simple to Install
- Dual Elastomeric Seals
- Available for All Sizes of Coiled Tubing
- Customization Options Available

TECHNICAL SPECIFICATIONS

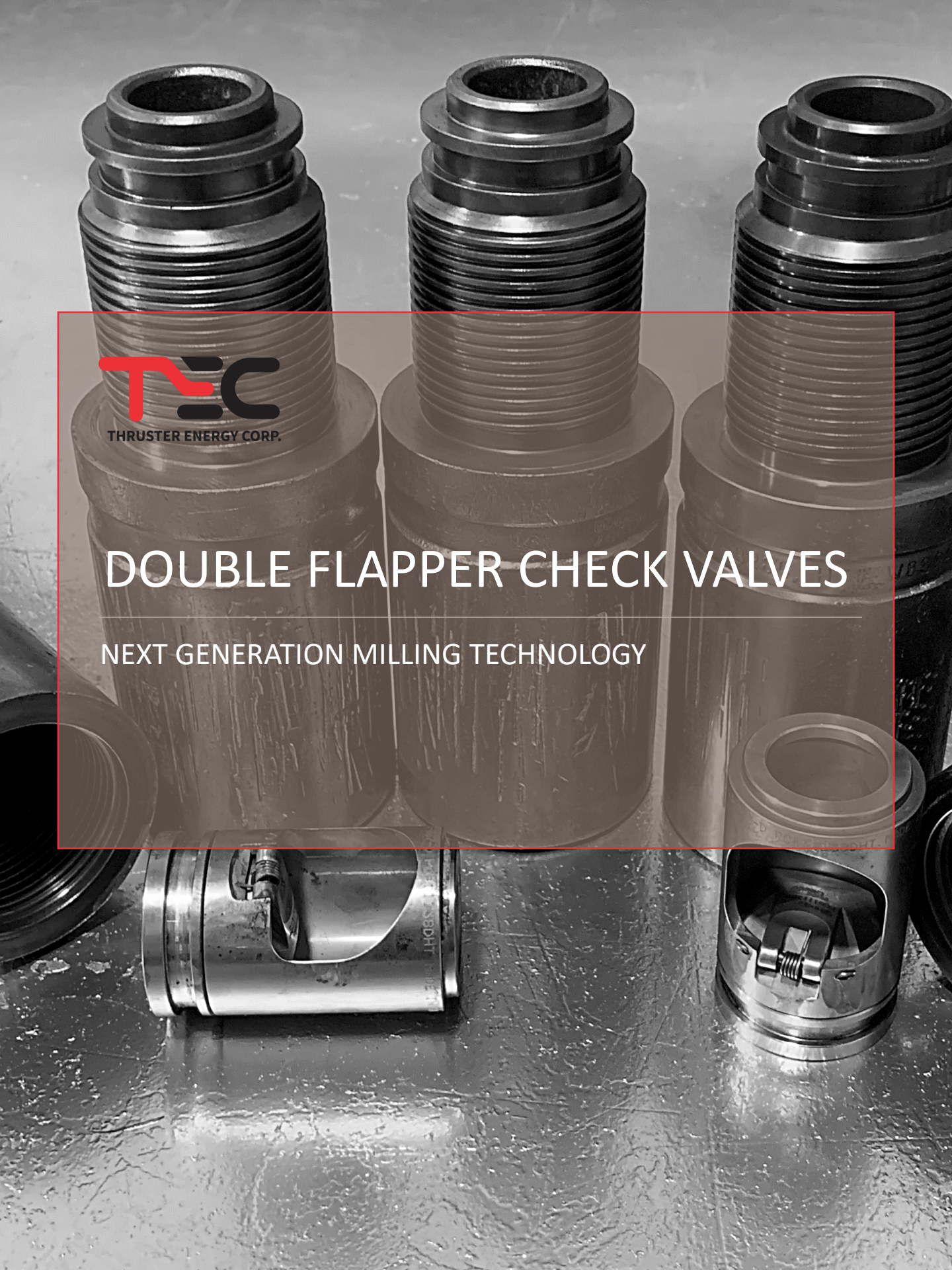
COIL OD	WALL THICKNESS	STANDARD ID	FLOW AREA (sq. in.)	O-RING	TENSILE YIELD	TORSIONAL YIELD ft-lbs	INTERNAL PRESSURE
60.3mm 2.375"	3.68mm 0.145"	38.1mm 1.500"	1.767	225	33,299 daNs 74,590 lbf	2,761	68.9 MPa 10,000 PSI
60.3mm 2.375"	3.96mm 0.156"	38.1mm 1.500"	1.767	224	36,240 daNs 81,179 lbf	3,023	57.2 MPa 8,300 PSI
60.3mm 2.375"	4.45mm 0.175"	36.5mm 1.438"	1.624	224	40,521 daNs 90,769 lbf	3,261	68.3 MPa 9,900 PSI
60.3mm 2.375"	4.76mm 0.188"	34.8mm 1.370"	1.474	224	42,064 daNs 94,224 lbf	3,261	68.9 MPa 10,000 PSI
60.3mm 2.375"	5.16mm 0.203"	33.3mm 1.312"	1.352	226	44,857 daNs 100,480 lbf	3,556	68.9 MPa 10,000 PSI

Additional Specs on Other Sizes Available Upon Request



DOUBLE FLAPPER CHECK VALVES

NEXT GENERATION MILLING TECHNOLOGY



DOUBLE FLAPPER CHECK VALVES

The Double Flapper Check Valve Sub prevents wellbore fluid from entering the Bottom Hole Assembly (BHA) and is the primary means of well control internally.

Equipped with high performance elastomeric seals improves sealing & reliability. Large Thru-Bore accommodates large Drop Balls for ball-activated tools below. The two flapper cartridges are easily removed and replaced at the field level if required.

Design Features:

- Simple Redress at the Field Level
- Large Thru-Bore
- Robust Design for Milling & Jarring Operations
- Redundant Flapper Cartridge for Safety
- High Quality Seals for Maximum Sealing

TECHNICAL SPECIFICATIONS

TOOL OD	Tensile Yield	Torsional Yield (ft-lbs)	Standard Connections	Working Pressure
42.86mm (1.690")	24,553 daNs 55,000 lbf	820	1.00" AMMT	68.9 MPa 10,000 PSI
54mm (2.125")	45,982 daNs 103,000 lbf	1,600	1-1/2" AMMT	68.9 MPa 10,000 PSI
60.3mm (2.375")	47,366 daNs/ 106,100 lbf	1,600	1-1/2" AMMT	68.9 MPa 10,000 PSI
73mm (2.875")	93,750 daNs 210,000 lbf	4,800	2-3/8" PAC	68.9 MPa 10,000 PSI
79mm (3.125")	93,750 daNs 210,000 lbf	4,800	2-3/8" REG	68.9 MPa 10,000 PSI

HydroPull™
Certified



MOTOR HEAD ASSEMBLY

NEXT GENERATION MILLING TECHNOLOGY

MOTOR HEAD ASSEMBLY- 1.690"/ 42.9mm

TEC’s Heavy Duty 1.690”/ 42.9mm Motor Head Assembly is a compact tool string which incorporates a variety of features including a Dual-Flapper Check Valve Assembly, a Ball-Activated disconnect and a Dual-Activated Circulating Sub. The tool also features torque-thru capability as well as a standard internal GS Fishing Neck profile.

The Dual Flapper Check Valves provide a uni-directional barrier between the well bore and the tubing above. The Disconnect facility is there to provide a means of disconnecting from the stuck tool string by simple deploying a drop-ball.

The Circulating Sub introduces a flow path from the tool ID to the annulus. However if for any reason circulating through the tool string is lost, an Overpressure-Activated Piston is incorporated.

Design Features:

- High Torsional Yield for High-Torque Milling Operations
- Robust Design for Milling & Jarring Operations
- Customizable Shear Values
- Highly Dependable & Durable

TECHNICAL SPECIFICATIONS

TOOL OD	1.690" 42.9mm
CONNECTION	1.00" AMMT
DISCONNECT DROP BALL	0.500" 12.7mm
DISCONNECT SHEAR SCREW VALUE/ SCREW	1,000 PSI
LENGTH AFTER DISCONNECT	11.38" 0.29m
CIRC SUB DROP BALL	0.438" 11.12mm
CIRC SUB SCREW VALUE/ SCREW	1,050 PSI
TYPICAL CIRCULATING OVER-PRESSURE (PER SHEAR SCREW)	2,450 PSI
MAKE-UP TORQUE SPECIFICATIONS	250 ft-lbs
PULLING TOOL REQUIRED	03-02-GS-200-A0
TENSILE YIELD	33,100 lbf 14,776 daNs
MAX FISHNECK LOAD	30,200 lbf 13,482 daNs





DISCONNECT TOOLS

NEXT GENERATION MILLING TECHNOLOGY

HEAVY DUTY HYDRAULIC DISCONNECT

TEC's Heavy Duty Hydraulic Disconnect is simple to redress and maintain, yet designed to withstand tremendous abuse imposed upon it during high-torque/ high-flow/ high-agitation milling applications.

This Release Tool is a ball-activated tool & can be "disconnected" simply by pumping an appropriately-sized drop-ball onto a piston seat within the tool creating differential pressure, which ultimately shears the disconnect mechanism inside.

This allows the upper section of the Disconnect Tool & Bottom Hole Assembly to be released, leaving the bottom section of the Disconnect Tool & the rest of the Bottom Hole Assembly below left downhole for Fishing Operations.

Standard with all 2.875" & 3.125" OD HD Hydraulic Disconnect Tools is a #3 GS internal profile for "slim-hole" recovery options.

Design Features:

- High Torsional Yield for High-Torque Milling Operations
- Robust Design for Milling & Jarring Operations
- Customizable Shear Values
- Highly Dependable & Durable

**HydroPull™
Certified**

**When using the tool, an appropriate allowance should be made as a safety factor when fishing bottom sub with a Pulling tool- see subsequent Specifications Sheet for details.*

HEAVY DUTY HYDRAULIC DISCONNECT

TECHNICAL SPECIFICATIONS

TOOL OD	MINIMUM YIELD POINT & LOAD TO YIELD	TORSION WEAK POINT & LOAD TO YIELD	PSI TO RELEASE PER SHEAR SCREW	SHEAR SCREW SIZE	O-RINGS	DISCONNECT BALL SIZE	TOP & BOTTOM SUB M.U.T.
42.86mm/ 1.690"	Bottom Sub 1.00" AMMT Pin Connection 25,334 daNs/ 56,750 lbf; Internal B&W Fishing Neck Strength 22,500 daNs/ 50,400 lbf (note fishing neck is not tensile loaded when assembled. Above number is used as a guide line when fishing bottom sub with pulling tool)	Bottom Sub 1.00" AMMT Pin Connection 638 ft-lbs	1700-2100 (NO SHEAR SCREWS) 2378-3138 (1 SHEAR SCREW) 3416-4176 (2 SHEAR SCREWS) 4454-5214 (3 SHEAR SCREWS) 5492-6252 (4 SHEAR SCREWS) 6530-7290 (5 SHEAR SCREWS) 7568-8328 (6 SHEAR SCREWS)	10-32 UNC X 3/16"	FLOW TUBE 2-018 (1) TOP SUB 2-123 (1) 2-123BU (2) SUPPORT PISTON 2-118 (1)	1/2"	500 ft-lbs
54mm/ 2.125"	Bottom Sub 1-1/2" AMMT Pin Connection 55,491 daNs/ 124,300 lbf; Internal Custom Fishing Neck Strength 33,616 daNs/ 75,300 lbf (note fishing neck is not tensile loaded when assembled, above number is used as a guide line when fishing bottom sub with pulling tool)	Bottom Sub 1-1/2" AMMT Pin Connection 1,770 ft-lbs	1900-2400 (NO SHEAR SCREWS) 2581-3081 (1 SHEAR SCREW) 3262-3762 (2 SHEAR SCREWS) 3943-4443 (3 SHEAR SCREWS) 4624-5124 (4 SHEAR SCREWS) 5305-5805 (5 SHEAR SCREWS) 5986-6486 (6 SHEAR SCREWS)	10-32 UNC X 1/4"	TOP SUB 2-128 (1) 2-128BU (2) SUPPORT PISTON 2-122 (1)	3/4"	950 ft-lbs
73mm/ 2.875"	Bottom Sub 2-3/8" PAC Pin Connection 88,705 daNs/ 198,700 lbf; Internal 3" GS Fishing Neck Strength 65,223 daNs/ 146,100 lbf (note fishing neck is not tensile loaded when assembled. Above number is used as a guide line when fishing bottom sub with pulling tool)	Bottom Sub 2-3/8" PAC Pin Connection 4,800 ft-lbs	1900-2300 (NO SHEAR SCREWS) 2488-2888 (1 SHEAR SCREW) 3076-3476 (2 SHEAR SCREWS) 3664-4064 (3 SHEAR SCREWS) 4252-4652 (4 SHEAR SCREWS) 4840-5240 (5 SHEAR SCREWS) 5428-5828 (6 SHEAR SCREWS)	1/4-20 UNC X 5/16"	TOP SUB 2-226 (1) 2-226BU (2) SUPPORT PISTON 2-222 (1) 2-222BU (1)	7/8"	1,500 ft-lbs
79mm/ 3.125"	Top Sub Collet Section 100,446 daNs/ 225,000 lbf; Internal 3" GS Fishing Neck strength 263,700 lbs/117,723 daNs (note fishing neck is not tensile loaded when assembled. This number is used as a guide line when fishing bottom sub with pulling tool)	Bottom Sub 2-3/8" REG Pin Connection 5,800 ft-lbs	1900-2300 (NO SHEAR SCREWS) 2488-2888 (1 SHEAR SCREW) 3076-3476 (2 SHEAR SCREWS) 3664-4064 (3 SHEAR SCREWS) 4252-4652 (4 SHEAR SCREWS) 4840-5240 (5 SHEAR SCREWS) 5428-5828 (6 SHEAR SCREWS)	1/4-20 UNC X 5/16"	TOP SUB 2-226 (1) 2-226BU (2) SUPPORT PISTON 2-222 (1) 2-222BU (1)	7/8"	1,500 ft-lbs

Unless otherwise stated, all the strength figures shown are the results of calculations based on the yield strength of the material used to manufacture this tool. The strength calculations are considered accurate within ~20% of the stated value, and should be used as a guide line only. They do not constitute a guarantee, actual or implied. When using the tool an appropriate allowance should be made as a safety factor.



DUAL ACTIVATED CIRC SUBS

NEXT GENERATION MILLING TECHNOLOGY

As the name suggests, the Dual-Acting Circulating Sub has two important functions:

- Allows pressure relief by applying internal pressure on a Rupture Disc (Burst Disc) and overcoming the Rupture Discs burst value, which is pre-determined prior to running the tools in hole. This may be necessary if the flow path is restricted to the tools below, to create a secondary flow path so as to deploy a drop-ball.
- The second capability of the Circulating Sub is a ball-activated option in which a drop-ball can be deployed via fluid to a piston seat within the Circulating sub to shear a piston, opening up (3) large ports to the annulus allowing pump rates to exceed motor flow rates as well as isolating the flow path to all the tools below the Circulating Sub in the Bottom Hole Assembly.

Design Features:

- Simple Redress at the Field Level
- (3) 3-/8" (9.5mm) Ports to Annulus for High Flow Rates
- Robust Design for Milling & Jarring Operations
- Various Pressure Values Available for Burst Disc Option
- 3/4" (0.750"/ 19.05mm) Drop Ball

TECHNICAL SPECIFICATIONS

TOOL OD	TENSILE YIELD	TORSIONAL YIELD	STANDARD DROP BALL SIZES	SHEAR SCREW PRESSURE VALUE	PRESSURE RATING	STANDARD CONNECTIONS
73mm/ 2.875"	93,750 daNs 210,000 lbf	3,900 ft-lbs	0.750"	1,595 PSI/ SHEAR SCREW	68.9 MPa 10,000 PSI	2-3/8" PAC



FLEX SUBS

NEXT GENERATION MILLING TECHNOLOGY

The Flex Sub is a simple, single-piece component specially designed for tortuous well bores. The Flex Sub is designed to reduce bending stresses on more rigid components of the milling BHA.

TECHNICAL SPECIFICATIONS	
MAX OUTSIDE DIAMETER	73mm/ 2.875"
MIN INSIDE DIAMATER	34.9mm/ 1.375"
OVERALL LENGTH (OAL)	0.59m/ 23.25"
CONNECTION	2-3/8" PAC
TENSILE YIELD	99,000 daNs 224,000 lbf
TORSIONAL YIELD	4,520 ft-lbs

OTHER SIZES AVAILABLE UPON REQUEST



KNUCKLE JOINTS

NEXT GENERATION MILLING TECHNOLOGY

The Knuckle Joint was designed to provide additional flexibility to the tool string and allows tools to be ran in restricted or highly deviated wells

- ### Design Features

 - Flow-Thru Capability
 - 360° Rotation
 - Angular of 15°



TECHNICAL SPECIFICATIONS

TOOL OD	CONNECTION	TENSILE YIELD	ID	LENGTH	WORKING PRESSURE
1.690" 43mm	1" AMMT	20,000 lbf 8,928 daNs	0.625" 15.9mm	9.44" 0.24m	10,000 PSI 68.9 MPa
1.750" 44.45mm	1" AMMT	30,000 lbf 13,392 daNs	0.656" 16.7mm	9.44" 0.24m	10,000 PSI 68.9 MPa
2.125" 54mm	1-1/2" AMMT	40,000 lbf 17,857 daNs	0.875" 22.2mm	11.13" 0.28m	10,000 PSI 68.9 MPa
2.875" 73mm	2-3/8" PAC	75,000 lbf 33,482 daNs	0.875" 22.2mm	14.56" 0.37m	10,000 PSI 68.9 MPa

*NOTE: ALL VALUES ARE RATED FOR STANDARD MATERIAL
 **OTHER SIZES AND THREAD VARIATIONS AVAILABLE UPON REQUEST

The Torque Thru Knuckle Joint was designed to provide additional flexibility to the tool string and allow tools to be ran in restricted or highly deviated wells.

The Torque Thru design allows for full angular movement, but at the same time not allowing any rotation.

Design Features

- Flow-Thru Capability
- High Torque Ratings
- Robust Castellation Design
- Angular of 15°



TECHNICAL SPECIFICATIONS

TOOL OD	CONNECTION	TENSILE YIELD	TORSIONAL YIELD	ID	LENGTH	WORKING PRESSURE
1.500" 38.1mm	1" AMMT	18,000 lbf 8,035 daNs	370 ft-lbs	0.438" 11.1mm	8.75" 0.22m	5,000 PSI 34.5 MPa
1.690" 43mm	1" AMMT	20,000 lbf 8,928 daNs	440 ft-lbs	0.625" 15.9mm	9.44" 0.24m	10,000 PSI 68.9 MPa
1.750" 44.45mm	1" AMMT	30,000 lbf 13,392 daNs	450 ft-lbs	0.656" 16.7mm	9.44" 0.24m	10,000 PSI 68.9 MPa
2.125" 54mm	1-1/2" AMMT	40,000 lbf 17,857 daNs	1,050 ft-lbs	0.875" 22.2mm	11.13" 0.28m	10,000 PSI 68.9 MPa
2.875" 73mm	2-3/8" PAC	75,000 lbf 33,482 daNs	3,100 ft-lbs	0.875" 22.2mm	14.56" 0.37m	10,000 PSI 68.9 MPa

*NOTE: ALL VALUES ARE RATED FOR STANDARD MATERIAL



THRUSTER ENERGY CORP.

TEC MOTORS

NEXT GENERATION MILLING TECHNOLOGY

TEC PREDATOR & BRUTE FORCE MOTORS

The heart of any Milling BHA is the TEC PREDATOR (2.875"/ 73mm) & BRUTE FORCE (3.125"/ 79.4mm) Series Milling Motors and their Ultra High-Rate Platforms, the EV Series (Extreme Velocity- 800 LPM/ 5 Bbl/ Min & 950 LPM/ 6 Bbl/ Min). TEC Motor technology has a proven track record of performance & reliability in high-stage count plug milling. TEC utilizes dependable, industry-leading components to constantly strive for single-run, high-stage count mill outs in long, tortuous horizontal wells.

Scale & Cement Milling, Cement Retainer Milling, Under-Reaming, Stage Tool & Debris Sub Milling, Composite Bridge/ Dissolvable Bridge Plug Milling & Liner Seat Milling, Casing Deformation Milling and certain Fishing Operation have proven quite successful using motors where down-hole rotation is required, especially for Coiled Tubing Fishing Operations.

Design Features:

- **High-Strength Bearing Sections**
- **Hydrocarbon-Resistant Stators**
- **Bit Box Catch**
- **Rotor Catch**
- **Duvernay, Montney Field-Proven Dependable Motors**
- **Industry-Leading Power & Flow Rate Specs on Both 2.875"/ 73mm & 3.125"/ 79.4mm Platforms**
- **Tempress HydroPull™ Compatible Thread Connections**
- **Engineered Flex Points Designed to Handle the Most Tortuous Horizontal Wells on the Planet!**

TECHNICAL SPECIFICATIONS

Overall Motor Length	8' 3-1/4" (2.52m)
Overall Motor Weight	155# (69 kg)
Stage Count	NOT AVAILABLE
Lobe Configuration	NOT AVAILABLE
MAX WOB- While Pumping	8,500 lbf (3,777 daNs)
MAX WOB- No Pump Rate	50,500 lbf (22,544 daNs)
Overpull to Yield (Bit Stuck)	67,000 lbf (29,910 daNs)
MAX Pull on Housings	170,500 lbf (76,116 daNs)
**20% Safety Factor Should be Taken into Account as Values are Actual	

PERFORMANCE SPECIFICATIONS

Flow Range	47 - 119 GPM (180 - 450 LPM)
Speed Range RPM	157 - 395
Rotation	3.320 Rev/ Gal 0.8771 Rev/ Liter
MAX Differential Pressure	444 PSI (3,061 kpa)
Stall Differential Pressure	696 PSI (4,798 kpa)
MAX Torque	420 ft-lbs (569 Nm)
Stall Torque	668 ft-lbs (906 Nm)

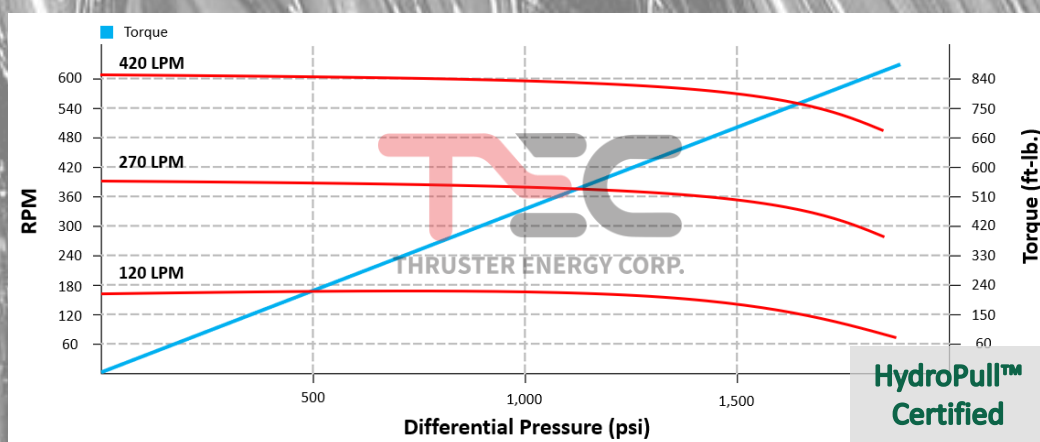
TEC MOTORS- PREDATOR LOW RATE MOTOR- 2.88" (73mm)

TECHNICAL SPECIFICATIONS

Overall Motor Length	12.9' (3.92m)
Overall Motor Weight	205 # (93 Kg)
Lobe Config./ Stage Count	NOT AVAILABLE
MAX WOB @ 100 RPM	22,000# (9,821 daNs)
MAX WOB @ 200 RPM	18,000# (8,035 daNs)
MAX WOB @ 300 RPM	16,000# (7,142 daNs)
MAX Pull at Bit to Fail Bearings	40,000# (17,857 daNs)
MAX Pull on Body to Yield	130,000# (58,035 daNs)
MAX Temp	320 °F (160 °C)

PERFORMANCE SPECIFICATIONS

Flow Range	31 - 110 GPM (118 - 418 LPM)
Speed Range RPM	168 - 598
Rotation	5.420 Rev/ Gal 1.4318 Rev/ Liter
MAX Differential Pressure	1,050 PSI (7,300 kpa)
Stall Differential Pressure	2,600 PSI (17,900 kpa)
MAX Torque	866 Ft-Lbs (1,174 Nm)
Stall Torque	1,357 Ft-Lbs (1,839 Nm)
Torque Slope	0.93 ft-lbs/ PSI (0.19 Nm/ kpa)



****Performance curves are for reference only. Performance data and dimensions are subject to change without notice.**
Performance curves based upon Dyno Testing in ambient temperatures, and are dependent on flow rate & power section fit. Actual field performance may vary with field-operational conditions. Operating beyond the parameters given will significantly reduce the longevity of the motor's life and/ or damage.

TEC MOTORS- PREDATOR ALL-METAL MOTOR- 2.88" (73mm)

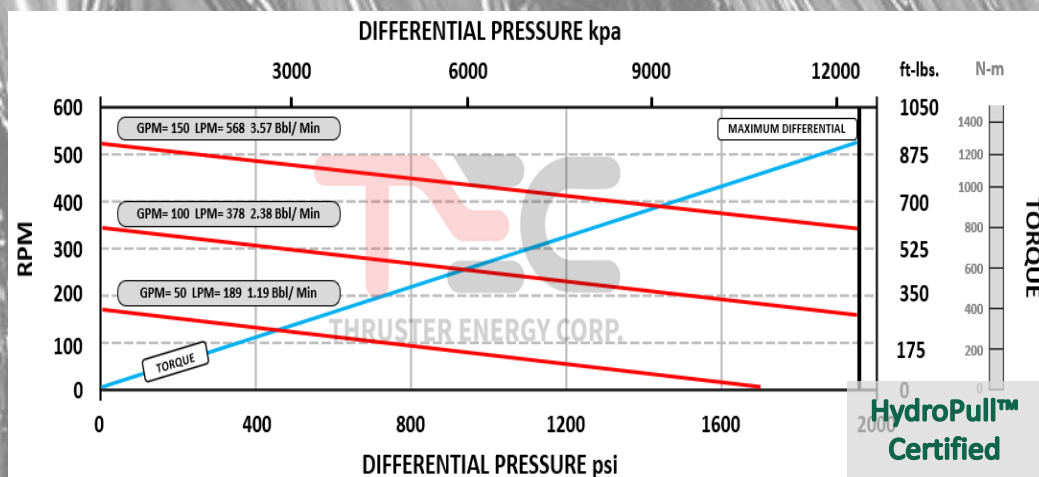
TECHNICAL SPECIFICATIONS

Overall Motor Length	13.7' (4.17m)
Overall Motor Weight	268 # (122 Kg)
Lobe Config./ Stage Count	NOT AVAILABLE
Temperature Rating	480° F (250° C)
Maximum Weight on Bit	22,500 # (10,000 daNs)

PERFORMANCE SPECIFICATIONS

Flow Range	50 - 150 GPM (189 - 568 LPM)
Speed Range RPM	183.8 - 551.4 (198.5 - 596.4)
Rev/ Unit Volume	3.676 Rev/ Gal (1.05 Rev/ Liter)
MAX Differential Pressure	1,950 PSI (13,445 kpa)
Pressure Drop ΔP	500 psi (3,448 kpa)
Full Load Torque	890 Ft-Lbs (1,206 Nm)

Compatible with oil-based muds, acids, solvents and high chloride content fluids.



****Performance curves are for reference only. Performance data and dimensions are subject to change without notice.**

Performance curves based upon Dyno Testing in ambient temperatures, and are dependent on flow rate & power section fit. Actual field performance may vary with field-operational conditions. Operating beyond the parameters given will significantly reduce the longevity of the motor's life and/ or damage.

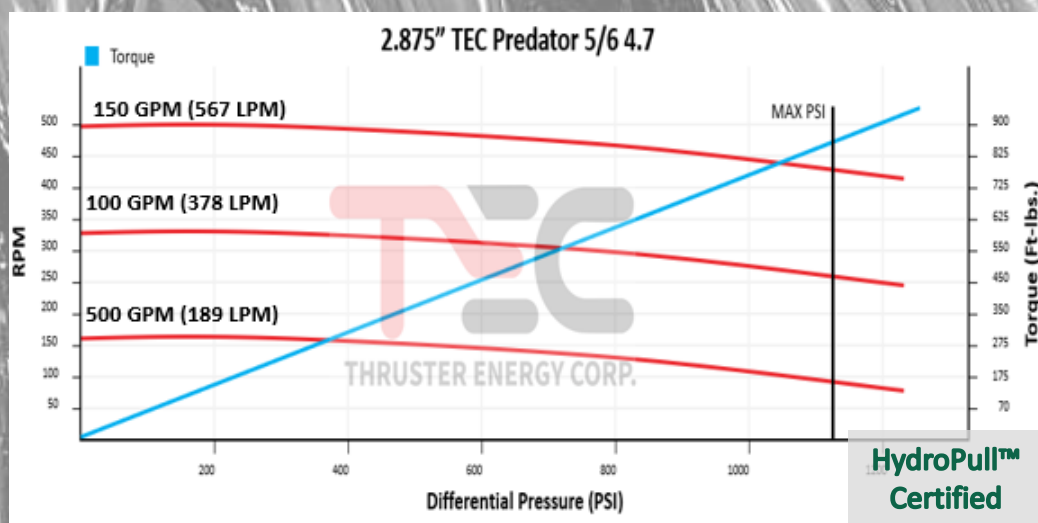
TEC MOTORS- PREDATOR MOTOR- 2.88" (73mm) 5/6 4.7 STAGE

TECHNICAL SPECIFICATIONS

Overall Motor Length	12.9' (3.92m)
Overall Motor Weight	205 # (93 Kg)
Lobe Config./ Stage Count	5/6 4.7
MAX WOB @ 100 RPM	22,000# (9,821 daNs)
MAX WOB @ 200 RPM	18,000# (8,035 daNs)
MAX WOB @ 300 RPM	16,000# (7,142 daNs)
MAX Pull at Bit to Fail Bearings	40,000# (17,857 daNs)
MAX Pull on Body to Yield	130,000# (58,035 daNs)
MAX Temp	329 °F (165 °C)

PERFORMANCE SPECIFICATIONS

Flow Range	50 - 168 GPM (190 - 636 LPM)
Speed Range RPM	170 - 550
Rotation	3.320 Rev/ Gal 0.8771 Rev/ Liter
MAX Differential Pressure	1,110 PSI (7,700 kpa)
Stall Differential Pressure	1,740 PSI (12,000 kpa)
MAX Torque	780 Ft-Lbs (1,100 Nm)
Stall Torque	1,220 Ft-Lbs (1,700 Nm)
Torque Slope	0.47 ft-lbs/ PSI (0.09 Nm/ kpa)



****Performance curves are for reference only. Performance data and dimensions are subject to change without notice. Performance curves based upon Dyno Testing in ambient temperatures, and are dependent on flow rate & power section fit. Actual field performance may vary with field-operational conditions. Operating beyond the parameters given will significantly reduce the longevity of the motor's life and/ or damage.**

TEC MOTORS- PREDATOR EV (EXTREME VELOCITY)

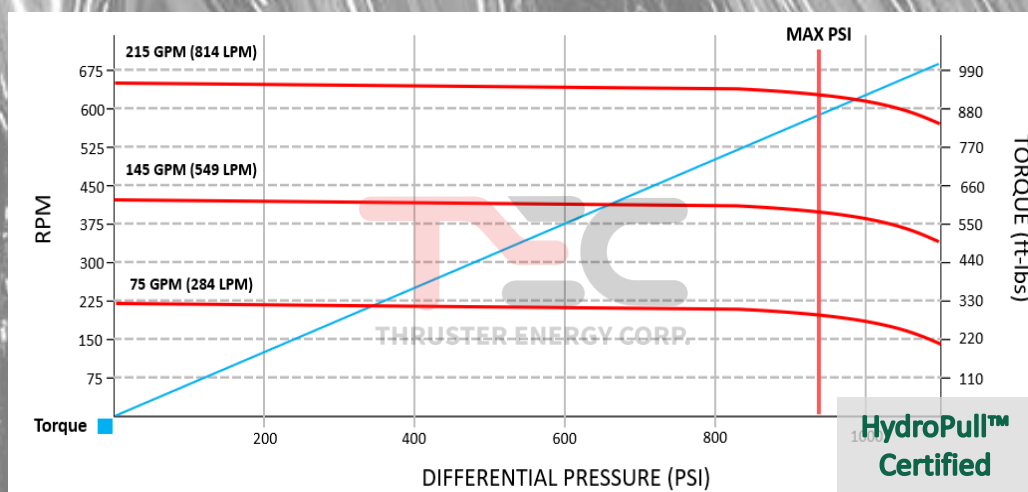
MOTOR- 2.88" (73mm)

TECHNICAL SPECIFICATIONS

Overall Motor Length	12.9' (3.92m)
Overall Motor Weight	205 # (93 Kg)
Lobe Config./ Stage Count	NOT AVAILABLE
MAX WOB @ 100 RPM	22,000# (9,821 daNs)
MAX WOB @ 200 RPM	18,000# (8,035 daNs)
MAX WOB @ 300 RPM	16,000# (7,142 daNs)
MAX Pull at Bit to Fail Bearings	40,000# (17,857 daNs)
MAX Pull on Body to Yield	130,000# (58,035 daNs)
MAX Temp	329 °F (165 °C)

PERFORMANCE SPECIFICATIONS

Flow Range	75 - 215 GPM (284 - 814 LPM)
Speed Range RPM	212 - 622
Rotation	2.965 Rev/ Gal 0.7808 Rev/ Liter
MAX Differential Pressure	952 PSI (6,563 kpa)
Stall Differential Pressure	1,496 PSI (10,314 kpa)
MAX Torque	866 Ft-Lbs (1,174 Nm)
Stall Torque	1,357 Ft-Lbs (1,839 Nm)
Torque Slope	0.93 ft-lbs/ PSI (0.19 Nm/ kpa)



****Performance curves are for reference only. Performance data and dimensions are subject to change without notice.**
Performance curves based upon Dyno Testing in ambient temperatures, and are dependent on flow rate & power section fit. Actual field performance may vary with field-operational conditions. Operating beyond the parameters given will significantly reduce the longevity of the motor's life and/ or damage.

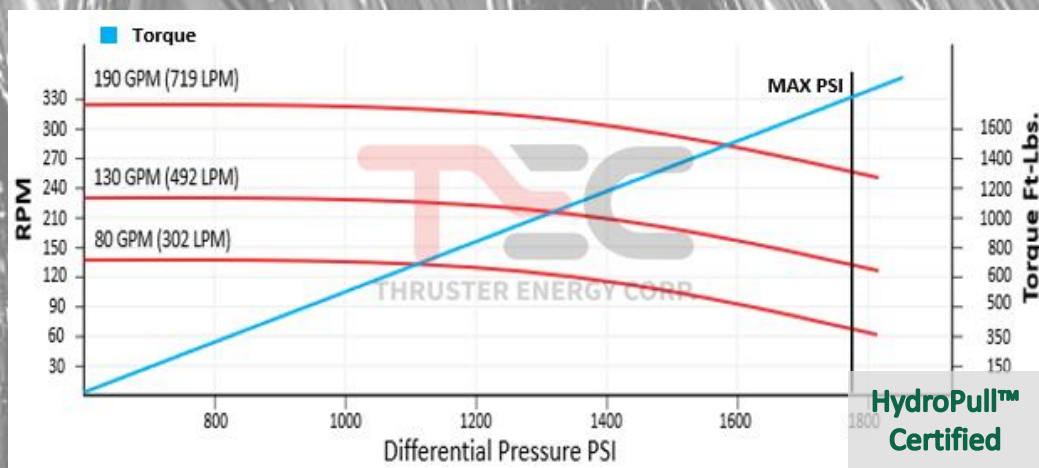
TEC MOTORS- BRUTE FORCE MOTOR- 3.13" (79mm) 7/8 3.0 STAGE

TECHNICAL SPECIFICATIONS

Overall Motor Length	14.8' (4.5m)
Overall Motor Weight	300# (136 Kg)
Lobe Config./ Stage Count	7/8 3.0
MAX WOB @ 100 RPM	21,000# (9,375 daNs)
MAX WOB @ 200 RPM	17,000# (7,589 daNs)
MAX WOB @ 300 RPM	15,000# (6,696 daNs)
MAX Pull at Bit to Fail Bearings	83,000# (37,053 daNs)
MAX Pull on Body to Yield	179,000# (79,910 daNs)
MAX Temp	320 °F (160 °C)

PERFORMANCE SPECIFICATIONS

Flow Range	80 - 190 GPM (302 - 720 LPM)
Speed Range RPM	140 - 330
Rotation	1.80 Rev/ Gal 0.4755 Rev/ Liter
MAX Differential Pressure	1,357 PSI (9,50 kpa)
Stall Differential Pressure	1,571 PSI (11,000 kpa)
MAX Torque	1,845 Ft-Lbs. (2,501 kpa)
Stall Torque	2,624 Ft-Lbs. (3,557 kpa)
Torque Slope	1.46 ft-lbs/ PSI (0.30 Nm/ kpa)



****Performance curves are for reference only. Performance data and dimensions are subject to change without notice.**

Performance curves based upon Dyno Testing in ambient temperatures, and are dependent on flow rate & power section fit. Actual field performance may vary with field-operational conditions. Operating beyond the parameters given will significantly reduce the longevity of the motor's life and/ or damage.

TEC MOTORS- BRUTE FORCE EV (EXTREME VELOCITY)

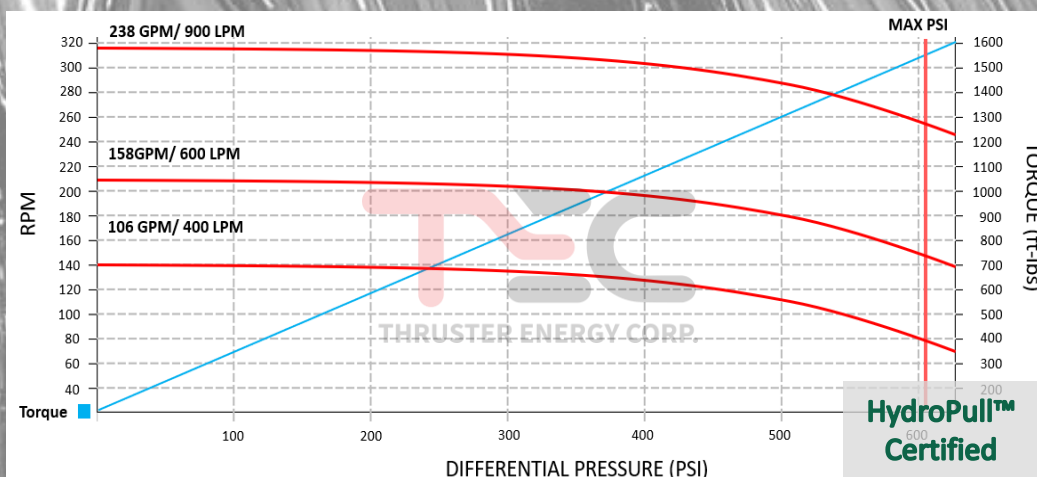
MOTOR- 3.13" (79mm)

TECHNICAL SPECIFICATIONS

Overall Motor Length	14.8' (4.5m)
Overall Motor Weight	300# (136 Kg)
Stage Count	NOT AVAILABLE
Lobe Configuration	NOT AVAILABLE
MAX WOB @ 100 RPM	21,000# (9,375 daNs)
MAX WOB @ 200 RPM	17,000# (7,589 daNs)
MAX WOB @ 300 RPM	15,000# (6,696 daNs)
MAX Pull at Bit to Fail Bearings	83,000# (37,053 daNs)
MAX Pull on Body to Yield	179,000# (79,910 daNs)
MAX Temp	320 °F (160 °C)

PERFORMANCE SPECIFICATIONS

Flow Range	108 - 251 GPM (410 - 950 LPM)
Speed Range RPM	120 - 315
Rotation	1.26 Rev/ Gal 0.35 Rev/ Litre
MAX Differential Pressure	610PSI (4,206 kpa)
Stall Differential Pressure	930 PSI (6,400 kpa)
MAX Torque	1,245 ft-lbs (1,687 Nm)
Stall Torque	1,830 ft-lbs (2,500 Nma)
Torque Slope	2.01 ft-lbs/ PSI (0.41 Nm/ kpa)



****Performance curves are for reference only. Performance data and dimensions are subject to change without notice.**
Performance curves based upon Dyno Testing in ambient temperatures, and are dependent on flow rate & power section fit. Actual field performance may vary with field-operational conditions. Operating beyond the parameters given will significantly reduce the longevity of the motor's life and/ or damage.



TEC MILLS

NEXT GENERATION MILLING TECHNOLOGY

Known for its milling prowess & gauge integrity/ OD (Outside Diameter), the BRAMA Reaper Mill is the hardest mill on the planet...period. The BRAMA Reaper Mill technology was a collaborated effort by Thruster Energy & BRAMA Carbide Services out of Nisku, Alberta to develop the Reaper Mill for high-stage count milling while still maintaining gauge integrity throughout the course of the entire job. This is essential in managing debris size. The longer the mill maintains “Gauge”, the smaller the debris is and thus easier to circulate out of the well.

The hard-coating application to the gauge area of the Reaper Mill creates an incredibly hard surface that sets it apart from the competition. The Reaper Mill is available in any size required.

- Design Benefits:
- Proprietary Hard-Coating to Gauge Area (OD) Keeps Debris Size Small & Manageable
 - Gauge OD Keeps 99% Integrity Even After High Stage Count (65+) Composite Plug Milling
 - Available in Flat Bottom, Concave, Convex & Offset Options
 - Rapid Customization Available
 - Available in All Thru Tubing Connection Types & Sizes
 - Available in Any Desired Size

TECHNICAL SPECIFICATIONS			
FISH NECK OD	STANDARD CONNECTION	TORSIONAL YIELD	TENSILE YIELD
73mm 2.875"	2-3/8" PAC	4,300 ft-lbs	63,392 daNs 142,000 lbf
79.4mm 3.125"	2-3/8" REG	4,870 ft-lbs	71,473 daNs 160,100 lbf

TEC’s world-class Taper Mills are designed specifically to deal with casing deformation or other downhole obstructions that require a different mill-type other than conventional mills. TEC has established itself as the Casing Deformation Specialists thanks in part their second-to-none Taper Mill product line. Available in a wide variety of sizes for all casing sizes and obstruction sizes. Rapid customization available.

TECHNICAL SPECIFICATIONS

FISH NECK OD	STANDARD CONNECTION	TORSIONAL YIELD	TENSILE YIELD
73mm 2.875"	2-3/8" PAC	4,300 ft-lbs	63,392 daNs 142,000 lbf
79.4mm 3.125"	2-3/8" REG	4,870 ft-lbs	71,473 daNs 160,100 lbf

TEC MILLS- REAPER POLYCRYSTALLINE DIAMOND COMPACT (PDC) BITS

TEC’s unrivalled Reaper PDC (Polycrystalline Diamond Compact) bits are designed specifically as a versatile option for milling operations to deal with minor casing deformation, cement, shale, scale, composite FRAC plugs and dissolvable FRAC plugs or other downhole obstructions that require a different mill-type other than conventional mills. TEC has established itself as the Casing Deformation Specialists thanks in part to their second-to-none arsenal of mills, & the Reaper PDC distinguishes itself with its patented Bramide CROCODILE COMPOSITE® Gauge Protection for extended strength & durability.

Available in a wide variety of sizes for all casing sizes and obstruction sizes with appropriate lead times.

- Design Features & Benefits:**
- Patented CROCODILE COMPOSITE® Gauge Protection (Diamond Crush Instead of Crush Carbide)
 - Potential for Multiple Runs Without Redress
 - Unlike Rock Bits, No Cones can be Left Down Hole
 - Ability to Hone Minor Casing Deformation Events

TECHNICAL SPECIFICATIONS

FISH NECK OD	STANDARD CONNECTION	TORSIONAL YIELD	TENSILE YIELD
73mm 2.875"	2-3/8" PAC	4,300 ft-lbs	63,392 daNs 142,000 lbf
79.4mm 3.125"	2-3/8" REG	4,870 ft-lbs	71,473 daNs 160,100 lbf



FISHING TOOLS

NEXT GENERATION MILLING TECHNOLOGY

ITCO-type Spears are designed to engage fish internally when down-hole conditions cannot allow an Overshot to retrieve the fish.

TECHNICAL SPECIFICATIONS

GRAPPLE #	TOOL JOINT OD	TENSILE YIELD	MANDREL OD/ ID	ACTUAL CATCHING RANGE			OLD NOMINAL SIZE (GRAPPLES WERE MARKED WITH THIS DESCRIPTION)
				MINIMUM ID	NOMINAL CATCH SIZE	MAXIMUM ID	
#1230	3.750" 95.25mm	132,000 lbf 58,928 daNs	2.313" (58.75mm)/ 0.375" (9.53mm)	2.28	2.328	2.375	2-3/8" ID
				2.351	2.399	2.446	2-3/8" ID - 2-7/16" ID
				2.39	2.438	2.487	2-7/8" Tbg 6.25 - 6.5# 2-7/8" D.P. 6.45#
				2.468	2.516	2.563	2.562" - 2-15/32" ID
				2.515	2.562	2.61	3-1/2" OD 15.5# D.P.
				2.593	2.641	2.688	2-11/16" - 2-5/8" ID
				2.671	2.718	2.766	3-1/2" OD 13.3 - 12.4# D.P.
				2.7	2.748	2.813	2-13/16" ID & 2-3/4" ID
				2.827	2.875	2.922	3-1/2" OD 10.2 - 11.2# D.P.
				2.843	2.891	2.938	2-7/8" - 2-15/16" ID
				2.89	2.938	2.992	3-1/2" OD 9.20# - 10.20# D.P.
				2.984	3.032	3.079	3-1/2" OD 7.70# Tbg to 8.5# D.P.
				3.03	3.078	3.125	3-1/8" - 3-1/16" ID
				3.155	3.203	3.25	3-1/4" - 3-3/16" ID
				3.297	3.345	3.392	3.340" ID - 3.382" ID 4" OD 12.50# - 15.0# D.P.
				3.437	3.485	3.532	3-1/2" ID

ITCO-type Spears are designed to engage fish internally when down-hole conditions cannot allow an Overshot to retrieve the fish.

TECHNICAL SPECIFICATIONS

GRAPPLE #	TOOL JOINT OD	TENSILE YIELD	MANDREL OD/ ID	ACTUAL CATCHING			OLD NOMINAL SIZE (GRAPPLES WERE MARKED WITH THIS DESCRIPTION)
				MINIMUM ID	NOMINAL CATCH SIZE	MAXIMUM ID	
#1348	2.875" 73mm	132,000 lbf 58,928 daNs	1.875" (47.63mm)/ 0.375" (9.53mm)	1.788	1.828	1.867	1.867" I.D. (TURN BODY DOWN)
				1.796	1.836	1.876	1.875" I.D. (TURN BODY DOWN)
				1.889	1.929	1.968	1.937" - 1.968" I.D.
				1.952	1.992	2.041	2-3/8" TUBING - 4# - 4.70#
				1.983	2.023	2.062	2.000" - 2.062" I.D.
				2.045	2.085	2.125	2-1/8" I.D.
				2.091	2.131	2.172	2-7/8" D.P. 9.75# - 10.4#
				2.170	2.211	2.250	2-1/4" - 2-3/16" I.D.
				2.186	2.226	2.266	2-17/64" I.D.
				2.233	2.273	2.312	2-5/16" I.D.
				2.249	2.289	2.329	2-7/8" O.D. D.P. 7.80# - 8.35#
				2.295	2.335	2.375	2-3/8" I.D. NX 1/2 DRILL ROD
				2.358	2.398	2.438	2-3/8" I.D. & 2-7/16" I.D.
				2.390	2.430	2.469	2-7/8" TBG 6.25# - 6.5#, 2-7/8" * O.D. 6.45# BX
				2.420	2.460	2.500	2-7/16" I.D. & 2-1/2" I.D.
				2.556	2.596	2.625	2-5/8" I.D. & 2-9/16" I.D.
				2.608	2.648	2.688	2-5/8" I.D. & 2-11/16" I.D.
				2.670	2.710	2.750	2-3/4" I.D.
				2.921	2.961	3.000	3.000" I.D. & 2-5/16" I.D. NX DRIVE CASING
				3.046	3.086	3.126	3-1/16" I.D. & 3-1/8" I.D.
				3.170	3.210	3.250	3-1/4" I.D. & 3-3/16" I.D.
				3.264	3.304	3.344	3-11/32" I.D. & 3-9/32" I.D.

The GS Pulling Tool is specifically designed for Coiled Tubing Fishing Operations and to engage with standard GS fish necks. The latching mechanism is a robust dog/ core design which releases positively from the internal fish neck when a hydraulic differential is applied to the tool. Does not require drop balls or shear pins as the differential pressure required to activate the spear is provided by circulating through a choke inserted internally.

TECHNICAL SPECIFICATIONS

TOOL OD (in)	CONNECTIONS	TENSILE YIELD	CHOKE ID	LENGTH	WORKING PRESSURE
3.00" GS	2-3/8" PAC	53,571 daNs/ 120,000 lbf	1/4"	18"	68.9 MPa 10,000 PSI
2.50" GS	1-1/2" AMMT	30,803 daNs/ 69,000 lbf	1/4"	16"	68.9 MPa 10,000 PSI
2.00" GS	1.00" AMMT	16,071 daNs/ 36,000 lbf	1/8"	17.3"	48.3 MPa 7,000 PSI
1.50" GS	1.00" AMMT	11,160 daNs/ 25,000 lbf	1/8"	16"	48.3 MPa 7,000 PSI

Rope Spears are designed for retrieving wire line cable through restrictions or wire that has become “balled up”. The design incorporates uni-directional barbs on the ID only (manufactured from high-tensile steel) so that the prongs may be forced down into or around a reasonably compacted ball of wire. Cable on the outside of the tools may be easily pulled down rather than having to yield the wire creating smaller, unfishable sections.

- DESIGN BENEFITS:
- Rope Spears will Fish Through Restrictions
 - Tool will Fish Balls of Wire Without Creating Smaller, Severed Pieces of Wire
 - High-Tensile Steel
 - Can be used in Conjunction with Hailey’s Indexing Tool

TECHNICAL SPECIFICATIONS			
FISH NECK OD	TOOL OD	STANDARD CONNECTION	TENSILE YIELD
73mm 2.875"	98.mm 3.875"	2-3/8" PAC	63,392 daNs 142,000 lbf

Designed specifically to firmly engage and retrieve portions of a fish too short to be latched with conventional catch Overshots and where hole conditions prevent swallowing the Overshot past the fish.

Each Overshot has a specific MAX Catch size yet may be dressed with an under-size Grapple to engage any smaller diameter fish as well.

OPERATION: Identical to 150 Series Overshots, slowly lower the Overshot over the fish while maintaining slow right hand rotation (See Hailey’s Indexing Tool & ANGLER Fishing motor Spec Sheets) to make engagement with the fish profile; to release set down heavy weight sharply (bump), and then slowly raise the fishing string while simultaneously rotating the fishing string to the right (Jointed Pipe Operations).

TECHNICAL SPECIFICATIONS					
GRAPPLE NUMBER	MAXIMUM CATCH		STANDARD OVERSHOT OD	LOAD CAPACITY AT YIELD POINT	
	In.	mm.	In./ mm.	WITHOUT STOP	WITH STOP
17618	2-1/2"	63.5mm	3-.625" / 92.08mm	263,600 lbf 11,678 daNs	-
13538	2-5/8"	66.7mm	3.750" / 95.25mm	239800 lbf 107,053 daNs	239800 lbf 107,053 daNs

**OTHER SIZES AVAILABLE UPON REQUEST*

The 150 Series Overshot is a carefully engineered unit, designed to externally engage, pack-off and retrieve a fish. The grapples engage a positive latch over a large area of the fish and is therefore capable of withstanding extremely heavy pulling, torsional and jarring strains without damage or distortion to either the tool or the fish.

Each Overshot is designed to engage a specific MAX Catch size, and are designed to retrieve tool joints, drill collars, couplings, pipe, tubing, coiled tubing or smooth tools up to the MAX Catch size and smaller for the Overshot selected.

TECHNICAL SPECIFICATIONS

GRAPPLE NUMBER	MAXIMUM CATCH		OVER SHOT OD	LOAD CAPACITY @ YIELD POINT		
	SPIRAL	BASKET		SPIRAL	BASKET	
	In. (mm)	In. (mm)			WITHOUT STOP	WITH STOP
9272	2-7/8" 73mm	2-19/32" 65.9mm	3.625" 92.08mm	193,500 lbf 86,838 daNs	157,400 lbf 70,267 daNs	78,700 lbf 35,133 daNs
37590	3-1/16" 77.8mm	2-11/16" 68.3mm	3.750" 95.25mm	217,700 lbf 97,187 daNs	221,200 lbf 98,750 daNs	179,700 lbf 80,223 daNs
1837	3-1/8" 79.4mm	2.625" 66.7mm	3.875" 98.4mm	155,100 lbf 69,241 daNs	144,200 lbf 64,375 daNs	98,000 lbf 43,750 daNs
3607	3-1/2" 88.9mm	2-7/8" 73mm	4.375" 111mm	267,400 lbf 119,375 daNs	220,700 lbf 98,526 daNs	144,300 64,419 daNs
6662	3-21/32" 92.9mm	3-1/8" 79.4mm	**4-11/16" 119.06mm	332,000 lbf 148,214 daNs	279,000 lbf 124,553 daNs	199,500 lbf 189,062 daNs

**CAN BE SHAVED DOWN TO 4-1/2" (114.3mm) OD TO CATCH LARGER OD FISH

FISHING TOOLS- HAILEY'S INDEXING TOOL (YANKEE SCREWDRIVER)

The Rotating Indexing Tool, aka Yankee Screwdriver, is a fully mechanical fishing Index Tool that can provide a full rotation per stroke with no minimum set down force requirement.

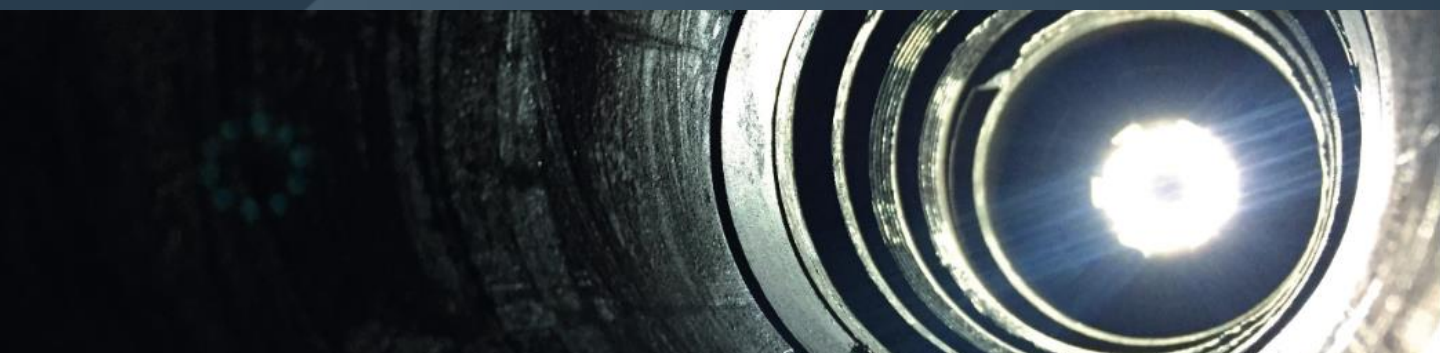
- Design Features:**
- Available in 1-11/16" (42.9mm) – 2-7/8" (73mm)
 - No Setting or Adjustment is Required
 - Zero Force Activation
 - 360° Rotation Per Stroke
 - Custom Indexing Options Available Including Left Hand Turn
 - Custom Rotation Degrees

TECHNICAL SPECIFICATIONS

TOOL OD	TOOL ID	CONNECTION	OVERALL LENGTH	MAX DETENT WORKING LOAD	TENSILE YIELD	TORSIONAL YIELD	TOTAL STROKE LENGTH
1.690" 42.9mm	1/2" 12.7mm	1" AMMT	47" 1.19m	2,000 lbf 892 daNs	42,900 lbf 19,151 daNs	585 ft-lbs	12" 0.30m
2.125" 54mm	5/8" 15.9mm	1-1/2" AMMT	57.5" 1.46m	16,000 lbf 7,142 daNs	55,000 lbf 24,553 daNs	1,200 ft-lbs	12" 0.30m
2.875" 73mm	1" 25.4mm	2-3/8" PAC	59" 1.49m	30,000 lbs 13,392 daNs	100,000 lbf 44,642 daNs	3,200 ft-lbs	12" 0.30m
3.125" 79.4mm	1-11/16" 42.9mm	2-3/8" REG	59" 1.49m	36,000 lbf 16,071 daNs	122,000 lbf 54,464 daNs	3,800 ft-lbs	12" 0.30m

OPTIS® VIDEO WHILE FISHING

The integration of EV's high definition, high frame rate memory camera with Thruster Energy's range of overshot tools, provides a diagnostic fishing service that increases the efficiency and success rate of complex fishing operations.



Footage from inside the Camera Overshot showing wireline wrapped around the Fish Top preventing it from entering the fishing grapple.

SPECIFICATIONS

Diameter	3.625 in	92.0 mm
Length	87 in	2200 mm
Pressure Rating	10,000 psi	690 bar (68.9 MPa)
Temperature Rating	257 °F	125 °C
Overshot Model	Bowen 150 Series - 9272	
Connection Type	2-3/8" REG Box	
Flow Rate	Up to 6 bbl/min	Up to 0.95 m ³ /min
Max Catch Range	2.875 in	73 mm
Tensile Strength	180,000 lbs	800,000 N
Camera Type	Full Color, Down view	
Video Frame Rate	30 fps	
Recording Time	Up to 5 hours with up to 60 programmable intervals	
Power	Lithium or Alkaline Batteries	





CABLE HEADS

NEXT GENERATION MILLING TECHNOLOGY

TEC’s E-Coil Cable Head is designed for Coiled Tubing E-Coil Operations and connects to the wireline inside of the Coiled Tubing and the Coiled Tubing itself. Job Scopes include logging, perforation guns, down-hole camera/ ultrasound applications as well as Smart Coil applications.

There is a termination point for the wireline and gives an electrical connection to the subsequent tool being ran in the well. The lower Pack-Off creates a chamber which allows the wireline to be terminated to a standard electrical connection that is not affected by wellbore/ pumped fluid.

The E-Coil Cable Head is designed with a shock-mounted dual-activated disconnect, which serves as an emergency release in case the tools become stuck in the well. Well control is performed through the double-flapper check valves.

Design Features

- Pressure Rated to 10,000 PSI (68.9 MPa)
- Shroud Available to Run with a Camera to Direct Flow to the End of the Camera
- Pump-Thru Design
- Well Control
- Dual-Activated Release Tool
- Temp Rated to 302° F/ 150° C

TECHNICAL SPECIFICATIONS (2.5 STUB ACME)

TEMP	TENSILE YIELD	TORSIONAL YIELD	MAX WORKING PRESSURE
302° F 150° C	103,000 lbf 46,000 daNs	1,900 ft-lbs	10,000 PSI 68.9 MPa

TECHNICAL SPECIFICATIONS (GO PIN)

TEMP	TENSILE YIELD	TORSIONAL YIELD	MAX WORKING PRESSURE
302° F 150° C	66,000 lbf 25,900 daNs	300 ft-lbs	10,000 PSI 68.9 MPa

TEC’s 2.875” Flow-Release Tool is designed to work with the TEC 2.875” Cable Head Tool.

The design of the Flow-Release Tool requires the operator to perform two concurrent operations in order to release from the BHA, first through a pre-determined flow rate followed by an overpull exceeding the shear value of any combination of brass or steel shear pins.

- ### Design Features
- Shear Pin configuration easily calibrated at the field level
 - Two-step operation to release from the BHA, giving the operator full strength to pull or push the BHA to its maximum parameters of the BHA if necessary
 - Designed to withstand extreme environments during Perforating Operations

TEMP RATING	TENSILE YIELD	MAX WORKING PRESSURE	SHEAR VALUE PER PIN (BRASS)	SHEAR VALUE PER PIN (STEEL)
150° C 302° F	42,300 daNs 42,300 lbf	68.9 MPa 10,000 PSI	1,900 PSI	3,600 lbf



SURFACE EQUIPMENT

NEXT GENERATION MILLING TECHNOLOGY

SURFACE EQUIPMENT- SAFETY CLAMP (DOG COLLAR)

The T-Type Safety Clamp (Dog Collars) help guard against dropping flush-joint pipe, tool strings, stream-lined collars, etc. into the hole while making/ breaking the tool string. These clamps are ideal as an emergency elevator shoulder for lifting items which have no shoulders for attaching conventional elevators. Can also be used in conjunction with a C-Plate as redundancy for holding the hanging weight when Blow Out Preventer's Slip Rams are activated on a string, during an emergency coiled tubing splice operation above the BOPs. In this scenario it is good practice to use (2) Safety Clamps, one on top of the other.



Gripping pressure is always uniform around the pipe so there is little chance of crushing thin-walled pipe or damaging the surface of the pipe/ tool. Each link has a tapered slip and is interchangeable as a unit, making it readily adaptable to several sizes, from 1-1/8" – 4-1/2" OD tools/ pipe. Each link changes the effective working range approximately 1.00" in diameter. For sizes larger than 4-1/2" OD, the C-Type Safety Clamp must be used.

TEC designs & manufactures a variety of Lifting Subs to allow the safe handling of heavy tools. They are designed to accept shackles which are certified for the anticipated loads. Lifting Subs are commonly used in pressure deployment operations where long BHAs are used.



TECHNICAL SPECIFICATIONS		
STANDARD CONNECTIONS	TENSILE YIELD	SHACKLE SIZE
1.00" AMMT	21,875 daNs 49,000 lbf	3.25 Ton x 19mm Pin Diameter
1-1/2" AMMT	31,584 daNs 70,750 lbf	4.75 Ton x 22mm Pin Diameter
2-3/8" PAC	40,178 daNs 90,000 lbf	4.75 Ton x 22mm Pin Diameter

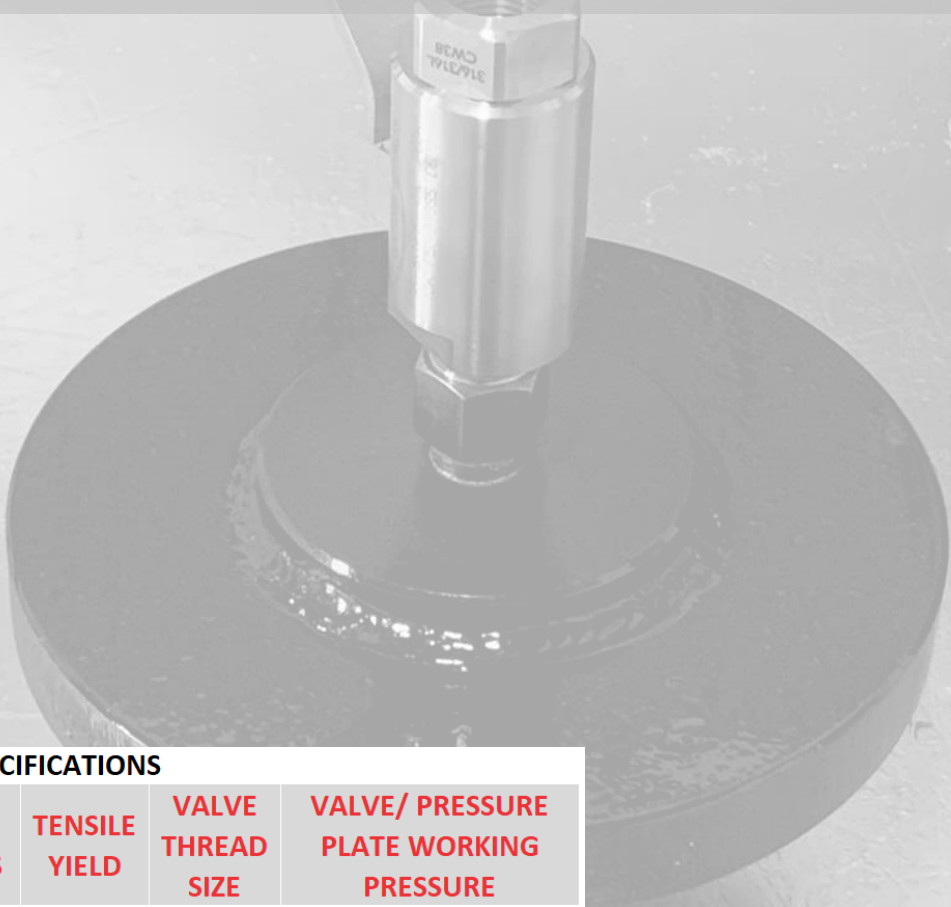
Design Features:

- Simple, One-Piece Design
- Designed to Accept Load-Rated/ Specific Shackles

Note:

- Other Sizes & Connections Available Upon Request
- Other Shackle Sizes Available Upon Request

TEC designs & manufactures their own Pull/ Pressure plates, used for confirming the Coiled Tubing Connectors are properly installed by the user. The “Plate” itself threads onto the connection of the Connector, and is used as something to pull against with the CTU’s injector against the bottom of their lubricator, testing that the Connector will not pull out of the Coiled Tubing. The valves is used to pressure up the Coiled Tubing to ensure the Connector has an intimate fit with the Coiled Tubing and can maintain a high pressure seal throughout the entire operation.



TECHNICAL SPECIFICATIONS

STANDARD CONNECTIONS	TENSILE YIELD	VALVE THREAD SIZE	VALVE/ PRESSURE PLATE WORKING PRESSURE
1.00" AMMT	21,875 daNs 49,000 lbf	1/2" NPT	68.9 MPa 10,000 PSI
1-1/2" AMMT	31,584 daNs 70,750 lbf	1/2" NPT	68.9 MPa 10,000 PSI
2-3/8" PAC	40,178 daNs 90,000 lbf	1/2" NPT	68.9 MPa 10,000 PSI

The Kureha Degradable Frac Plug (KDP) is designed to eliminate the risk of costly plug mill-out operations. It is manufactured from the industry's original degrading material that is field-tested and highly suitable for frac plug material. The KDP hybrid design includes the degradable polymer (Polyglycolic acid, PGA) and dissolvable sealing element that predictable degrade to provide a clear wellbore for production without intervention, and assist in reaching longer laterals that coiled tubing cannot reach.

KDP has the advantages of:

- Reliable run/ frac performance
- Stable degradation

KDP can save, lower or eliminate:

- Coil unit cost
- Equipment rental cost
- Flowback cost
- Associated tools cost
- Man Hours
- TRIR
- Time of mill out
- Time of waiting coil unit
- Stuck risk
- Frequency of trips/ short trips

Performance

- Suitable for up to 10,000 psi (68.9 MPa) frac pressure for BHTs of 125° F – 325° F (51° C – 163° C)
- Degrades without any trigger (acid or salt) of degradation
- More stable and predictable degradability compared with metal plugs

Reliability & Suppliability

- High quality with integrated production from materials
- Successful run history
- Covered by U.S. patents and pending patent applications owned by Kureha Corporation

Options

- Ball-in-place options
- Optional pump-down wipers available

Features & Benefits:

- Standard, low, ultra-low and extra-low temperature grades available
- 500 ft/ min (152 m/ min) and 18 bbl/ min (2.86 m³/ min) run-in speeds
- Bottom-set shear-off eliminates tensile loading
- Large ID area to accommodate immediate flow back
- Utilizes standard industry setting tools
- Optional pump-down rings available

Polyglycolic acid

- Degrades without any trigger
- Stable degradation

Dissolvable sealing element

- Degrades without any trigger
- Stable degradation

Dissolvable metal slips

- Optimized metal composition to degrade in fresh water
- Large surface area design for fast and stable degradation

