Schlumberger

Equipment Sales Catalog

Bits and Drilling Tools

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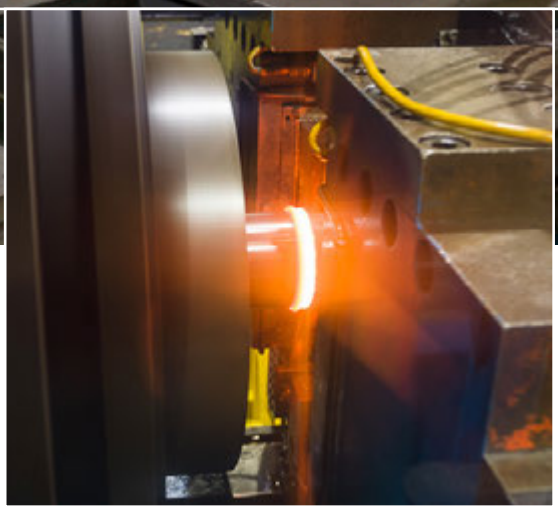
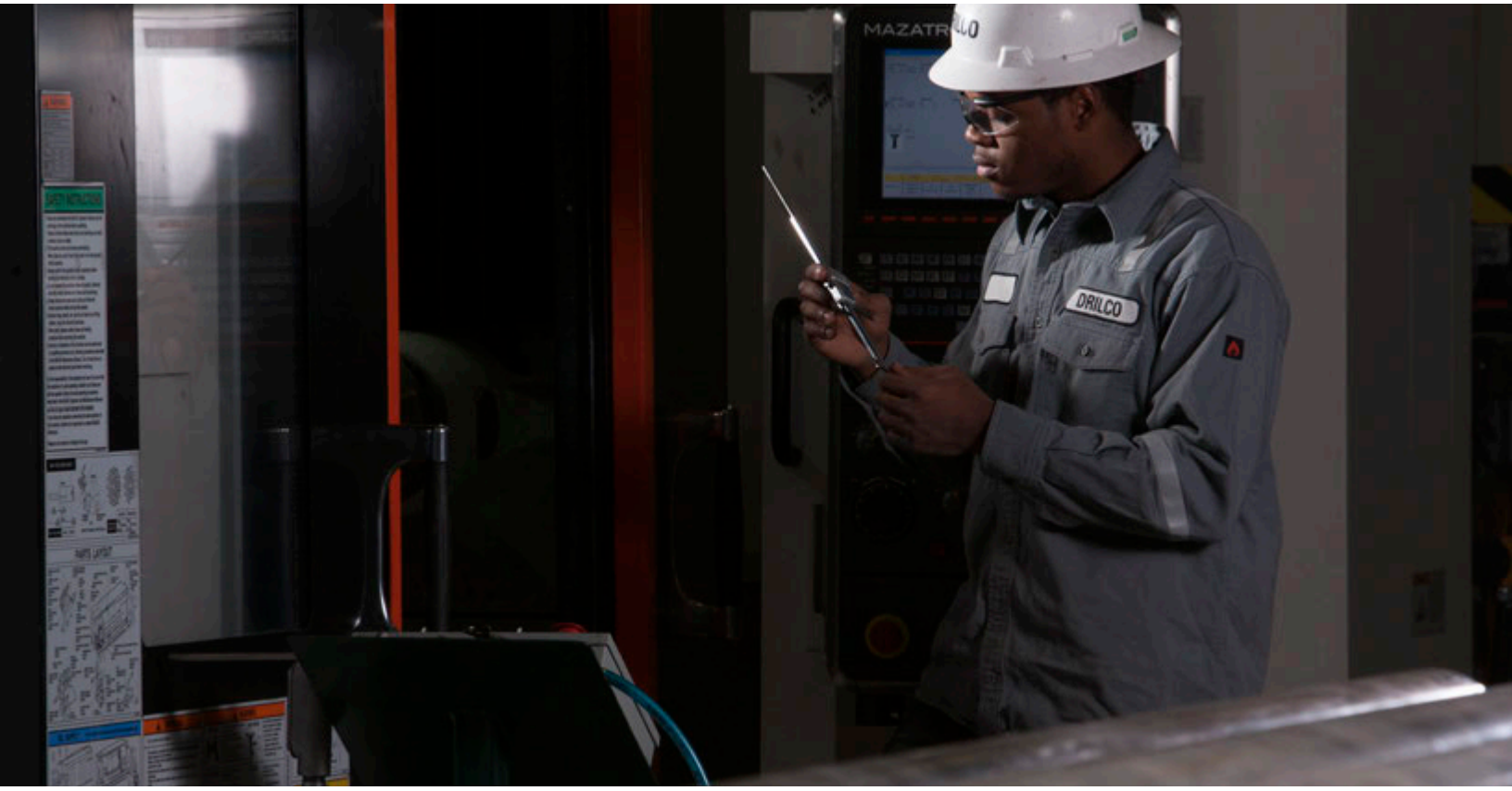


Manufactured in Accordance with
API, NS-1™, or Customer Guidelines

Drill Collars Customized for Trouble-Free BHA Performance

Because drill collars are the most common components of BHAs and the most essential to overall performance, DRILCO* inspection services help manufacture them to specifications more stringent than API requirements. The care that Schlumberger takes in materials specification, heat treatment, machining, and inspection is reflected in the performance of every DRILCO services drill collar. Our representatives can help in the selection of optimal connections and optional features for trouble–free BHA performance.



Advantages of standard features

- Materials conform to standard industry specifications, including API Specification 7-1, NS-1z, and individual customer specifications, as required
- Surface finishes are rolled, milled, or machined
- Critical threaded section has a hardness range of 285 to 341 BHN and a guaranteed Charpy impact value of 40 ft.lbf at room temperature 1 in below the surface.
- Rotary-shouldered connections are manufactured to API Specification 7-1 or DRILCO services premium connection specifications.
- Rigorous quality assurance checks during manufacturing include ultrasonic testing after heat treating.
- Phosphate-coated connections protect from the elements after machining and help prevent galling at initial makeup.
- Cold-rolled thread roots on API and H90 connections (excluding the 2.38- and 2.88-in Reg and slimline H90) compress the fibers in the thread root and make this area of the connection more fatigue resistant.
- Pressed-steel thread protectors are supplied for all drill collars equipped with standard connections.

Advantages of optional features

Slip and elevator recesses, which can be provided together or separately, eliminate lift subs and safety clamps to reduce drill collar handling time. Schlumberger machines smooth radii free of tool marks. Cold rolling the radii at the upper shoulder of each recess extends the fatigue life of the drill collar.

An API stress-relief groove on the pin and an API bore back box are recommended for all downhole tools where fatigue can occur as a result of bending. Unengaged threads are removed in highly stressed areas of the drill collar connection so that bending occurs in areas with smooth surfaces that are free of stress concentrations. Consequently, the connection is less likely to crack because of fatigue.

Note: Stress relief features are not common for connections on drill collar sizes NC 38 and smaller.

When differential sticking is a problem, spiral drill collars reduce the area of contact between the drill collar and the borehole wall.

Drill collar hardbanding is the most effective means of retarding the wear of the collar OD that occurs during normal openhole drilling. Standard hardbanding material consists of granular tungsten carbide that is added to the molten weld puddle to obtain uniform distribution of tungsten carbide particles. The resulting deposit is flush to 0.03 in beyond the collar OD. Hardbanding should not be applied to the box end unless the drill collar has been equipped with a slip recess because hardbanding will cover the normal slip area.

Note: The 4.75-in-OD drill collar is the smallest diameter that can be hardbanded.

Drill collar weight, sizing, and stiffness

Drilling weight is the primary application of drill collars. The buoyed weight of a typical drill collar string is approximately 15% more than the maximum WOB required for optimal bit performance, ensuring that enough drill collars are run in compression to maintain the neutral point within the drill collar string.

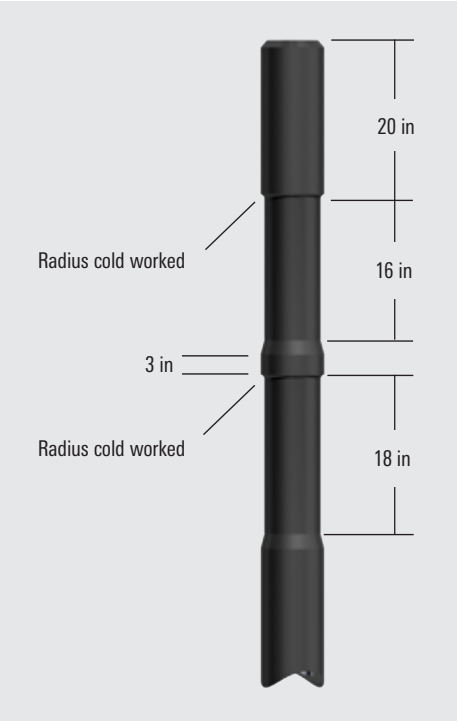
Proper drill collar sizing results in improved borehole integrity to run the desired casing size to bottom. The drill collar limits the lateral movement of the drill bit in the absence of larger-diameter drilling tools.

Drill collar stiffness is important for drilling and maintaining a straight wellbore, with the highest impact at the first 90 ft of BHA above the bit where drill collar stiffness should be optimized. Please refer to the *DRILCO Drilling Assembly Handbook* for more information.

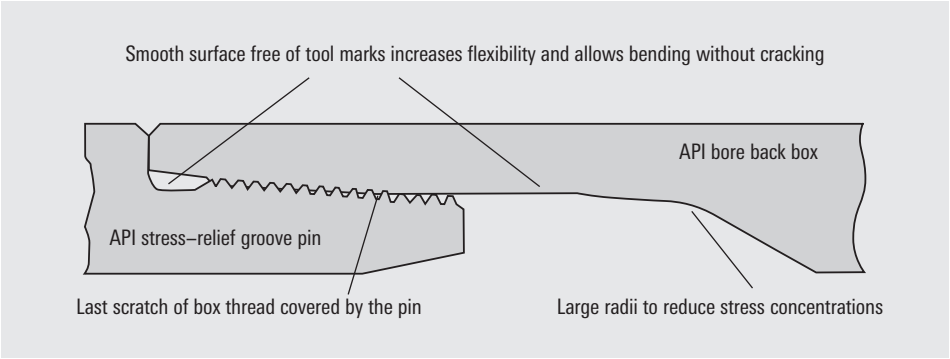
Note: Drill collars are available in both standard and spiral designs.

Standard drill collar.

Spiral drill collar.



Slip– and elevator–recess option. Slip and elevator recesses may be used together or separately.



Stress–relief option.

Drill Collar Specifications

Drill Collar Connection Size and Type, in	Minimum OD, in [cm]	Bore, in [cm]	Length, ft [m]	Bending Strength Ratio†	Drill Collar Weight, lbm [kg]
NC 26 (2.38 IF)	3.50 [8.89]	1.50 [3.81]	30 [9.14]	2.42:1	801 [363]
NC 31 (2.88 IF)	4.13 [10.48]	2 [5.08]	30 [9.14]	2.43:1	1,041 [472]
NC 38 (3.50 IF)	4.75 [12.07]	2.25 [5.72]	31 [9.45]	1.85:1	1,451 [658]
NC 38 (3.50 IF)	5 [12.70]	2.25 [5.72]	31 [9.45]	2.38:1	1,652 [749]
NC 44	6 [15.24]	2.25 [5.72]	31 [9.45]	2.49:1	2,561 [1,161]
NC 44	6 [15.24]	2.81 [7.14]	31 [9.45]	2.84:1	2,353 [1,067]
NC 44	6.25 [15.88]	2.25 [5.72]	31 [9.45]	2.91:1	2,806 [1,273]
NC 46 (4 IF)	6.25 [15.88]	2.81 [7.14]	31 [9.45]	2.63:1	2,598 [1,178]
NC 46 (4 IF)	6.50 [16.51]	2.25 [5.72]	31 [9.45]	2.76:1	3,085 [1,399]
NC 46 (4 IF)	6.50 [16.51]	2.81 [7.14]	31 [9.45]	3.05:1	2,877 [1,304]
NC 46 (4 IF)	6.75 [17.15]	2.25 [5.72]	31 [9.45]	3.18:1	3,364 [1,526]
NC 50 (4.50 IF)	7 [17.78]	2.25 [5.72]	31 [9.45]	2.54:1	3,643 [1,652]
NC 50 (4.50 IF)	7 [17.78]	2.81 [7.14]	31 [9.45]	2.73:1	3,434 [1,558]
NC 50 (4.50 IF)	7.25 [18.42]	2.81 [7.14]	31 [9.45]	3.12:1	3,714 [1,685]
NC 56	8 [20.32]	2.81 [7.14]	31 [9.45]	3.02:1	4,675 [2,121]
6.63 Reg	8 [20.32]	2.81 [7.14]	31 [9.45]	2.60:1	4,675 [2,121]
6.63 Reg	8.25 [20.96]	2.81 [7.14]	31 [9.45]	2.93:1	5,016 [2,275]
7.63 Reg	9.50 [24.13]	3 [7.62]	31 [9.45]	2.81:1	6,727 [3,051]
7.63 Reg‡	9.75 [24.77]	3 [7.62]	31 [9.45]	3.09:1	7,130 [3,234]
8.63 Reg‡	11 [27.94]	3 [7.62]	30 [9.14]	2.78:1	8,970 [4,069]

† Ratio of box-to-pin section modulus. See API RP7G for explanation.

‡ Low-torque face.

Other sizes and connections are available. Optional features are available upon request. The 4.75-in OD drill collar is the smallest diameter that can be hardbanded. The weight of a round drill collar will be reduced by approximately 4% by spiral conversion.

When ordering, please specify

- drill collar OD
- drill collar bore ID
- drill collar length
- size, type, and location of connections (e.g., NC 50 box up × NC 50 pin down)
- cast or pressed-steel thread protectors
- hardbanding (see the hardbanding section in this catalog for available options).

Hevi-Wate Transition Drillpipe

Hevi–Wate* transition drillpipe—the industry standard for an intermediate–weight drillstem member—is available in standard, spiral, and nonmagnetic designs for use in a number of applications. Designed and built for easier handling by the rig crew, Hevi–Wate drillpipe uses a unique center upset wear pad or spiral to increase tube life while reducing hole drag and differential sticking problems.

Advantages of standard features

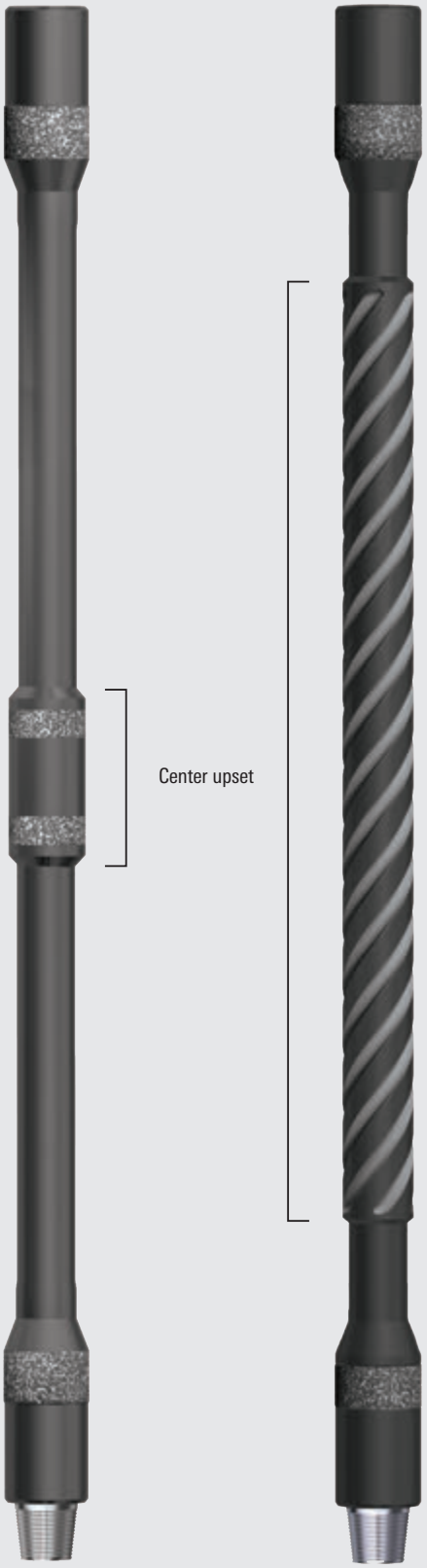
- Materials conform to standard industry specifications, including API Specification 7-1, NS-1, and individual customer specifications, as required
- Long tool joints provide ample space to recut connections, reduce OD wear rate, and extend service life
- Unique center upset or wear pad protects the tube from OD wear and increases its life by keeping it away from the borehole wall while reducing hole drag and the risk of differential sticking
- Standard API bore back box for the box connection on 4-in Hevi-Wate drillpipe and larger extends the service life of connections
- Cold-rolling of the thread roots on all connections increases the ability to resist fatigue cracking
- Drillpipe can be picked up with the drillpipe elevators for fast, efficient handling on the rig floor

Advantages of optional features

- Hardbanding placed on the tool joints and center wear pad increases abrasion resistance and extends service life
- An API stress-relief groove can be placed on the pin connections for 4-in joints and larger

Applications

- Directional drilling
- Vertical drilling
- Transition zone drilling
- Tapered drillstrings
- Remedial operations
- Jar placement
- Hydraulic improvements



Spiral Hevi-Wate transition drillpipe

Designs for a variety of applications

Hevi-Wate transition drillpipe is designed for use in a variety of applications, providing many benefits for operators.

In extended-reach, horizontal, and conventional directional wells, Hevi-Wate drillpipe can serve as an effective WOB member. It improves directional control because of reduced torque and drag, and the center upset helps reduce the risk of differential sticking.

Hevi-Wate drillpipe can serve as an active WOB member in place of a portion of the drill collar string to reduce torque and shorten trip time when drilling vertical wells. It can also provide part of the anticipated drilling weight when using soft-formation PDC bits. Hevi-Wate drillpipe is not recommended to provide WOB in vertical holes larger than specified in the following table.

Running 18 to 21 joints of Hevi-Wate drillpipe above drill collars reduces the risk of drillpipe fatigue failure in transition zones.

Hevi-Wate drillpipe is recommended for use in the crossover area of a drillstring when the bending strength ratio between the drill collars and the drillpipe exceeds 5.5. It provides a gradual transition in stiffness between the drill collars and drillpipe, reducing fatigue damage to the drillpipe. Refer to the table, "Hevi-Wate Transition Drillpipe Bending Strength Ratios," to find the maximum drill collar size that can be run directly below Hevi Wate drillpipe and to the *DRILCO Drilling Assembly Handbook* for additional information.

Hevi-Wate drillpipe provides the weight required in milling, underreaming, and hole-opening operations.

Well-suited for jar placement, Hevi-Wate drillpipe uses a sufficient number of joints below the jar to ensure that the jar is not in the transition zone and that 20% of the recommended jar overpull is above the jar in areas where differential sticking is a problem.

Hevi-Wate drillpipe can reduce drillstring pressure losses when it replaces part of the drill collar string in hole sizes ranging from 6 to 8.75 in and where drill collar bore size is relatively small.

A variety of abrasion-resistant materials is available for standard hardbanding applications, including

- pin—5 in of hard metal applied flush with the OD at the pin end
- box—4 in of hard metal applied flush with the OD and 1 in on the taper at the box end
- center upset—two 3-in bands applied to each end at upset OD.

Nonmagnetic Hevi-Wate drillpipe enables isolating MWD tools from the undesirable effects of drillstring magnetic interference. This intermediate-weight drillstring member is manufactured with stringent material specifications to ensure the low magnetic permeability required for nonmagnetic downhole drilling tools. It has corresponding drillpipe dimensions and can be picked up with the drillpipe elevators for fast, efficient handling on the rig floor. Nonmagnetic Hevi-Wate drillpipe is a special-order product that meets specific requirements.

Hevi-Wate Transition Drillpipe Specifications—Standard and Spiral

Nominal Size, in [mm]	Tube					Mechanical Properties Tube Section		Tool Joint			
	Nominal Tube Dimensions			Center Upset OD, in [mm]	Elevator Upset OD, in [mm]	Tensile Yield, lbf [N]	Torsional Yield, ft.lbf [N.m]	Connection Size and Type	OD, in [mm]	ID, in [mm]	Tensile Yield, lbf [N]
	ID, in [mm]	Wall Thickness, in [mm]	Area, in^2 [cm^2]								
3.50 [89]	2.25 [57]	0.63 [16]	5.65 [36.45]	4 [102]	3.63 [92]	310,475 [1,381,000]	18,460 [25,030]	NC 38 (3.50 IF)	4.75 [121]	2.38 [60]	675,045 [3,003,000]
4 [102]	2.56 [65]	0.72 [18]	7.41 [47.81]	4.50 [114]	4.13 [105]	407,550 [1,813,000]	27,635 [37,470]	NC 40 (4 FH)	5.25 [133]	2.69 [68]	711,475 [3,164,000]
4.50 [114]	2.75 [70]	0.88 [22]	9.97 [64.32]	5 [127]	4.63 [118]	548,075 [2,438,000]	40,715 [55,200]	NC 46 (4 IF)	6.25 [159]	2.88 [73]	1,024,500 [4,557,000]
5 [127]	3 [76]	1 [25]	12.57 [81.10]	5.50 [140]	5.13 [130]	691,185 [3,075,000]	56,495 [76,600]	NC 50 (4.50 IF)	6.63 [168]	3.06 [78]	1,266,000 [5,631.000]
5.50 [140]	3.38 [86]	1.06 [27]	14.81 [95.55]	6 [152]	5.63 [143]	814,660 [3,624,000]	74,140 [100,520]	5.50 FH	7 [178]	3.50 [89]	1,349,365 [6,002,000]
6.63 [168]†	4.50 [114]	1.06 [27]	18.57 [119.81]	7.13 [181]	6.75 [171]	1,021,185 [4,542,000]	118,845 [161,130]	6.63 FH	8 [203]	4.63 [118]	1,490,495 [6,630,000]

†OD size 6⅝-in references API only. The NS-1 qualification references OD sizes less than 6⅝ in.

Hevi-Wate Transition Drillpipe Specifications—Standard and Spiral (Continued)

Nominal Size, in [mm]	Tool Joint			Approximate Overall Length, ft [m]
	Torsional Yield, ft.lbf [N.m]	Makeup Torque, ft.lbf [N.m]	Approximate Overall Length of Pin/Box, in [mm]	
3.50 [89]	17,575 [23,830]	10,000 [13,560]	30/27 [762/686]	31 [9.45]
4 [102]	23,525 [31,900]	13,300 [18,030]	30/27 [762/686]	31 [9.45]
4.50 [114]	38,800 [52,610]	21,800 [29,560]	30/27 [762/686]	31 [9.45]
5 [127]	51,375 [69,660]	29,200 [39,590]	30/27 [762/686]	31 [9.45]
5.50 [140]	53,080 [71,970]	32,800 [44,470]	30/27 [762/686]	31 [9.45]
6.63 [168]†	73,215 [99,270]	45,800 [62,100]	30/27 [762/686]	31 [9.45]

†OD size 6⅝-in references API only. The NS-1 qualification references OD sizes less than 6⅝ in.

Hevi-Wate Transition Drillpipe Bending Strength Ratios

Nominal Size, in [mm]	Maximum Drill Collar Size,‡ in [mm]	Bending Strength Ratios
3.50 [89]	5.75 × 2.25 [146 × 57]	18.2 / 3.50 = 5.2:1
4 [102]	6.50 × 2.25 [165 × 57]	26.5 / 5.2 = 5.1:1
4.50 [114]	7.50 × 2.81 [191 × 71]	36.5 / 7.7 = 4.7:1
5 [127]	8.25 × 2.81 [210 × 71]	54.3 / 10.7 = 5.1:1
5.50 [140]	9 × 2.81 [229 × 71]	70.8 / 14 = 5.1:1
6.63 [168]†	10.50 × 3 [267 × 76]	113 / 22.4 = 5.0:1

†OD size 6.63-in references API only. The NS-1 qualification references OD sizes less than 6.63 in.

‡6.63-in drillpipe is the largest size of drill collar that can be run directly below the Hevi-Wate drillpipe. If drill collars larger than the maximum size shown above are used, run at least three collars of the maximum size between the large drill collar and the Hevi-Wate drillpipe.

Hevi-Wate Transition Drillpipe Weight and Center Upset Specifications

Nominal Size, in [mm]	Spiral Hevi-Wate Transition Drillpipe			Standard Hevi-Wate Transition Drillpipe		
	Approximate Weight, Including Tube and Joints, lbm [kg]		Center Upset Length, ft [m]	Approximate Weight, Including Tube and Joints, lbm [kg]		Center Upset Length, in [mm]
	Per foot	Per 31 ft		Per foot	Per 31 ft	
3.50 [89]	27.49 [12.47]	849 [385]	18.50 [5.64]	23.39 [10.61]	721 [327]	24 [610]
4 [102]	34.30 [15.56]	1,057 [479]	18.50 [5.64]	29.89 [13.56]	920 [417]	24 [610]
4.50 [114]	46.50 [21.09]	1,431 [649]	18.50 [5.64]	41.09 [18.64]	1,265 [574]	24 [610]
5 [127]	55.40 [25.13]	1,706 [774]	18.50 [5.64]	50.09 [22.72]	1,543 [700]	24 [610]
5.50 [140]	63.80 [28.94]	1,962 [890]	18.50 [5.64]	57.61 [26.13]	1,770 [803]	24 [610]
6.63 [168]†	77.69 [35.24]	2,389 [1,084]	18.50 [5.64]	71.30 [32.34]	2,193 [995]	24 [610]

†OD size 6⅝-in references API only. The NS-1 qualification references OD sizes less than 6⅝ in.

Hevi-Wate Transition Drillpipe Versus Maximum Hole Size

Drillpipe Size, in [mm]	Maximum Hole Size, in [mm]
3.50 [89]	7 [178]
4 [102]	8.13 [207]
4.50 [114]	9.06 [230]
5 [127]	10.06 [256]
5.50 [140]	11 [279]
6.63 [168]†	13.50 [343]

†OD size 6.63 in references API only. The NS-1 qualification references OD sizes less than 6.63 in.

Rotary Kellys—Hex and Square

Rotary kellys transmit torsional energy from the rotary table to the drillstring and ultimately to the bottom of the hole. The mechanical properties of the steel and the specifications used by Schlumberger to manufacture kellys protect and extend this capability.

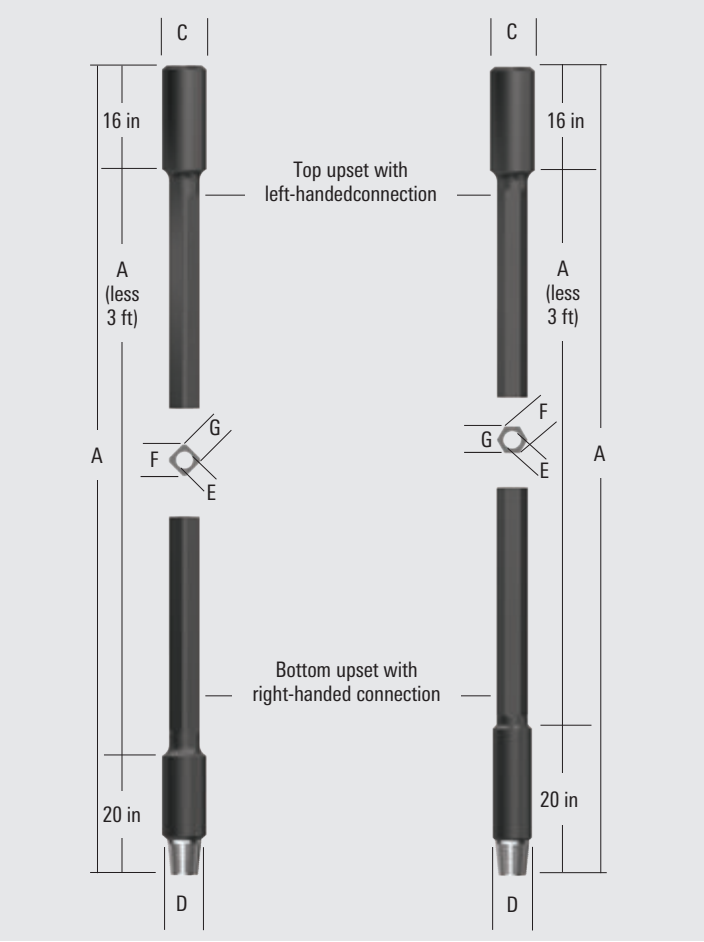
Each DRILCO services rotary kelly is heat treated along its entire length for uniform toughness and durability. A hardness range of 285 to 341 BHN and a Charpy V-notch impact value of 40 ft.lbf are guaranteed 1 in below the surface at room temperature. Each rotary kelly conforms to the mechanical properties listed in API Specification 7–1 and can be stamped with the API monogram.

Machined flats and upsets ensure tight tolerances and a high-quality drive section. These features retard wear on the kelly and prolong the service life of its drive-bushing rollers.

Kellys can have a square or hexagonal cross section and are available in two standard lengths:

- 40 ft [12.2 m] with a 37-ft [11.3-m] working space
- 46 ft [14.0 m] with a 43-ft [13.1-m] working space.

Other sizes may be available through special order.



Square kelly (left) and hexagonal kelly (right).

Hexagonal Kelly Specifications

Nominal Size, in [mm]	Available Lengths, ft (A)	Top Upset		Bottom Upset		Bore, in [mm] (E)	Drive Section		Weight of 40-ft Length, lbm [kg]
		API Box Lefthand Connection	OD, in [mm] (C)	Righthand Connection	OD, in [mm] (D)		Across Corners, in [mm] (F)	Across Flats, in [mm] (G)	
3.50 [89]	40 and 46	6.63 Reg	7.75 [197]	NC 31 (2.88 IF)	4.13 [105]	2 [51]†	3.94 [100]	3.50 [89]	1,300 [590]
3.50 [89]	40 and 46	4.50 Reg	5.75 [146]	NC 31 (2.88 IF)	4.13 [105]	2 [51]†	3.94 [100]	3.50 [89]	1,200 [544]
4.25 [108]	40 and 46	6.63 Reg	7.75 [197]	NC 38 (3.50 IF)	4.75 [121]	2.25 [57]	4.78 [121]	4.25 [108]	1,740 [789]
5.25 [133]	40 and 46	6.63 Reg	7.75 [197]	NC 46 (4 IF)	6–6.38 [152–162]	2.81 [71]	5.90 [150]	5.25 [133]	2,550 [1,157]
5.25 [133]	40 and 46	6.63 Reg	7.75 [197]	NC 50 (4.50 IF)	6.13–6.38 [156–162]	3 [76]	5.90 [150]	5.25 [133]	2,550 [1,157]

Square Kelly Specifications

Nominal Size, in [mm]	Available Lengths, ft (A)	Top Upset		Bottom Upset		Bore, in [mm] (E)	Drive Section		Weight of 40-ft Length, lbm [kg]
		API Box Lefthand Connection	OD, in [mm] (C)	Righthand Connection	OD, in [mm] (D)		Across Corners, in [mm] (F)	Across Flats, in [mm] (G)	
3 [76]	40 and 46	6.63 Reg	7.75 [197]	NC 31 (2.88 IF)	4.13 [105]	2 [51]†	3.88 [99]	3 [76]	1,080 [490]
3 [76]	40 and 46	4.50 Reg	5.75 [146]	NC 31 (2.88 IF)	4.13 [105]	2 [51]†	3.88 [99]	3 [76]	980 [445]
3.50 [89]	40 and 46	6.63 Reg	7.75 [197]	NC 38 (3.50 IF)	4.75 [121]	2.25 [57]	4.44 [113]	3.25 [83]	1,320 [599]
3.50 [89]	40 and 46	4.50 Reg	5.75 [146]	NC 38 (3.50 IF)	6–6.38 [152–162]	2.25 [57]	4.44 [113]	3.50 [89]	1,320 [599]
4.25 [108]	40 and 46	6.63 Reg	7.75 [197]	NC 46 (4 IF)	6.13–6.38 [156–162]	2.81 [71]	5.50 [140]	4.25 [108]	1,820 [826]
4.25 [108]	40 and 46	6.63 Reg	7.75 [197]	NC 50 (4.50 IF)	6.13–6.38 [156–162]	2.81 [71]	5.50 [140]	4.25 [108]	1,820 [826]

† Not an API standard.

Thread Protectors—Pressed Steel and Cast Steel

Thread protectors are recommended to protect the pin and box connections when drillstring components are being shipped or stored at the warehouse or wellsite.

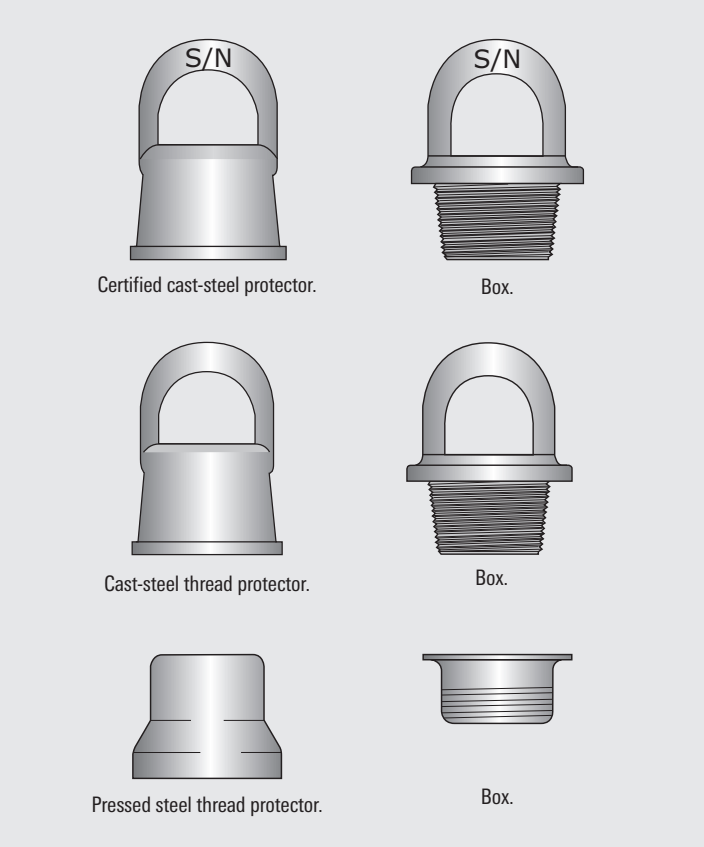
Three types of thread protectors are available:

- Cast-steel thread protectors, with lifting bail, are made from steel castings that meet ASTM Specification A27 Grade 60–30. (60,000-lbf tensile–30,000-lbf yield). They are equipped with heavy-duty bails to enable drill collars to be picked up and set down with a catline. Cast-steel thread protector's threads and shoulders are precision machined.
- Pressed steel, light-duty protectors are used when drillstem components require shipping and storing protection.
- Plastic light-duty protectors are used when threaded drillstem components need to be protected against shipping or storage.

Certified cast-steel thread protector

- Certified cast-steel thread protectors (CCSTP) with lifting bails offer the ultimate thread protection and have certified lifting capacities to ensure safe handling of tubular products during manufacture, shipping, or at the rig site.
- Each lifting bail is tested to 300% of the maximum anticipated load and NDT inspected for cracks after pull testing.
- It is capable of picking up one drill collar within the recommended diameter for the type and size of connection on the CCSTP.
- Threads and shoulders are precision machined to ensure proper makeup on the protected connection.
- A unique serial number is permanently affixed to each protector for complete traceability of test date, applied load versus time, and inspection results.
- Because drill collars are often handled roughly, Schlumberger recommends frequent inspection to ensure that the bail is not cracked and that proper makeup to connections is possible.

Note: CCSTPs are only intended to assist with pickup or laydown of one drill collar at a time.



Schlumberger offers three types of steel thread protectors—certified cast-steel, cast-steel, and pressed steel.

Thread protectors are recommended when storing or transporting tubulars.

Rotary Substitutes (Subs)

Rotary substitutes (subs) have two primary applications—to cross over from one connection size to another or as the disposable component to extend the connection life of a more expensive drillstring member.

DRILCO services subs are heat treated to meet or exceed API specifications for drillpipe tool joint mechanical properties. They are available with box × pin, box × box, or pin × pin connections. The sub connections are protected by a phosphate surface coating that minimizes galling on initial makeup. Precision-machined API connections are standard; proprietary connections machined by licensed vendors are also available. When subs are ordered to conform to API Specification 7–1, Schlumberger is authorized to apply the API monogram.

The following rotary subs are available:

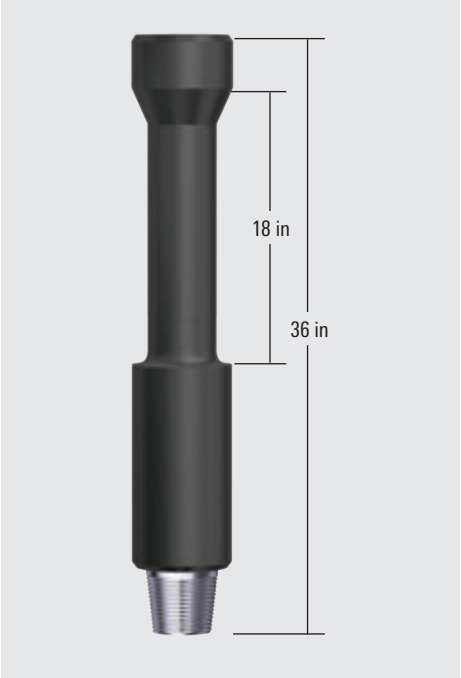
- A straight-OD sub connects drillstring members that have a similar OD. The drill bit, downhole tools, Hevi-Wate drillpipe, and drillpipe can be crossed over using this sub.
- A reduced-section sub connects drillstring members with different diameters that warrant the cross-sectional change to accommodate different connections. This sub would be used to cross over large-OD drilling tools or a tapered drill collar string.
- A kelly saver sub provides a less-expensive connection between the pin end of a kelly and the box end of another drillstem component. This interposing arrangement extends the life of a kelly by enabling the saver sub to absorb the repeated connection wear a kelly would otherwise have to endure during makeup to other drillstem components. The saver sub can be equipped with a rubber protector to reduce BOP equipment and casing wear resulting from contact damage with the lower kelly connection.

Bit sub

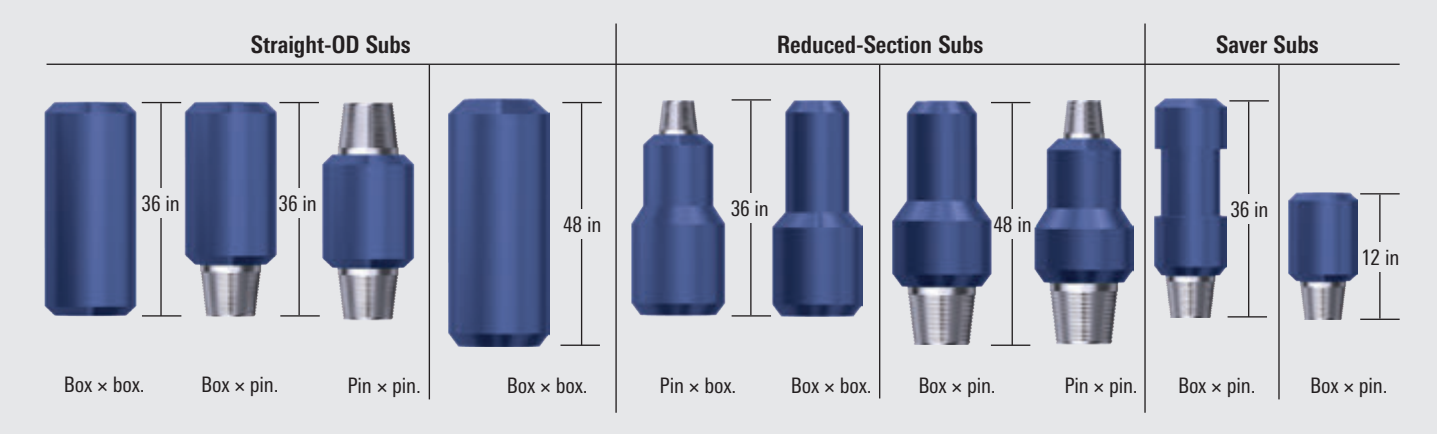
Schlumberger manufactures a complete line of bit subs made from materials that are heat treated to drill collar specifications. Sizes range from 3.13-in to 11-in OD and 36-in to 48-in length.

Lift sub

A lift sub enables the efficient handling of straight-OD tubulars such as drill collars, shock tools, jars, and directional equipment with the drillpipe elevators.



Lift sub.



Top drive sub

Top drive subs are positioned between the drillstring and top drive to protect their threads from repeated makeup wear, which could lead to expensive maintenance and replacement costs of top drive components. Alternately, a top drive sub can be repaired or replaced easily and at much less expense if its lower pin threads become galled or damaged. They are manufactured from selected bars of alloy steel and heat treated to provide the strength required to carry the entire weight of the drillstring.

Features

- Heat treated to meet or exceed API specifications for drillpipe tool joint mechanical properties
- Precision-machined API connections standard with proprietary connections available machined by licensed vendors
- Serialized for complete material traceability

Top drive sub.

Top Drive Sub Specifications

OD, in [mm]	ID, in [mm]	Upper Pin Connection Size	Lower Pin Connection Size	Lower Pin Connection	
				Tensile Yield, lbf [N]	Torsional Yield, ft.lbf [N.m]
8.63 [219]	4 [102]	7.63 Reg	6.63 FH	2,296,000 [10,213,000]	118,000 [160,000]
8.63 [219]	3.50 [89]	7.63 Reg	5.50 FH	1,619,000 [7,202,000]	72,000 [97,600]
8.63 [219]	3 [76]	7.63 Reg	NC 50	1,416,000 [6,299,000]	57,000 [77,300]
8.63 [219]	2.50 [64]	7.63 Reg	NC 46	1,307,000 [5,814,000]	49,000 [66,400]
8.63 [219]	2.25 [57]	7.63 Reg	NC 38	790,000 [3,514,000]	24,000 [32,500]

Standard sizes shown above. Additional sizes available upon request, including box up design.
Mechanical properties based on 120,000-lbf material yield strength.
When ordering, please specify

- use (e.g., kelly sub, crossover drillpipe to drill collar, drill collar to drill collar, or bit sub)
- overall length shoulder to shoulder
- largest diameter
- bore ID
- size and type of upper and lower connections, indicating pin or box
- cast- or pressed-steel thread protectors
- reduced-section subs (add diameter and length of reduced section: 8, 12, 18, or 24 in)
- bit subs (add float bore size and type, if desired)
- kelly saver subs with protectors (add casing OD and weight to properly size the casing protector)
- lift subs (specify tapered or square shoulder and drillpipe OD).

Ezy-Torq Hydraulic Cathead

Hydraulic power increases torque arc smoothly

The Ezy-Torq* hydraulic cathead delivers smooth and even torque to makeup loads ranging from 40,000 to 150,000 ft.lbf for making up large-diameter BHA components with either premium or standard connections. When the system is used for rotary shouldered connections requiring less than 40,000 ft.lbf of makeup torque, the unit should be set up with a regularly calibrated load cell.

Application of smooth and consistent line pull to the rig tongs ensures proper makeup of all rotary shouldered connections. Maintaining proper connection torque helps reduce wear on drillstring connections, decrease maintenance costs, and reduce potential connection failures.

Note: In all applications, the torque rating of the rig tongs should never be exceeded.

Ezy-Torq catheads are available to fit individual rig requirements and operation parameters. The Ezy-Torq cathead is available in three power systems to suit individual rig requirements. Available systems can be self-contained, powered by the rig, or use an independent power source. System components rated for operations in high-temperature (>131 degF [55.0 degC]) environments are available upon request.

Type I: Self-contained system

The Type I Ezy-Torq cathead is a fully self-contained system. It incorporates a hydraulic power source and control console to operate the unit's hydraulic cylinder assembly, which includes a specially rated wireline for easy connection to rig tongs. The entire unit can be temporarily or permanently installed on the rig floor as a self-contained system featuring a hydraulic power unit, a remote control module, five 25-ft [7.32-m] remote control module hoses, and two 25-ft cylinder hoses.

Accurate and remote hydraulic pressure control

The unit is powered by its positive-displacement, tandem pump with a typical high-low pump circuit. It produces low-power-consumption, high-speed cylinder movement at low force-to-work-loading and a slow, steady pull at high force. When a work load causes system pressure to rise, the high-volume pump stage automatically discharges into the reservoir, and the low-volume stage continues to supply high force for connection makeup.

The power unit can be controlled from a convenient location on the rig with a remote control module, which features a lever-actuated control valve, pressure gauge, and a pilot relief valve to enable pressure operation and regulation.

Advantages

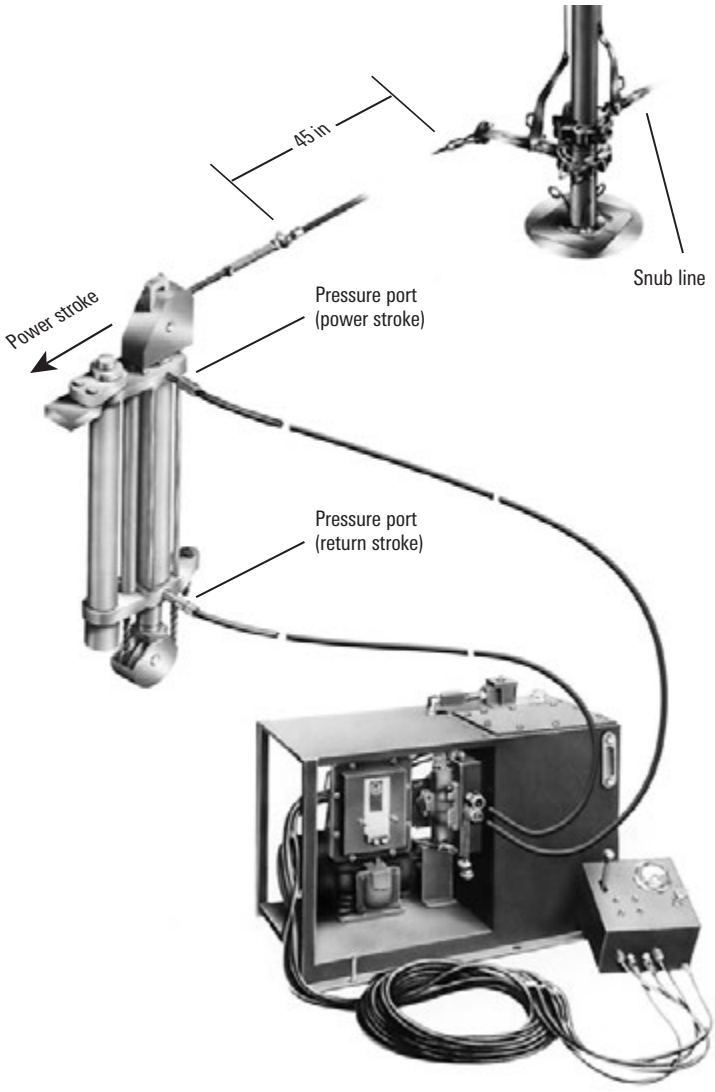
- Precise pressure control enables correct makeup
- Positive-displacement, tandem pump provides efficient, steady hydraulic energy
- Control module enables remote pressure regulation and cylinder operation
- Hydraulic operation of remote control module eliminates electrical hazards
- Simple hydraulic circuit ensures trouble-free performance
- Unitized construction enhances durability

Type II: Connection to existing rig hydraulic system

The Type II Ezy-Torq cathead provides the same reliable performance as the Type I system but has a smaller footprint. It operates with hydraulic components that connect to an existing rig hydraulic power source, such as the accumulator portion of a BOP system. The Type II cathead consists of the main control unit, a remote control module, six 50-ft [15.24-m] remote control module hoses, and two 25-ft [7.62 m] cylinder hoses. Conversion hydraulic fittings to existing rig components are supplied by the customer.

Pressure control with a minimized footprint

The remote control module is operated by air and hydraulics, eliminating the hazards associated with electrical circuits. It features an adjustable relief valve and a high-pressure gauge for setting the required fluid pressure. The pilot relief valve operates a pressure-reducing valve on the main control unit that governs the maximum pressure developed on the blind end of the cylinder (makeup stroke). An additional preset relief valve limits maximum pressure



The Type I Ezy-Torq hydraulic cathead is a self-contained system with three main components—power source, control console, and hydraulic cylinder.

on the rod side of the cylinder (retraction stroke). A lever-actuated air valve mounted on the remote control module can extend, retract, or stop cylinder movement.

Advantages

- Use of existing rig hydraulic equipment minimizes unit space requirements
- Air and hydraulic operation eliminates electrical hazards
- Remote control
- Adjustable relief valve and high pressure gauge sets required fluid pressure

Note: The hydraulic auxiliary control unit is designed with a closed center valve for connection to a hydraulic system using accumulators. A conversion kit may be required depending on the rig's hydraulic power source, such as when powered by a positive-displacement pump.

Type III: Rigs with positive-displacement hydraulic systems

The Type III Ezy-Torq cathead (Type II system with conversion kit) offers the same advantages as the Type I and Type II systems but is designed to connect to a rig hydraulic power source that uses positive-displacement pumps. This system is not intended for use with a hydraulic system that uses an accumulator (see Type II system instead).

The hydraulic supplies on many rigs use continuously running pumps such as positive-displacement gear pumps. If flow is blocked, fluid pressure builds up, and the hydraulic supply motor can overload or a rupture may occur. The Type III Ezy-Torq cathead uses a pilot-operated relief valve to bypass flow to the reservoir return line at low pressure when the remote control lever is released. This capability helps prevent the damage that may be caused by a blockage in the hydraulic system.

Rig hydraulic supplies that contain relief valves capable of bypassing fluid to the reservoir can be used with a Type II system. However, oil heating may become a problem if fluid flows continuously across the relief valve for long periods of time at high pressures.

Note: The Type III conversion kit must not be used if the Ezy-Torq hydraulic cathead is to be connected to an accumulator system.

Ezy-Torq Cathead Recommended Spare Parts Kits for 12-Month Operation

Description	Part Number
Type I Model E power unit spare parts kit	07257001
Type II auxiliary unit spare parts kit	03677801
Type III auxiliary unit spare parts kit	03677801
Cylinder assembly spare parts kit (includes wireline assembly)	03677701

Shipping Weight Data

Hydraulic Cylinder Assembly,† lbm [kg]	Power Unit Assembly,‡ lbf [N]	Auxiliary Power Unit Assembly,‡ lbf [N]
850 [386]	900 [4,000]	400 [1,800]

† Contains remote control module with hoses.
‡ Contains wireline assembly.

System Power Design Data

Motor Design	Cycle Frequency, Hz	Amperage, amp				Cylinder Time, s	
		230 V	460 V	220 V	380 V	Power Stroke	Return Stroke
10 hp–1,750 rpm	60	25.4	12.7	N/A	N/A	10	5
7.50 hp–1,450 rpm	50	N/A	N/A	23.4	11.7	11	6

Cylinder Assembly

Min. Flow Rate, galUS/min [L/min]	Max. Flow Rate, galUS/min [L/min]	Max. Test Pressure, psi [MPa]	Max. Working Pressure, psi [MPa]	Stroke Length, in [mm]	Line Pull, lbf [N]	Torque Range, ft.lbf [N.m]
4 [15]	35 [130]	3,000 [20.7]	2,500 [17.2]	22.50 [572]	32,900 [146,350]	40,000–150,000 [54,200–203,400]

When ordering, please specify
- Ezy-Torq Type I cathead (standard)
- Ezy-Torq Type II cathead for rig accumulator utilization
- Ezy-Torq Type III cathead for positive-displacement systems.

Rig pump systems
- Hertz (Hz) of power source: 50 Hz or 60 Hz
- Motor voltage
  - 60 Hz–230V or 460 V, 1,750 rpm, 10 hp
  - 50 Hz–220V or 380 V, 1,450 rpm, 7.50 hp
  - Other voltages upon special order
- Motor temperature rating
  - 104-degF [40.0 degC] ambient operating temperature standard
  - 131-degF [55.0 degC] ambient operating temperature optional

AccuTorque Makeup Torque Control and Monitoring System

Application

Land drilling operations

Benefits

- Ensures the application of correct makeup torque
- Mitigates risk of drill pipe twistoff and washout events
- Reduces drillstring repair and maintenance costs
- Improves trip speeds by reducing connection makeup time
- Records breakout events to help detect downhole makeup anomalies

Features

- User-friendly interface for entering and selecting tool joint sizes
- Easy installation onto iron roughnecks
- Onboard event log storage for easy retrieval
- Temperature-compensating strain gauges in each load pin for increased accuracy

The AccuTorque* makeup torque control and monitoring system is a peripheral attachment for compatible iron roughnecks that measures, controls, and records torque values to ensure that the recommended torque is correctly applied during drillstring makeup. When connected to an iron roughneck, it automates makeup operations, decreasing the possibility of a twistoff event and reducing makeup time for faster trip speeds.

Although the industry generally accepts a makeup torque error of 5%, 1 in 6 improperly calibrated iron roughnecks apply torque with an error of greater than 15%. When this happens, a drillstring twistoff event can occur—and the resulting nonproductive time (NPT) is costly. 1 in 20 wells experience back off or twistoff events,[1] and for every twistoff event the contractor can expect to pay an average of USD 400,000. Because of the extensive costs and NPT caused by twistoff events, Schlumberger designed the AccuTorque system to reduce the number and frequency of these events.

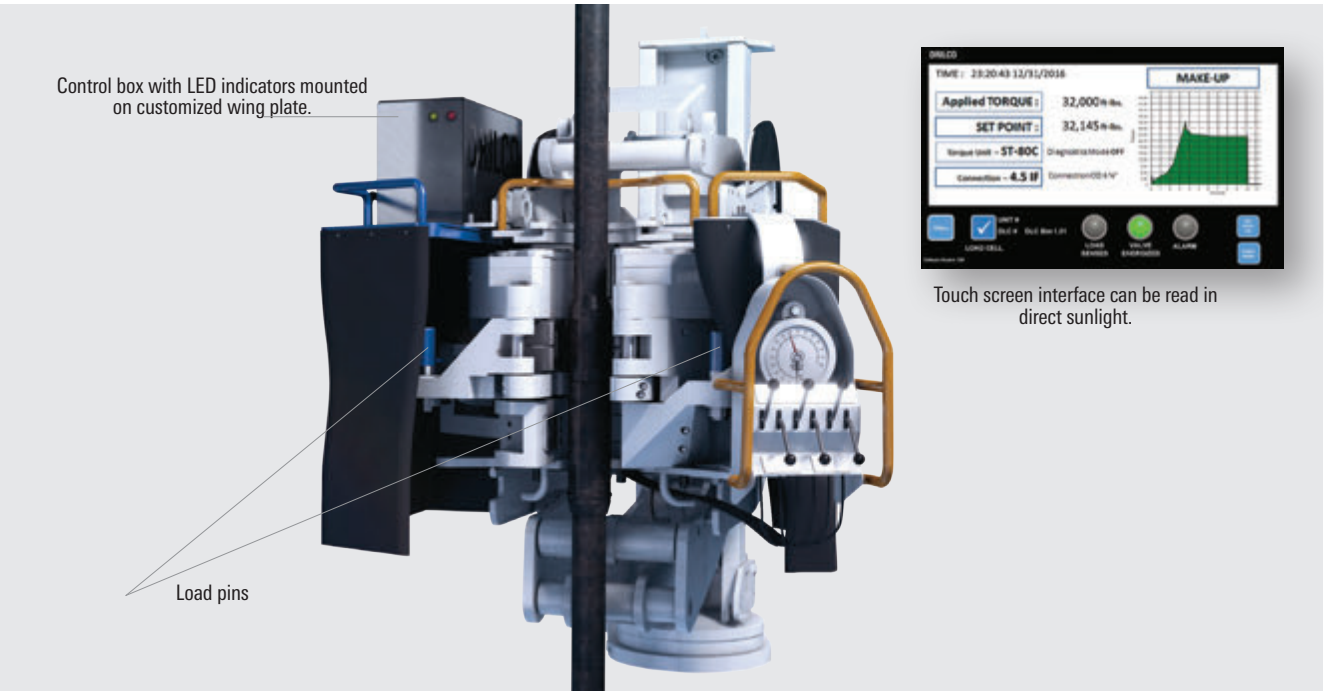
To begin the makeup process, the technician enters the size and type of connection and the proper makeup torque. The AccuTorque system then makes up each drillpipe to the specified makeup torque—without requiring recalibration.

System components include

- two load pins
- control box with LED indicators
- customized wing plate
- touch screen interface that can be read in direct sunlight.

Load Cell Specifications	
Calibration	1% at 30,000 lbf, NIST-traceable
Calibration sheet	Furnished upon request
Construction	Stainless steel and sealed for rugged use
Hazardous location ratings	Class 1, division 1: load pins, control box Class 1, division 2: touch screen monitor
System Specifications	
Compatible iron roughneck models	ST-80C, ST-80 Gen3
ATEX/IECEx certification	Zone 1: load pins, control box Zone 2: touch screen monitor
Temperature operating range	–40 to 185 degF [–40 to 85 degC]
Electrical power	94–265 V, AC auto switching, 47–63 Hz, AC line filter, 3-A maximum
Operating system	Windows 7
Network	802.11n via SMA CONN, 802.3 via MIL-SPEC CONN

[1]Zenero, N., Koneti, S., Schnieder, W.: "Iron Roughneck Makeup Torque—It's Not What You Think!" IADC/SPE Drilling Conference and Exhibition (2016), 3.



Touch screen interface can be read in direct sunlight.

Control box can be easily installed on the compatible iron roughneck.

Thru-Tubing Tools

PowerPak Motor

Applications

- Directional drilling
- Geosteering operations
- Performance straight hole drilling

Benefits

- Allows drilling complete hole sections with one bottomhole assembly
- Can run on mud, air or foam
- Can be used for both low-speed, high-torque and high-speed, low-torque applications

Features

- High-torque capabilities
- Compact, modular design
- Bent-housing section
- Stabilizer
- Designed minimizes noise interference with measurements-while-drilling telemetry

Positive displacement motors

PowerPak* steerable motors are positive displacement mud motors that incorporate a stabilizer and a bent-housing section that permits rotary drilling in vertical, tangential, or horizontal sections of the hole as well as oriented drilling in kickoffs or course corrections. The surface-adjustable bent housing provides for flexibility as orientation requirements change.

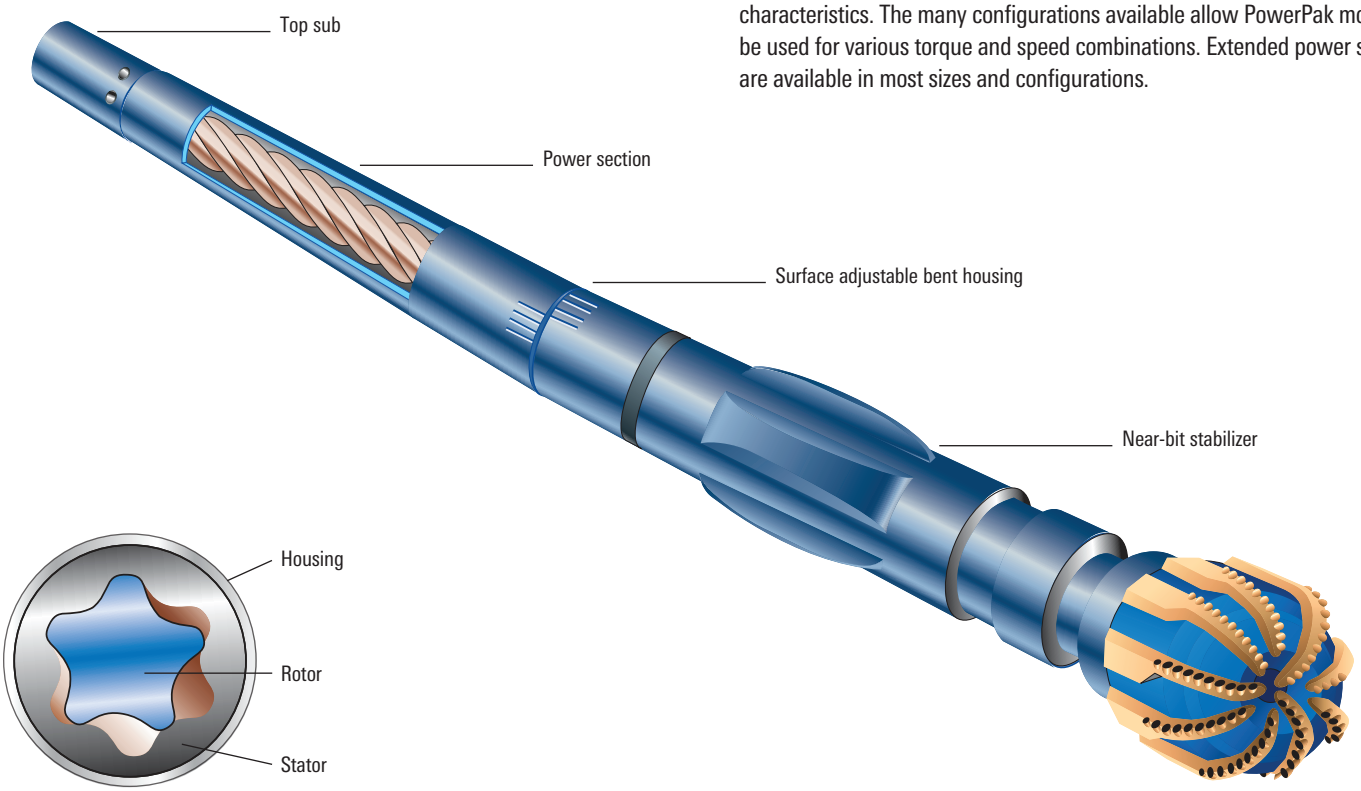
The PowerPak modular design meets a full range of directional drilling requirements. Air-drill power sections and field-changeable motor stabilizers are available. The superior design of the tool features short bit-to-bend and bit-to-stabilizer spacings to allow high surface rotary speeds for improved hole cleaning. In addition, the Geosteering* instrumented steerable positive displacement motor uses at-the-bit sensors to place the well trajectory in the heart of the reservoir.

PowerPak motors consist of three major components:

- power and transmission section
- SAB* Surface-Adjustable Bent housing
- bearing assembly section and surface exchangeable stabilizer.

Power and transmission section

The power section of the tool converts the hydraulic energy delivered to the motor by the drilling fluid to mechanical energy. The power section consists of two components: the rotor and the stator. Schlumberger offers different rotor and stator configurations, each designed to produce different power characteristics. The many configurations available allow PowerPak motors to be used for various torque and speed combinations. Extended power sections are available in most sizes and configurations.



PowerPak steerable motors offer performance drilling and predictable trajectories.

Power Sections

Dyna-Drill power sections have been the product of choice in oil and gas fields throughout the world for nearly half a century and have earned a global reputation for superior and reliable performance.

Dyna-Drill manufactures power sections from conventional to ultra high torque. The conventional series range from 10 ft to 14 ft and can be teamed with mud motors ranging from 1$^{11}/_{16}$-in to 11½-in diameter. Dyna-Drill is the only manufacturer capable of producing 25 ft long rotors worldwide.

Extended Length Series

Speeds

- Extra-slow Speed (ESX)
- Slow speed (SX)
- Medium speed (MX)
- High speed (HX)

Lengths

- X1 Series 17–19 ft
- X2 Series 21.7 ft
- X3 Series 25.0 ft

Extended Length Series

Dyna-Drill elastomers are compounded for even the most aggressive drilling fluids and temperatures.

- NBR-1A is engineered for most applications and exhibits excellent fluid compatibility and dynamic properties.
- HSN-38 is engineered for the most chemically aggressive fluids.
- NBR-HR™ will increase torque by 50% over conventional compounds, and it provides an economical alternative to metal reinforced stators.

Power Sections

									Maximum Recommended Operating Conditions						Replacement For					
Power Sections		Configuration				Performance			Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]								
Size, in	Model Number	Tube OD/ID, in [mm]	Stator Length, in [mm]	Lobes	Stages	Speed, rev/gal [rev/lit]	Torque Slope, ft-lb/psi [Nm/kPa]	Max. RPM	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford
1.68	DD168562.3	1.68 [1.29]	60.0 [1,524]	5:6	2.3	9.250 [2.444]	0.27 [0.054]	390	350 [2,380]	90 [130]	7 [5]	580 [3,960]	160 [210]	12 [9]		•				
	DD168564.0	1.68 [1.37]	57.6 [1,462]	5:6	4.0	16.314 [4.310]	0.17 [0.033]	690	600 [4,140]	100 [140]	13 [10]	1,000 [6,890]	170 [230]	22 [17]		•			•	
	DD168564.4	1.68 [1.37]	82.5 [2,096]	5:6	4.4	11.250 [2.972]	0.27 [0.053]	450	660 [4,550]	180 [240]	15 [12]	1,100 [7,580]	300 [400]	25 [19]		•			•	
2.13	DD213564.0	2.12 [1.75]	66.5 [1,689]	5:6	4.0	9.574 [2.529]	0.27 [0.053]	630	600 [4,140]	160 [220]	19 [15]	1,000 [6,890]	270 [370]	32 [24]		•			•	
	DD213564.9	2.12 [1.71]	84.8 [2,153]	5:6	4.9	9.410 [2.486]	0.28 [0.054]	620	740 [5,070]	200 [280]	24 [18]	1,230 [8,450]	340 [460]	40 [30]		•			•	
2.38	DD238564.0	2.37 [1.87]	71.6 [1,819]	5:6	4.0	7.175 [1.895]	0.36 [0.070]	580	600 [4,140]	210 [290]	23 [18]	900 [6,210]	320 [430]	35 [27]					•	
2.87	DD287124.9	2.87 [2.44]	117.0 [2,972]	1:2	4.9	10.937 [2.889]	0.25 [0.049]	990	740 [5,070]	180 [250]	34 [26]	1,100 [7,600]	270 [370]	51 [39]						
	DD287562.6	2.87 [2.44]	117.0 [2,972]	5:6	2.6	2.300 [0.608]	1.02 [0.200]	210	390 [2,690]	400 [540]	16 [12]	590 [4,030]	590 [810]	23 [18]	•					
	DD287564.7	2.87 [2.37]	98.0 [2,489]	5:6	4.7	3.732 [0.986]	0.70 [0.137]	340	710 [4,860]	490 [670]	31 [24]	1,060 [7,290]	740 [1,000]	47 [36]						
	DD287567.0	2.87 [2.37]	117.0 [2,972]	5:6	7.0	5.740 [1.516]	0.48 [0.095]	690	1,050 [7,240]	510 [690]	67 [51]	1,750 [12,070]	850 [1,150]	111 [84]		•				
	DD287783.5	2.87 [2.31]	80.0 [2,032]	7:8	3.5	4.000 [1.057]	0.65 [0.128]	480	530 [3,620]	340 [460]	31 [24]	880 [6,030]	570 [770]	52 [40]		•				
3.13	DD313783.0	3.12 [2.60]	106.0 [2,692]	7:8	3.0	1.690 [0.446]	1.45 [0.285]	240	450 [3,100]	650 [890]	29 [22]	680 [4,650]	980 [1,330]	44 [34]			•			
3.38	DD338563.0	3.50 [2.75]	79.8 [2,026]	5:6	3.0	2.372 [0.627]	1.11 [0.218]	270	450 [3,100]	500 [680]	25 [19]	680 [4,650]	750 [1,020]	37 [28]		•			•	
	DD338783.0	3.37 [2.75]	124.0 [3,150]	7:8	3.0	1.390 [0.367]	1.87 [0.368]	160	450 [3,100]	840 [1,140]	24 [19]	680 [4,650]	1,260 [1,710]	37 [28]		•				
	DD338784.7	3.37 [2.75]	134.0 [3,404]	7:8	4.7	1.769 [0.467]	1.44 [0.283]	290	710 [4,860]	1,010 [13,70]	55 [42]	1060 [7,290]	1,520 [2,060]	82 [62]						
3.50	DD350563.0	3.50 [2.75]	79.8 [2,026]	5:6	3.0	2.372 [0.627]	1.11 [0.218]	270	450 [3,100]	500 [680]	25 [19]	680 [4,650]	750 [1,020]	37 [28]		•			•	
	DD350784.3	3.50 [2.75]	133.8 [3,397]	7:8	4.3	1.846 [0.488]	1.43 [0.281]	210	650 [4,450]	920 [1,250]	36 [27]	970 [6,670]	1,380 [1,870]	53 [41]		•				
3.75	DD375238.0	3.75 [3.00]	135.0 [3,429]	2:3	8.0	5.800 [1.532]	0.48 [0.095]	930	1,200 [8,270]	580 [790]	102 [78]				•					
	DD375349.0	3.75 [2.75]	149.0 [3,785]	3:4	9.0	5.375 [1.420]	0.50 [0.098]	860	1,350 [9,310]	670 [910]	110 [84]	2,030 [13,960]	1,010 [1,360]	165 [125]				•		
	DD375452.0	3.75 [3.00]	82.5 [2,096]	4:5	2.0	1.580 [0.417]	1.82 [0.358]	260	300 [2,070]	550 [740]	26 [20]	450 [3,100]	820 [1,110]	39 [30]						
	DD375453.5	3.75 [3.00]	135.0 [3,429]	4:5	3.5	1.550 [0.409]	1.82 [0.358]	250	530 [3,620]	960 [1,300]	45 [34]	790 [5,430]	1,430 [1,940]	68 [52]		•	•	•		
	DD375563.0	3.50 [2.75]	79.8 [2,026]	5:6	3.0	2.372 [0.627]	1.11 [0.218]	270	450 [3,100]	500 [680]	25 [19]	680 [4,650]	750 [1,020]	37 [28]		•			•	
	DD375563.8	3.75 [3.00]	80.5 [2,045]	5:6	3.8	2.275 [0.601]	1.24 [0.243]	460	570 [3,930]	700 [950]	61 [46]					•				
	DD375564.2	3.75 [3.00]	160.0 [4,064]	5:6	4.2	1.563 [0.413]	1.67 [0.328]	250	630 [4,340]	1,050 [1,420]	50 [38]				•					
	DD375782.3	3.75 [3.00]	141.0 [3,581]	7:8	2.3	0.768 [0.203]	3.22 [0.633]	130	350 [2,380]	1,110 [1,510]	26 [20]	520 [3,570]	1,670 [2,260]	39 [30]		•	•	•		

Power Sections

									Maximum Recommended Operating Conditions						Replacement For					
Power Sections		Configuration				Performance			Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]								
Size, in	Model Number	Tube OD/ID, in [mm]	Stator Length, in [mm]	Lobes	Stages	Speed, rev/gal [rev/lit]	Torque Slope, ft-lb/psi [Nm/kPa]	Max. RPM	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Dyna-Drill	RdM	Mono/PV	Roper	Drilex	Weatherford
3.75	DD375786.7	3.75 [3.00]	180.0 [4,572]	7:8	6.7	1.613 [0.426]	1.63 [0.321]	260	1,010 [6,930]	1,640 [2,230]	81 [61]	1,510 [10,390]	2,460 [3,340]	121 [92]		•				
	DD3757810.1	3.75 [3.00]	225.0 [5715]	7:8	10.1	1.950 [0.515]	1.34 [0.263]	320	1,520 [10,450]	2,030 [2,750]	120 [92]					•				
4.75	DD475127.0	4.75 [3.87]	190.0 [4,826]	1:2	7.0	3.300 [0.872]	0.93 [0.183]	830	1,050 [7,240]	980 [1,330]	154 [117]	1,580 [10,860]	1,470 [1,990]	231 [176]				•		
	DD475238.5	4.75 [3.75]	260.0 [6,604]	2:3	8.5	1.913 [0.505]	1.49 [0.293]	580	1,280 [8,790]	1,900 [2,580]	208 [158]	1,910 [13,190]	2,850 [3,860]	311 [237]	•					
	DD475453.5	4.75 [3.75]	115.8 [2,940]	4:5	3.5	1.020 [0.269]	2.76 [0.543]	260	530 [3,620]	1,450 [1,960]	70 [54]	790 [5,430]	2,170 [2,950]	105 [80]		•	•	•		
	DD475456.0	4.75 [3.75]	187.0 [4,750]	4:5	6.0	1.020 [0.269]	2.73 [0.537]	260	900 [6,210]	2,460 [3,330]	119 [91]	1,350 [9,310]	3,690 [5,000]	179 [136]		•	•	•		•
	DD475456.3	4.75 [3.75]	207.0 [5,258]	4:5	6.3	1.020 [0.269]	2.73 [0.537]	260	950 [6,520]	2,580 [3,500]	125 [95]	1,420 [9,770]	3,870 [5,250]	188 [143]		•	•			•
	DD475456.5 MX	4.75 [3.75]	229.3 [5,823]	4:5	6.5	0.933 [0.247]	2.82 [0.555]	280	980 [6,720]	2,750 [3,730]	147 [112]				•					
	DD475564.0	4.75 [3.75]	143.0 [3,632]	5:6	4.0	0.960 [0.254]	2.63 [0.516]	240	600 [4,140]	1,580 [2,140]	72 [55]				•					
	DD475566.0	4.75 [3.88]	198.0 [5,029]	5:6	6.0	0.839 [0.222]	3.04 [0.598]	300	900 [6,210]	2,740 [3,710]	153 [117]				•					
	DD475566.7	4.75 [3.87]	198.0 [5,029]	5:6	6.7	0.946 [0.250]	2.69 [0.529]	340	1010 [6,930]	2,700 [3,670]	170 [130]	1,510 [10,390]	4,060 [5,500]	256 [195]	•					
	DD475568.3	4.75 [3.75]	242.6 [6,162]	5:6	8.3	1.000 [0.264]	2.58 [0.507]	300	1250 [8,580]	3,210 [4,350]	183 [140]	1,870 [12,880]	4,810 [6,520]	275 [209]		•				
	DD475782.0	4.75 [3.75]	180.5 [4,585]	7:8	2.0	0.438 [0.116]	7.31 [1.437]	110	300 [2,070]	2,190 [2,970]	46 [35]	450 [3,100]	3,290 [4,460]	69 [52]						
	DD475782.1	4.75 [3.75]	187.0 [4,750]	7:8	2.1	0.294 [0.078]	8.00 [1.573]	74	320 [2,170]	2,520 [3,420]	35 [27]				•					
	DD475782.2	4.75 [3.75]	115.8 [2,940]	7:8	2.2	0.522 [0.138]	4.74 [0.932]	140	330 [2,280]	1,560 [2,120]	39 [30]	500 [3,410]	2,350 [3,180]	58 [44]		•	•	•		
	DD475782.2 SLOW	4.75 [3.75]	198.0 [5,029]	7:8	2.2	0.322 [0.085]	7.90 [1.554]	81	330 [2,280]	2,610 [3,540]	40 [30]									
	DD475782.6 ESX	4.75 [3.75]	229.3 [5,823]	7:8	2.6	0.263 [0.070]	8.97 [1.765]	79	390 [2,690]	3,500 [4,750]	53 [40]	590 [4,030]	5,250 [7,120]	79 [60]	•					
	DD475782.9	4.75 [3.75]	250.0 [6,350]	7:8	2.9	0.308 [0.081]	7.98 [1.569]	77	440 [3,000]	3,470 [4,710]	51 [39]	650 [4,500]	5,210 [7,060]	76 [58]			•			
	DD475783.1	4.75 [3.75]	238.0 [6,045]	7:8	3.1	0.316 [0.083]	7.83 [1.540]	95	470 [3,210]	3,640 [4,940]	66 [50]	700 [4,810]	5,460 [7,410]	99 [75]		•				
	DD475783.7	4.75 [3.87]	235.0 [5,969]	7:8	3.7	0.368 [0.097]	6.90 [1.357]	130	560 [3,830]	3,830 [5,190]	94 [72]	830 [5,740]	5,750 [7,790]	141 [107]						
	DD475783.8	4.75 [3.75]	187.0 [4,750]	7:8	3.8	0.521 [0.138]	5.20 [1.023]	140	570 [3,930]	2,960 [4,020]	74 [56]	860 [5,900]	4,450 [6,030]	110 [84]		•	•	•		•
	DD475784.5 SX	4.75 [3.75]	229.3 [5,823]	7:8	4.5	0.463 [0.122]	5.19 [1.020]	140	680 [4,650]	3,500 [4,750]	93 [71]	1,010 [6,980]	5,250 [7,120]	139 [106]	•					
	DD475785.0	4.75 [3.75]	198.0 [5,029]	7:8	5.0	0.642 [0.170]	3.96 [0.779]	180	750 [5,170]	2,970 [4,030]	100 [76]	1,130 [7,760]	4,460 [6,040]	150 [114]						
5.00	DD500568.3	5.00 [3.75]	242.6 [6,162]	5:6	8.3	1.000 [0.264]	2.58 [0.507]	280	1250 [8,580]	3,210 [4,350]	168 [128]	1,870 [12,880]	4,810 [6,520]	252 [192]		•				
	DD500678.0	5.00 [4.00]	246.0 [6,248]	6:7	8.0	0.810 [0.214]	3.18 [0.625]	290	1200 [8,270]	3,810 [5,170]	206 [157]	1,800 [12,410]	5,720 [7,750]	309 [235]						

Power Sections

									Maximum Recommended Operating Conditions						Replacement For					
Power Sections		Configuration				Performance			Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]								
Size, in	Model Number	Tube OD/ID, in [mm]	Stator Length, in [mm]	Lobes	Stages	Speed, rev/gal [rev/lit]	Torque Slope, ft-lb/psi [Nm/kPa]	Max. RPM	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Dyna-Drill	Rd&M	Mono/PV	Roper	Drilex	Weatherford
5.00	DD500782.2	5.00 [3.75]	116.0 [2,946]	7:8	2.2	0.522 [0.138]	4.74 [0.932]	140	330 [2,280]	1,560 [2,120]	39 [30]	500 [3,410]	2,350 [3,180]	58 [44]		•	•	•		•
	DD500782.6 ESX	5.00 [3.75]	229.3 [5,823]	7:8	2.6	0.263 [0.070]	8.97 [1.765]	79	390 [2,690]	3,500 [4,750]	53 [40]	590 [4,030]	5,250 [7,120]	79 [60]	•					
	DD500783.0 ESX2	5.00 [4.00]	250.0 [6,350]	7:8	3.0	0.258 [0.068]	9.40 [1.848]	84	450 [3,100]	4,230 [5,740]	68 [51]	680 [4,650]	6,350 [8,600]	101 [77]	•					
	DD500783.1	5.00 [3.75]	238.0 [6045]	7:8	3.1	0.316 [0.083]	7.83 [1.540]	95	470 [3,210]	3,640 [4,940]	66 [50]	700 [4,810]	5,460 [7,410]	99 [75]		•				
	DD500783.7	5.00 [3.87]	235.0 [5969]	7:8	3.7	0.368 [0.097]	6.90 [1.357]	130	560 [3,830]	3,830 [5,190]	94 [72]	830 [5,740]	5,750 [7,790]	141 [107]						
	DD500783.8	5.00 [3.75]	187.0 [4,750]	7:8	3.8	0.521 [0.138]	5.20 [1.023]	140	570 [3,930]	2,960 [4,020]	74 [56]	860 [5,900]	4,450 [6,030]	110 [84]		•	•	•		•
	DD500784.5 SX	5.00 [3.75]	229.3 [5823]	7:8	4.5	0.463 [0.122]	5.19 [1.020]	140	680 [4,650]	3500 [4750]	93 [71]	1,010 [6,980]	5,250 [7120]	139 [106]	•					
	DD500788.2	5.00 [4.00]	250.0 [6,350]	7:8	8.2	0.700 [0.185]	3.63 [0.714]	250	1,230 [8,480]	4,470 [6,060]	208 [159]	1,850 [12,720]	6,700 [9,080]	313 [238]						
6.25	DD625457.5	6.25 [5.00]	203.5 [5,169]	4:5	7.5	0.659 [0.174]	4.24 [0.834]	270	1,130 [7,760]	4,770 [6,470]	239 [182]	1,690 [11,630]	7,150 [9,700]	359 [274]		•	•			
	DD625675.0	6.25 [5.00]	188.0 [4775]	6:7	5.0	0.456 [0.120]	7.02 [1.381]	230	750 [5,170]	5,270 [7,140]	229 [174]	1,130 [7,760]	7,900 [10,710]	343 [261]						
	DD625782.5	6.25 [5.00]	203.2 [5161]	7:8	2.5	0.171 [0.045]	16.61 [3.265]	86	380 [2,590]	6,230 [8,440]	101 [77]	560 [3,880]	9,340 [12,660]	152 [116]		•				
	DD625782.8	6.25 [5.00]	124.0 [3,150]	7:8	2.8	0.332 [0.088]	7.95 [1.562]	140	420 [2,900]	3,340 [4,520]	84 [64]	630 [4,340]	5,010 [6,790]	127 [96]		•	•			•
	DD625782.9 ESX	6.25 [5.00]	228.8 [5,810]	7:8	2.9	0.170 [0.045]	14.71 [2.893]	85	440 [3,000]	6,400 [8,680]	104 [79]	650 [4,500]	9,600 [13,020]	155 [118]	•	•				
	DD625783.0 Slow	6.25 [5.00]	204.0 [5,182]	7:8	3.0	0.196 [0.052]	12.64 [2.485]	120	450 [3,100]	5,690 [7,710]	127 [97]	680 [4,650]	8,530 [11,570]	191 [145]						•
	DD625783.3 ESX2	6.25 [5.00]	260.0 [6,604]	7:8	3.3	0.160 [0.042]	15.56 [3.059]	80	500 [3,410]	7,700 [10,440]	117 [89]	740 [5,120]	11,550 [15,660]	176 [134]	•					
	DD625783.5	6.25 [5.00]	231.3 [5,874]	7:8	3.5	0.208 [0.055]	12.50 [2.458]	83	530 [3,620]	6,560 [8,900]	104 [79]	790 [5,430]	9,840 [13,350]	156 [119]		•				
	DD625783.8 ESX3	6.25 [5.00]	299.8 [7,614]	7:8	3.8	0.158 [0.042]	15.76 [3.100]	79	570 [3,930]	8,980 [12,180]	135 [103]				•					
	DD625784.0	6.25 [5.00]	160.0 [4,064]	7:8	4.0	0.352 [0.093]	6.89 [1.355]	180	600 [4,140]	4,130 [5,610]	139 [106]	900 [6,210]	6,200 [8,410]	208 [158]						
	DD625784.8	6.25 [5.00]	203.2 [5,161]	7:8	4.8	0.330 [0.087]	7.98 [1.569]	140	720 [4,960]	5,740 [7,790]	144 [110]	1,080 [7,450]	8,620 [11,680]	217 [165]		•	•	•		•
	DD625786.7 SX3	6.25 [5.00]	299.8 [7,614]	7:8	6.7	0.278 [0.073]	9.00 [1.769]	140	1010 [6,930]	9,040 [12,260]	239 [182]				•					
6.50	DD650124.0	6.50 [5.00]	185.8 [4,718]	1:2	4.0	1.186 [0.313]	2.29 [0.450]	480	600 [4,140]	1,370 [1,860]	124 [94]									
	DD650237.8	6.50 [5.50]	203.5 [5,169]	2:3	7.8	1.000 [0.264]	2.81 [0.553]	600	1,170 [8,070]	3,290 [4,460]	376 [286]	1,760 [12,100]	4,940 [6,690]	564 [430]	•					
	DD650457.0	6.50 [5.40]	214.6 [5,452]	4:5	7.0	0.497 [0.131]	5.77 [1.135]	300	1,050 [7,240]	6,060 [8,210]	344 [262]	1,580 [10,860]	9,090 [12,320]	516 [393]		•	•	•		•
	DD650457.5	6.50 [5.00]	203.5 [5,169]	4:5	7.5	0.659 [0.174]	4.24 [0.834]	270	1,130 [7,760]	4,770 [6,470]	239 [182]	1,690 [11,630]	7,150 [9,700]	359 [274]		•	•			
	DD650563.5	6.50 [5.00]	152.0 [3,861]	5:6	3.5	0.422 [0.111]	6.22 [1.224]	190	450 [3,100]	2,800 [3,800]	101 [77]				•					

Power Sections

									Maximum Recommended Operating Conditions						Replacement For					
Power Sections		Configuration				Performance			Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]								
Size, in	Model Number	Tube OD/ID, in [mm]	Stator Length, in [mm]	Lobes	Stages	Speed, rev/gal [rev/lit]	Torque Slope, ft-lb/psi [Nm/kPa]	Max. RPM	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford
6.50	DD650675.0	6.50 [5.50]	200.0 [5,080]	6:7	5.0	0.292 [0.077]	8.31 [1.635]	180	750 [5,170]	6,230 [8,450]	208 [158]	1,130 [7,760]	9,350 [12,680]	312 [238]		•	•	•		•
	DD650782.1 ESX	6.50 [5.31]	230.0 [5,842]	7:8	2.1	0.133 [0.035]	19.50 [3.835]	67	320 [2,170]	6,140 [8,330]	78 [59]	470 [3,260]	9,210 [12,490]	117 [89]	•					•
	DD650782.8	6.50 [5.00]	130.0 [3,302]	7:8	2.8	0.332 [0.088]	7.95 [1.562]	140	420 [2,900]	3,340 [4,520]	84 [64]	630 [4,340]	5,010 [6,790]	127 [96]		•	•			•
	DD650782.9 ESX	6.50 [5.00]	228.8 [5,810]	7:8	2.9	0.170 [0.045]	14.71 [2.893]	85	440 [3,000]	6,400 [8,680]	104 [79]	650 [4,500]	9,600 [13,020]	155 [118]	•	•				
	DD650783.0	6.50 [5.50]	125.0 [3,175]	7:8	3.0	0.283 [0.075]	9.30 [1.829]	170	450 [3,100]	4,190 [5,670]	135 [103]	680 [4,650]	6,280 [8,510]	203 [155]		•	•	•		•
	DD650783.0 Slow	6.50 [5.40]	204.0 [5,182]	7:8	3.0	0.155 [0.041]	16.00 [3.146]	93	450 [3,100]	7,200 [9,760]	127 [97]	680 [4,650]	10,800 [14,640]	191 [145]						•
	DD650783.3	6.50 [5.50]	245.0 [6,223]	7:8	3.3	0.140 [0.037]	19.00 [3.736]	84	500 [3,410]	9,410 [12,750]	150 [115]	740 [5,120]	14,110 [19,130]	226 [172]		•				
	DD650783.3 ESX2	6.50 [5.00]	260.0 [6,604]	7:8	3.3	0.160 [0.042]	15.56 [3.059]	80	500 [3,410]	7,700 [10,440]	117 [89]	740 [5,120]	11,550 [15,660]	176 [134]	•					
	DD650783.5	6.50 [5.00]	231.3 [5,874]	7:8	3.5	0.208 [0.055]	12.50 [2.458]	83	530 [3,620]	6,560 [8,900]	104 [79]	790 [5,430]	9,840 [13,350]	156 [119]		•				
	DD650783.8 ESX3	6.50 [5.00]	299.8 [7,614]	7:8	3.8	0.158 [0.042]	15.76 [3.100]	79	570 [3,930]	8,980 [12,180]	135 [103]				•					
	DD650784.8	6.50 [5.00]	203.5 [5,169]	7:8	4.8	0.330 [0.087]	7.98 [1.569]	140	720 [4,960]	5,740 [7,790]	144 [110]	1,080 [7,450]	8,620 [11,680]	217 [165]		•	•	•		•
	DD650785.0	6.50 [5.50]	194.5 [4,940]	7:8	5.0	0.288 [0.076]	9.30 [1.829]	180	750 [5,170]	6,980 [9,460]	229 [175]	1,130 [7,760]	10,460 [14,190]	344 [262]		•	•	•		•
	DD650785.3	6.50 [5.40]	242.0 [6,147]	7:8	5.3	0.278 [0.073]	9.15 [1.799]	170	800 [5,480]	7,270 [9,860]	231 [176]	1,190 [8,220]	10,910 [14,790]	347 [264]						
	DD650786.0	6.50 [5.40]	232.0 [5,893]	7:8	6.0	0.288 [0.076]	9.30 [1.829]	180	900 [6,210]	8,370 [11,350]	275 [210]	1,350 [9,310]	12,560 [17,020]	413 [315]						•
	DD650786.7 SX3	6.50 [5.00]	299.8 [7,614]	7:8	6.7	0.278 [0.073]	9.00 [1.769]	140	1,010 [6,930]	9,040 [12,260]	239 [182]				•					
	DD650894.0	6.50 [5.25]	170.0 [4,318]	8:9	4.0	0.288 [0.076]	8.83 [1.737]	150	600 [4,140]	5,300 [7,190]	145 [111]	900 [6,210]	7,950 [10,780]	218 [166]			•			
	DD6509103.8	6.50 [5.40]	300.0 [7,620]	9:10	3.8	0.150 [0.040]	16.20 [3.186]	90	670 [4,590]	10,770 [14,610]	185 [141]				•					
6.75	DD675237.8	6.75 [5.50]	203.5 [5,169]	2:3	7.8	1.000 [0.264]	2.81 [0.553]	600	1,170 [8,070]	3,290 [4,460]	376 [286]	1,760 [12,100]	4,940 [6,690]	564 [430]	•					
	DD675453.1	6.75 [5.50]	104.5 [2,654]	4:5	3.1	0.497 [0.131]	5.77 [1.135]	300	470 [3,210]	2,680 [3,640]	152 [116]					•	•			
	DD675456.0 MX	6.75 [5.31]	230.0 [5,842]	4:5	6.0	0.491 [0.130]	6.31 [1.241]	250	900 [6,210]	5,680 [7,700]	266 [202]	1,350 [9,310]	8,520 [11,550]	398 [303]	•					
	DD675456.5 MX2	6.75 [5.50]	260.0 [6,604]	4:5	6.5	0.350 [0.092]	7.51 [1.477]	210	980 [6,720]	7,320 [9,930]	293 [223]				•					
	DD675457.0	6.75 [5.50]	210.0 [5,334]	4:5	7.0	0.497 [0.131]	5.77 [1.135]	300	1,050 [7,240]	6,060 [8,210]	344 [262]	1,580 [10,860]	9,090 [12,320]	516 [393]		•	•	•		•
	DD675564.0	6.75 [5.50]	169.5 [4,305]	5:6	4.0	0.378 [0.100]	7.00 [1.377]	190	600 [4,140]	4,200 [5,690]	151 [115]				•					
	DD675675.0	6.75 [5.50]	200.0 [5,080]	6:7	5.0	0.292 [0.077]	8.31 [1.635]	180	750 [5,170]	6,230 [8,450]	208 [158]	1,130 [7,760]	9,350 [12,680]	312 [238]		•	•	•		•
	DD675782.0	6.75 [5.50]	153.5 [3,899]	7:8	2.0	0.154 [0.041]	16.00 [3.146]	77	300 [2,070]	4,800 [6,510]	70 [54]	450 [3,100]	7,200 [9,760]	106 [80]			•			

Power Sections

									Maximum Recommended Operating Conditions						Replacement For					
Power Sections		Configuration				Performance			Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]								
Size, in	Model Number	Tube OD/ID, in [mm]	Stator Length, in [mm]	Lobes	Stages	Speed, rev/gal [rev/lit]	Torque Slope, ft-lb/psi [Nm/kPa]	Max. RPM	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Dyna-Drill	Rd&M	Mono/PV	Roper	Drilex	Weatherford
6.75	DD675782.1 ESX	6.75 [5.31]	230.0 [5,842]	7:8	2.1	0.133 [0.035]	19.50 [3.835]	67	320 [2,170]	6,140 [8,330]	78 [59]	470 [3,260]	9,210 [12,490]	117 [89]	•					•
	DD675782.9	6.75 [5.50]	220.0 [5,588]	7:8	2.9	0.160 [0.042]	15.38 [3.024]	80	440 [3,000]	6,690 [9,070]	102 [78]	650 [4,500]	10,030 [13,600]	153 [116]			•			
	DD675782.9 ESX	6.75 [5.31]	228.8 [5,810]	7:8	2.9	0.170 [0.045]	14.71 [2.893]	85	440 [3,000]	6,400 [8,680]	104 [79]	650 [4,500]	9,600 [13,020]	155 [118]	•	•				
	DD675783.0	6.75 [5.50]	125.0 [3,175]	7:8	3.0	0.283 [0.075]	9.30 [1.829]	170	450 [3,100]	4,190 [5,670]	135 [103]	680 [4,650]	6,280 [8,510]	203 [155]		•	•	•		•
	DD675783.0 Slow	6.75 [5.40]	204.0 [5,182]	7:8	3.0	0.155 [0.041]	16.00 [3.146]	93	450 [3,100]	7,200 [9,760]	127 [97]	680 [4,650]	10,800 [14,640]	191 [145]						•
	DD675783.3	6.75 [5.50]	245.0 [6,223]	7:8	3.3	0.140 [0.037]	19.00 [3.736]	84	500 [3,410]	9,410 [12,750]	150 [115]	740 [5,120]	14,110 [19,130]	226 [172]		•				
	DD675783.5 ESX2	6.75 [5.50]	260.0 [6,604]	7:8	3.5	0.150 [0.040]	17.14 [3.371]	90	530 [3,620]	9,000 [12,200]	154 [118]	790 [5,430]	13,500 [18,300]	231 [176]	•					
	DD675784.1 ESX3	6.75 [5.50]	299.8 [7,614]	7:8	4.1	0.150 [0.040]	17.07 [3.357]	90	620 [4,240]	10,500 [14,240]	180 [137]				•					
	DD675785.0	6.75 [5.50]	194.5 [4,940]	7:8	5.0	0.288 [0.076]	9.30 [1.829]	180	750 [5,170]	6,980 [9,460]	229 [175]	1,130 [7,760]	10,460 [14,190]	344 [262]		•	•	•		•
	DD675785.7 SX2	6.75 [5.50]	260.0 [6,604]	7:8	5.7	0.242 [0.064]	10.70 [2.104]	150	860 [5,900]	9,150 [12,400]	253 [192]	1,280 [8,840]	13,720 [18,600]	379 [289]	•					
	DD675786.0	6.75 [5.50]	232.0 [5,893]	7:8	6.0	0.288 [0.076]	9.30 [1.829]	180	900 [6,210]	8,370 [11,350]	275 [210]	1,350 [9,310]	12,560 [17,020]	413 [315]						•
	DD675786.4	6.75 [5.50]	245.2 [6,228]	7:8	6.4	0.288 [0.076]	9.30 [1.829]	180	960 [6,620]	8,930 [12,100]	294 [224]	1,440 [9,930]	13,390 [18,160]	441 [336]						
	DD675786.7 SX3	6.75 [5.50]	299.8 [7,614]	7:8	6.7	0.242 [0.064]	10.70 [2.104]	150	1,010 [6,930]	10,750 [14,580]	297 [226]				•					
	DD6759102.0	6.75 [5.59]	90.8 [2,305]	9:10	2.0	0.278 [0.073]	8.48 [1.668]	170	300 [2,070]	2,540 [3,450]	81 [62]	450 [3,100]	3,820 [5,170]	121 [92]					•	
	DD6759104.0	6.75 [5.59]	157.8 [4,007]	9:10	4.0	0.270 [0.071]	8.45 [1.662]	170	600 [4,140]	5,070 [6,870]	156 [119]	900 [6,210]	7,610 [10,310]	235 [179]					•	
7.00	DD700568.2	7.00 [5.50]	246.0 [6,248]	5:6	8.2	0.426 [0.113]	6.11 [1.201]	260	1,230 [8,480]	7,510 [10,190]	366 [279]	1,850 [12,720]	11,270 [15,280]	549 [418]						
	DD700785.0	7.00 [5.50]	194.5 [4,940]	7:8	5.0	0.288 [0.076]	9.30 [1.829]	180	750 [5,170]	6,980 [9,460]	229 [175]	1,500 [10,340]	13,950 [18,910]	459 [350]		•	•	•		•
	DD700786.8	7.00 [5.75]	246.0 [6,248]	7:8	6.8	0.304 [0.080]	9.56 [1.881]	190	1,020 [7,030]	9,760 [13,230]	339 [258]	1,530 [10,550]	14,630 [19,840]	508 [387]						
7.75	DD775455.3	7.75 [6.25]	228.0 [5,791]	4:5	5.3	0.253 [0.067]	11.16 [2.195]	230	800 [5,480]	8,880 [12,030]	385 [293]	1,190 [8,220]	13,310 [18,050]	577 [440]		•	•			•
	DD775456.0 MX2	7.75 [6.25]	260.0 [6,604]	4:5	6.0	0.246 [0.065]	11.33 [2.229]	230	900 [6,210]	10,200 [13,830]	429 [327]	1,350 [9,310]	15,300 [20,740]	644 [491]	•					
	DD775783.0	7.75 [6.25]	160.0 [4,064]	7:8	3.0	0.166 [0.044]	16.59 [3.262]	150	450 [3,100]	7,470 [10,120]	212 [162]	680 [4,650]	11,200 [15,180]	319 [243]		•	•	•		•
	DD775784.0	7.75 [6.25]	203.2 [5,161]	7:8	4.0	0.166 [0.044]	16.59 [3.262]	150	600 [4,140]	9,950 [13,490]	283 [216]	900 [6,210]	14,930 [20,240]	425 [324]		•	•	•		•
	DD7759103.0 ESX	7.75 [6.50]	234.0 [5,944]	9:10	3.0	0.112 [0.030]	24.56 [4.829]	110	450 [3,100]	11,050 [14,980]	212 [162]				•					
8.00	DD800452.7	8.00 [6.50]	129.5 [3,289]	4:5	2.7	0.239 [0.063]	11.00 [2.163]	220	410 [2,790]	4,450 [6,040]	182 [139]									
	DD800455.3	8.00 [6.25]	228.0 [5,791]	4:5	5.3	0.253 [0.067]	11.16 [2.195]	230	800 [5,480]	8,880 [12,030]	385 [293]	1,190 [8,220]	13,310 [18,050]	577 [440]		•	•			•

Power Sections

									Maximum Recommended Operating Conditions						Replacement For					
Power Sections		Configuration				Performance			Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]								
Size, in	Model Number	Tube OD/ID, in [mm]	Stator Length, in [mm]	Lobes	Stages	Speed, rev/gal [rev/lit]	Torque Slope, ft-lb/psi [Nm/kPa]	Max. RPM	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Pressure Difference, psi [kPa]	Torque, ft-lb [Nm]	Power, hp [kW]	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford
8.00	DD800456.0 MX2	8.00 [6.25]	260.0 [6,604]	4:5	6.0	0.246 [0.065]	11.33 [2.229]	230	900 [6,210]	10,200 [13,830]	429 [327]				•					
	DD800566.0 MX	8.00 [6.50]	234.0 [5,944]	5:6	6.0	0.248 [0.066]	11.33 [2.229]	230	900 [6,210]	10,200 [13,830]	433 [330]				•					
	DD800782.5	8.00 [6.25]	254.0 [6,452]	7:8	2.5	0.080 [0.021]	30.98 [6.091]	72	380 [2,590]	11,620 [15,750]	159 [121]									
	DD800783.0	8.00 [6.25]	160.0 [4,064]	7:8	3.0	0.166 [0.044]	16.59 [3.262]	150	450 [3,100]	7,470 [10,120]	212 [162]	680 [4,650]	11,200 [15,180]	319 [243]		•	•	•		•
	DD800783.4 ESX3	8.00 [6.50]	300.0 [7,620]	7:8	3.4	0.089 [0.023]	28.04 [5.514]	81	510 [3,520]	14,300 [19,390]	218 [166]	770 [5,270]	21,450 [29,080]	327 [249]	•					
	DD800784.0	8.00 [6.25]	203.2 [5,161]	7:8	4.0	0.166 [0.044]	16.59 [3.262]	150	600 [4,140]	9,950 [13,490]	283 [216]	900 [6,210]	14,930 [20,240]	425 [324]		•	•	•		•
	DD8009103.0 ESX	8.00 [6.50]	234.0 [5,944]	9:10	3.0	0.112 [0.030]	24.56 [4.829]	110	450 [3,100]	11,050 [14,980]	212 [162]	680 [4,650]	16,580 [22,470]	318 [242]	•					
9.62	DD962346.0	9.62 [7.87]	228.0 [5791]	3:4	6.0	0.221 [0.058]	12.75 [2.507]	270	900 [6,210]	11,480 [15,560]	579 [442]	1,350 [9,310]	17,210 [23,340]	869 [662]		•	•			•
	DD962562.5	9.62 [7.87]	164.0 [4,166]	5:6	2.5	0.117 [0.031]	20.80 [4.090]	150	380 [2,590]	7800 [10,580]	209 [159]				•					
	DD962563.0	9.62 [7.87]	178.0 [4,521]	5:6	3.0	0.113 [0.030]	24.32 [4.782]	140	450 [3,100]	10,940 [14,840]	283 [215]					•	•	•		
	DD962564.0	9.62 [7.87]	228.0 [5,791]	5:6	4.0	0.122 [0.032]	21.37 [4.203]	150	600 [4,140]	12,820 [17,390]	357 [272]	900 [6,210]	19,240 [26,080]	536 [409]						
	DD962565.0 MX	9.62 [7.87]	232.0 [5,893]	5:6	5.0	0.138 [0.036]	21.49 [4.225]	170	750 [5,170]	16,120 [21,850]	506 [386]	1130 [7,760]	24,170 [32,770]	759 [579]	•					•
	DD962675.0	9.62 [7.87]	218.0 [5,537]	6:7	5.0	0.127 [0.034]	20.31 [3.993]	160	750 [5,170]	15,230 [20,650]	442 [337]	1130 [7,760]	22,840 [30,970]	663 [505]						
	DD962783.9 ESX3	9.62 [7.87]	300.0 [7,620]	7:8	3.9	0.068 [0.018]	38.46 [7.563]	82	590 [4,030]	22,500 [30,510]	350 [266]	880 [6,050]	33,750 [45,760]	524 [400]	•					
	DD962784.8	9.62 [7.87]	246.5 [6,261]	7:8	4.8	0.144 [0.038]	22.27 [4.379]	180	720 [4,960]	16,030 [21,740]	528 [402]	1,080 [7,450]	24,050 [32,610]	791 [603]						
	DD962786.5 SX3	9.62 [7.87]	300.0 [7,620]	7:8	6.5	0.113 [0.030]	23.08 [4.538]	140	980 [6,720]	22,500 [30,510]	581 [443]				•					
11.25	DD1125564.6	11.25 [9.25]	230.0 [5,842]	5:6	4.6	0.089 [0.024]	31.59 [6.213]	170	690 [4,760]	21,800 [29,560]	665 [507]	1,040 [7,140]	32,700 [44,330]	997 [760]	•					
	DD1125784.8	11.25 [7.85]	246.5 [6,261]	7:8	4.8	0.114 [0.030]	22.26 [4.377]	140	720 [4,960]	16,030 [21,730]	417 [318]	1,080 [7,450]	24,040 [32,590]	626 [477]						
11.50	DD1150564.6	11.50 [9.25]	230.0 [5,842]	5:6	4.6	0.089 [0.024]	31.59 [6.213]	170	690 [4,760]	21,800 [29,560]	665 [507]	1,040 [7,140]	32,700 [44,330]	997 [760]	•					
	DD1150565.0	11.50 [7.87]	232.0 [5,893]	5:6	5.0	0.135 [0.036]	19.24 [3.783]	180	750 [5,170]	14,430 [19,560]	482 [367]	1,130 [7,760]	21,640 [29,340]	723 [551]						
	DD1150783.9	11.50 [7.87]	300.0 [7,620]	7:8	3.9	0.071 [0.019]	35.94 [7.067]	130	590 [4,030]	21,020 [28,510]	509 [388]	880 [6,050]	31,540 [42,760]	764 [582]	•					

Power Sections		Replacement For						Maximum Recommended Operating Conditions						
								Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]			
Size, in	Model Number	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford	Standard, in [mm]	Oversize, in [mm]	Double Oversize in [mm]	Undersize, in [mm]	Standard, in [mm]	Oversize, in [mm]	Double Oversize, in [mm]
1.68	DD168562.3		•						–0.005 [–0.13]			0.005 [0.13]		
	DD168564.0		•			•			–0.021 [–0.53]			–0.010 [–0.25]		
	DD168564.4		•			•						–0.007 [–0.18]		
2.13	DD213564.0		•			•			–0.003 [–0.08]			0.009 [0.23]		
	DD213564.9		•			•						–0.002 [–0.05]		
2.38	DD238564.0					•			–0.011 [–0.28]					
2.87	DD287124.9											0.022 [0.56]		
	DD287562.6	•						–0.003 [–0.08]			0.003 [0.08]			
	DD287564.7												0.011 [0.28]	
	DD287567.0		•					0.016 [0.41]	–0.002 [–0.05]	–0.015 [–0.38]		0.015 [0.38]	0.002 [0.05]	
	DD287783.5		•						–0.010 [–0.25]			–0.001 [–0.03]		
3.13	DD313783.0			•						–0.020 [–0.51]			–0.020 [–0.51]	
	DD338563.0		•			•						–0.016 [–0.41]		
3.38	DD338783.0		•					0.008 [0.20]			0.016 [0.41]			
	DD338784.7													
3.50	DD350563.0		•			•						–0.016 [–0.41]		
	DD350784.3		•					0.020 [0.51]	0.002 [0.05]			0.018 [0.46]		
3.75	DD375238.0	•						–0.003 [–0.08]						
	DD375349.0				•				–0.018 [–0.46]					
	DD375452.0											0.021 [0.53]		
	DD375453.5		•	•	•			0.021 [0.53]	–0.012 [–0.30]			0.021 [0.53]		
	DD375563.0		•			•						–0.016 [–0.41]		
	DD375563.8		•					0.020 [0.51]						
	DD375564.2	•						0.004 [0.10]						
	DD375782.3		•	•	•			0.019 [0.48]			0.036 [0.91]	0.012 [0.30]		
	DD375786.7		•						0.007 [0.18]	–0.032 [–0.81]		0.020 [0.51]	–0.015 [–0.38]	
	DD3757810.1		•					0.010 [0.25]						
4.75	DD475127.0				•			0.033 [0.84]	–0.007 [–0.18]			0.028 [0.71]		
	DD475238.5	•						–0.001 [–0.03]					–0.037 [–0.94]	
	DD475453.5		•	•	•			0.005 [0.13]			0.020 [0.51]			
	DD475456.0		•	•	•		•	0.015 [0.38]	–0.004 [–0.10]	–0.031 [–0.79]		0.012 [0.30]	–0.008 [–0.20]	
	DD475456.3		•	•			•	0.009 [0.23]	–0.009 [–0.23]	–0.037 [–0.94]		0.012 [0.30]	–0.008 [–0.20]	
	DD475456.5 MX	•						–0.010 [–0.25]						
	DD475564.0	•						–0.022 [–0.56]						
	DD475566.0	•						0.002 [0.05]						
	DD475566.7	•						0.002 [0.05]					–0.012 [–0.30]	
	DD475568.3		•					0.013 [0.33]	–0.015 [–0.38]			0.013 [0.33]	–0.011 [–0.28]	
	DD475782.0								0.001 [0.03]			0.021 [0.53]		–0.023 [–0.58]
	DD475782.1	•						0.012 [0.30]						
	DD475782.2		•	•	•			0.019 [0.48]	–0.002 [–0.05]		0.030 [0.76]	0.016 [0.41]		
	DD475782.2 SLOW													–0.025 [–0.64]
	DD475782.6 ESX	•						0.011 [0.28]	–0.013 [–0.33]		0.027 [0.69]	0.003 [0.08]	–0.009 [–0.23]	
	DD475782.9			•					–0.006 [–0.15]			0.009 [0.23]		
	DD475783.1		•									0.002 [0.05]		
	DD475783.7												–0.007 [–0.18]	

Power Sections

Power Sections		Replacement For						Maximum Recommended Operating Conditions						
								Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]			
Size, in	Model Number	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford	Standard, in [mm]	Oversize, in [mm]	Double Oversize in [mm]	Undersize, in [mm]	Standard, in [mm]	Oversize, in [mm]	Double Oversize, in [mm]
4.75	DD475783.8		•	•	•		•	0.013 [0.33]	–0.003 [–0.08]	–0.019 [–0.48]		0.009 [0.23]	–0.005 [–0.13]	–0.024 [–0.61]
	DD475784.5 SX	•						0.005 [0.13]	–0.013 [–0.33]			0.003 [0.08]	–0.014 [–0.36]	–0.032 [–0.81]
	DD475785.0								–0.006 [–0.15]	–0.022 [–0.56]		0.001 [0.03]	–0.014 [–0.36]	
5.00	DD500568.3		•										–0.023 [–0.58]	
	DD500678.0								–0.004 [–0.10]			0.017 [0.43]	0.001 [0.03]	
	DD500782.2		•	•	•		•	0.019 [0.48]	–0.002 [–0.05]			0.016 [0.41]		
	DD500782.6 ESX	•						0.011 [0.28]	–0.013 [–0.33]		0.027 [0.69]	0.003 [0.08]		–0.014 [–0.36]
	DD500783.0 ESX2	•						0.013 [0.33]	–0.009 [–0.23]			0.013 [0.33]		
	DD500783.1		•						–0.002 [–0.05]			0.010 [0.25]		
	DD500783.7												–0.007 [–0.18]	
	DD500783.8		•	•	•		•	0.013 [0.33]	–0.003 [–0.08]	–0.019 [–0.48]		0.009 [0.23]	–0.005 [–0.13]	
	DD500784.5 SX	•						0.005 [0.13]	–0.013 [–0.33]			0.003 [0.08]	–0.014 [–0.36]	–0.024 [–0.61]
	DD500788.2												–0.014 [–0.36]	–0.032 [–0.81]
6.25	DD625457.5		•	•				0.017 [0.43]	–0.019 [–0.48]			0.011 [0.28]		
	DD625675.0							0.016 [0.41]		–0.015 [–0.38]	0.034 [0.86]	0.018 [0.46]	0.003 [0.08]	–0.029 [–0.74]
	DD625782.5		•					0.015 [0.38]	–0.005 [–0.13]			0.007 [0.18]		
	DD625782.8		•	•			•	0.022 [0.56]	0.001 [0.03]			0.022 [0.56]		
	DD625782.9 ESX	•	•					0.001 [0.03]	–0.017 [–0.43]		0.027 [0.69]			
	DD625783.0 Slow						•	0.004 [0.10]						
	DD625783.3 ESX2	•						0.010 [0.25]	–0.017 [–0.43]			0.004 [0.10]		
	DD625783.5		•						–0.005 [–0.13]			0.013 [0.33]		
	DD625783.8 ESX3	•						0.005 [0.13]						
	DD625784.0								–0.017 [–0.43]			0.008 [0.20]		
	DD625784.8		•	•	•		•	0.027 [0.69]	–0.001 [–0.03]			0.008 [0.20]		
	DD625786.7 SX3	•						–0.005 [–0.13]						
6.50	DD650124.0							0.075 [1.91]						
	DD650237.8	•						0.003 [0.08]			0.011 [0.28]			
	DD650457.0		•	•	•		•	0.029 [0.74]	0.004 [0.10]			0.013 [0.33]		
	DD650457.5		•	•				0.017 [0.43]	–0.019 [–0.48]			0.011 [0.28]		
	DD650563.5	•						0.040 [1.02]						
	DD650675.0		•	•	•		•	0.001 [0.03]	–0.020 [–0.51]			–0.005 [–0.13]		
	DD650782.1 ESX	•					•	–0.014 [–0.36]			0.028 [0.71]			
	DD650782.8		•	•			•		0.001 [0.03]			0.022 [0.56]		
	DD650782.9 ESX	•	•					0.001 [0.03]	–0.017 [–0.43]		0.027 [0.69]			
	DD650783.0		•	•	•		•	0.023 [0.58]	0.005 [0.13]	–0.029 [–0.74]		0.013 [0.33]	–0.004 [–0.10]	
	DD650783.0 Slow						•	0.015 [0.38]	–0.004 [–0.10]			0.015 [0.38]		
	DD650783.3		•					0.262 [6.65]	–0.013 [–0.33]			0.004 [0.10]		
	DD650783.3 ESX2	•						0.002 [0.05]	–0.017 [–0.43]		0.016 [0.41]	0.004 [0.10]		
	DD650783.5		•						–0.005 [–0.13]			0.013 [0.33]		
	DD650783.8 ESX3	•						0.005 [0.13]						
	DD650784.8		•	•	•		•	0.027 [0.69]	–0.001 [–0.03]			0.008 [0.20]		
	DD650785.0		•	•	•		•	0.027 [0.69]	0.005 [0.13]	–0.029 [–0.74]		0.013 [0.33]	–0.004 [–0.10]	
	DD650785.3												–0.012 [–0.30]	
	DD650786.0						•	0.029 [0.74]	0.005 [0.13]			0.013 [0.33]		
	DD650786.7 SX3	•						–0.005 [–0.13]						

Power Sections		Replacement For						Maximum Recommended Operating Conditions						
								Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]			
Size, in	Model Number	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford	Standard, in [mm]	Oversize, in [mm]	Double Oversize in [mm]	Undersize, in [mm]	Standard, in [mm]	Oversize, in [mm]	Double Oversize, in [mm]
6.50	DD650894.0			•					–0.004 [–0.10]			0.013 [0.33]		
	DD6509103.8	•						0.005 [0.13]						
6.75	DD675237.8	•						0.003 [0.08]	–0.009 [–0.23]			0.003 [0.08]	–0.020 [–0.51]	
	DD675453.1		•	•				0.021 [0.53]						
	DD675456.0 MX	•						–0.028 [–0.71]	–0.056 [–1.42]			–0.032 [–0.81]		
	DD675456.5 MX2	•						–0.003 [–0.08]						
	DD675457.0		•	•	•		•	0.021 [0.53]		–0.030 [–0.76]		0.003 [0.08]	–0.026 [–0.66]	–0.026 [–0.66]
	DD675564.0	•						–0.006 [–0.15]						
	DD675675.0		•	•	•		•	0.001 [0.03]	–0.020 [–0.51]		0.027 [0.69]	–0.005 [–0.13]	–0.015 [–0.38]	
	DD675782.0			•				0.003 [0.08]			0.026 [0.66]			–0.026 [–0.66]
	DD675782.1 ESX	•					•	0.006 [0.15]	–0.011 [–0.28]		0.028 [0.71]	–0.001 [–0.03]		
	DD675782.9			•				0.013 [0.33]	–0.012 [–0.30]			0.013 [0.33]		–0.031 [–0.79]
	DD675782.9 ESX	•	•					–0.002 [–0.03]				–0.007 [–0.15]		
	DD675783.0		•	•	•		•	0.023 [0.58]	0.005 [0.13]	–0.029 [–0.74]		0.013 [0.33]	–0.004 [–0.10]	
	DD675783.0 Slow						•	0.015 [0.38]	–0.004 [–0.10]			0.015 [0.38]		–0.020 [–0.51]
	DD675783.3		•					0.004 [0.10]	–0.013 [–0.33]			0.004 [0.10]		
	DD675783.5 ESX2	•						0.012 [0.30]	–0.016 [–0.41]			0.005 [0.13]		
	DD675784.1 ESX3	•						0.007 [0.18]						
	DD675785.0		•	•	•		•	0.027 [0.69]	0.005 [0.13]	–0.029 [–0.74]		0.013 [0.33]	–0.004 [–0.10]	
	DD675785.7 SX2	•						0.005 [0.13]	–0.028 [–0.71]		0.014 [0.36]	–0.006 [–0.15]	–0.014 [–0.36]	
	DD675786.0						•	0.031 [0.79]	0.005 [0.13]			0.013 [0.33]	–0.015 [–0.38]	
	DD675786.4											0.013 [0.33]		
	DD675786.7 SX3	•						0.007 [0.18]						–0.020 [–0.51]
	DD6759102.0					•		0.018 [0.46]			0.025 [0.64]			
	DD6759104.0					•		0.008 [0.20]			0.026 [0.66]			
7.00	DD700568.2									–0.019 [–0.48]		0.013 [0.33]	–0.004 [–0.10]	–0.012 [–0.30]
	DD700785.0		•	•	•		•	0.027 [0.69]	–0.002 [–0.05]	–0.029 [–0.74]		0.021 [0.53]	–0.004 [–0.10]	
	DD700786.8							0.020 [0.51]	–0.011 [–0.28]	–0.041 [–1.04]		0.013 [0.33]	–0.017 [–0.43]	
7.75	DD775455.3		•	•			•	0.025 [0.63]	–0.005 [–0.13]			0.013 [0.33]		
	DD775456.0 MX2	•						0.007 [0.18]			0.027 [0.69]			
	DD775783.0		•	•	•		•	0.019 [0.48]	–0.006 [–0.15]			0.012 [0.30]		
	DD775784.0		•	•	•		•	0.019 [0.48]	–0.006 [–0.15]	–0.031 [–0.79]		0.012 [0.30]	–0.013 [–0.33]	
	DD7759103.0 ESX	•						0.001 [0.03]						–0.020 [–0.51]
8.00	DD800452.7							0.015 [0.38]						
	DD800455.3		•	•			•	0.025 [0.63]	–0.005 [–0.13]			0.013 [0.33]		–0.012 [–0.30]
	DD800456.0 MX2	•						0.007 [0.18]						
	DD800566.0 MX	•						–0.030 [–0.76]						
	DD800782.5							0.013 [0.33]						
	DD800783.0		•	•	•		•	0.015 [0.38]	0.001 [0.03]			0.004 [0.10]		
	DD800783.4 ESX3	•										–0.004 [–0.10]		
	DD800784.0		•	•	•		•	0.019 [0.48]	–0.006 [–0.15]			0.012 [0.30]	–0.013 [–0.33]	
	DD8009103.0 ESX	•						0.001 [0.03]			0.012 [0.30]			
9.62	DD962346.0		•	•			•	0.013 [0.33]						
	DD962562.5	•						0.035 [0.89]						
	DD962563.0		•	•	•			0.042 [1.07]						

Power Sections		Replacement For						Maximum Recommended Operating Conditions						
								Standard Rubber [NBR-1A]			Hard Rubber [NBR-HR]			
Size, in	Model Number	Dyna-Drill	R&M	Mono/PV	Roper	Drilex	Weatherford	Standard, in [mm]	Oversize, in [mm]	Double Oversize in [mm]	Undersize, in [mm]	Standard, in [mm]	Oversize, in [mm]	Double Oversize, in [mm]
9.62	DD962564.0							0.033 [0.84]	0.001 [0.03]	–0.025 [–0.63]		0.024 [0.61]	–0.005 [–0.13]	
	DD962565.0 MX	•					•	–0.023 [–0.58]	–0.060 [–1.52]			–0.050 [–1.27]		–0.023 [–0.58]
	DD962675.0							0.019 [0.48]		–0.018 [–0.46]		0.018 [0.46]		
	DD962783.9 ESX3	•						0.002 [0.05]			0.031 [0.79]			
	DD962784.8							0.037 [0.94]	0.021 [0.53]	–0.007 [–0.18]		0.029 [0.74]		
	DD962786.5 SX3	•						0.002 [0.05]						
11.25	DD1125564.6	•						0.011 [0.28]				0.011 [0.28]		–0.023 [–0.58]
	DD1125784.8											0.022 [0.56]	–0.009 [–0.23]	
11.50	DD1150564.6	•						0.011 [0.28]				0.011 [0.28]		
	DD1150565.0							–0.023 [–0.58]				–0.050 [–1.27]		
	DD1150783.9	•						0.002 [0.05]						

Drilling Tools

DynaForce TT High-Performance Thru-Tubing Motors

Applications

- Coiled tubing and thru-tubing equipment
- Frac and bridge plug milling, scale, cement, barium, etc.
- Cleanout operations with venturi jet baskets
- Thru-tubing underreaming and sidetracking

Benefits

- Saves time thorough a reduced number of connections
- Can perform multiple jobs between maintenance intervals

Features

- Highest power output in the industry
- Strong torque generation throughout the full flow range
- Fully designed, engineered, manufactured, assembled, and supported in-house
- Premium materials maximize strength and performance
- Rotor catch available on sizes 2.88 in and above

Schlumberger DynaForce TT* high-performance thru-tubing motors provide the highest mechanical power output of any conventional thru-tubing motor in the industry for any given model.

Power Section

The power section of the DynaForce TT motor features a hard, high-performance NBR-HR elastomer that can sustain up to a 350 degF working temperature. The extensively engineered profile design of the power sections, combined with countless hours of testing and validation, maximize efficiency and the power ratio to provide the industry's highest mechanical HP of any conventional motor. The DynaForce TT motor can be used in a nitrogen mixture of up to 60% gas.

This high-performance power section outputs power consistently throughout the life of the stator and drastically reduces debonding-related issues by using specifically designed and formulated bonding agents.

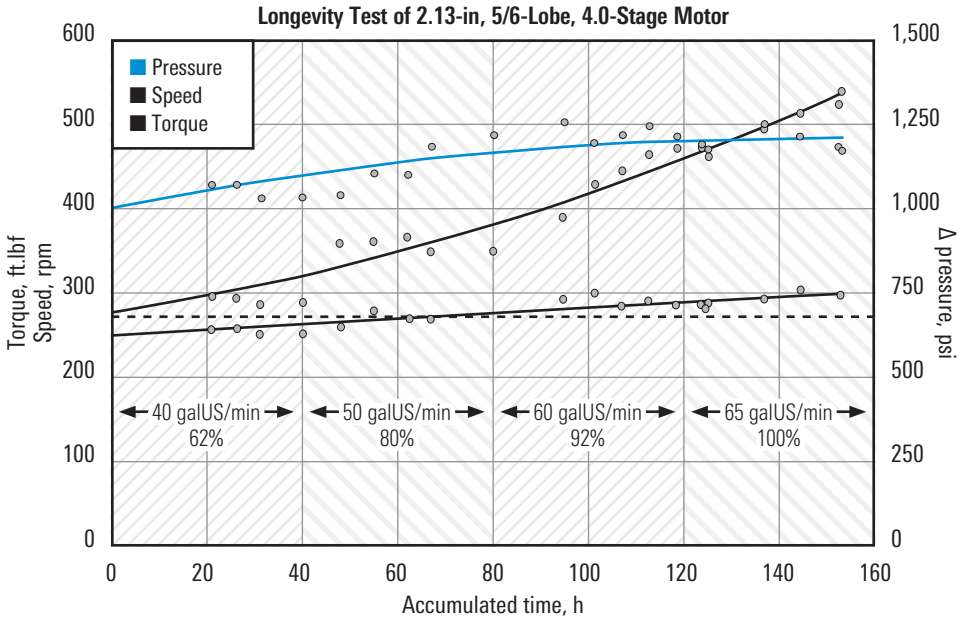
Lower End

The lower end of the DynaForce TT motor was designed in a modular fashion to accommodate a variety of power sections for any given size (OD), enabling the customer to switch only the power section to dramatically reduce final operational costs. In addition, the low maintenance design of the mud-lubricated lower end was designed to work seamlessly with all power sections. The trust bearing pack offers the choice between standard ball bearings or our patented diamond bearings for even more longevity.

The lower end features high-flow internals for improved annular velocity while displacing milling solids. It has a low-stress driveshaft catch and optimized connections for extreme torque output. It has a one-piece transmission with no moving parts, which enables it to withstand extreme torque.

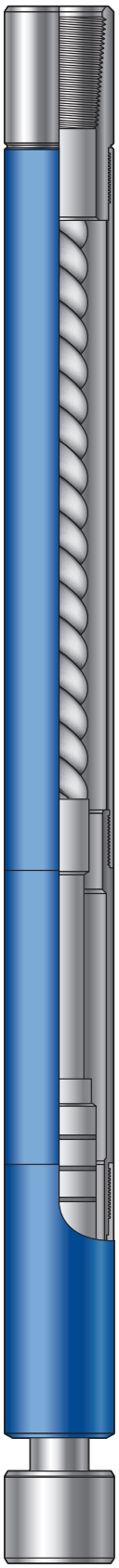
Fits

Schlumberger offers a variety of fits, with a choice of 2–3 stators and 2–3 rotors per model, for optimal performance at temperatures from 80 degF to 350 degF. If higher temperature resistance is needed, we offer other elastomer options to fit your needs.



Specifications

Motor Size, in	Lobes	Stages	Overall Length, ft	Weight, lbm	Flow Rate, galUS/min	Speed (rev/gal)	Max. Diff. Pressure, psi	Operation Torque, ft.lbf	Stall Torque, ft.lbf	Power, hp	Max.Temp., degF	WOB Capacity, lbf	Overpull Capacity, lbf
1 11/16	5/6	2.3	9.0	50	20–42	9.25	580	160	240	12	350	2,500	57,850
	5/6	4.0	8.8	47	20–42	16.31	1,000	170	250	22	350	2,500	57,850
2⅛	5/6	4.0	10.0	83	30–65	9.57	1,000	270	410	32	350	5,000	94,890
	5/6	4.9	11.1	97	30–65	9.57	1,230	340	510	41	350	5,000	94,890
2⅜	5/6	4.0	10.5	95	40–80	7.18	1,000	360	530	40	300	5,000	94,890
2⅞	7/8	3.5	12.2	179	60–120	3.38	880	570	850	52	350	12,500	150,960
	5/6	3.5	13.8	198	60–120	4.00	880	610	910	48	350	12,500	150,960
	5/6	4.7	13.8	450	60–145	3.73	1,175	820	1,250	64	350	12,500	150,960
	5/6	5.0	15.3	202	90–170	2.91	1,250	1,120	1,670	96	350	12,500	150,960
	5/6	7.0	15.3	202	60–120	5.74	1,750	850	1,300	112	350	12,500	150,960
3⅛	7/8	3.0	15.8	395	80–160	1.69	750	1,120	1,670	60	300	14,500	208,150
	7/8	3.3	16.6	375	120–210	1.49	830	1,510	2,260	92	350	14,500	208,150
3⅜	7/8	3.0	17.3	398	80–160	1.39	680	1,260	1,890	55	300	14,500	208,150
	7/8	4.7	18.2	405	120–210	1.85	1,060	1,520	2,280	113	300	14,500	208,150



Neyrfor TTT Thru-Tubing Turbodrill

Applications

- HPHT conditions (500 degF [260.0 degC])
- Underbalanced drilling operations
- Acid treatments
- Milling of scale, cement, barium, bridge and frac plugs, and steel
- Openhole sidetracking from cement plug or whipstock
- Directional drilling
- Well deepening
- Coiled tubing operations

Advantages

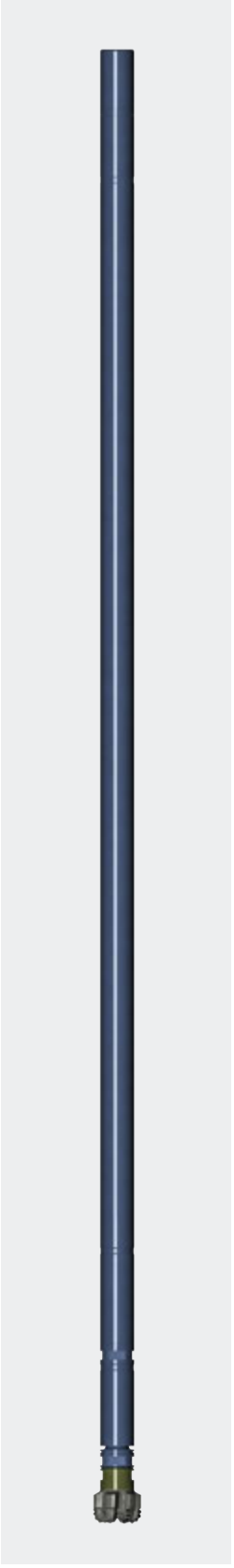
- Immune to mud additives, drill solids, and high temperatures
- Powerful output of 73 hp at nominal speed
- Efficient operation with single- or dual-phase drilling fluids without decrease in output power, reliability, or durability
- Capability of performing multiple jobs between required maintenance

Neyrfor TTT* thru-tubing turbodrills for coiled tubing deliver the industry's highest downhole mechanical power output by efficiently converting hydraulic energy into mechanical energy. These turbodrilling systems produce tailored power output with optimal efficiency for the most demanding applications. All-metallic construction makes these systems immune to temperature and acid. The Neyrfor TTT turbodrill drivetrain delivers excellent performance in two-phase, gas-cut mud systems—regardless of gas-cut mud or solids content.

Neyrfor TTT turbodrills are available in 2.125 and 2.88-in diameters and in configurations that supply the optimal mechanical power in any downhole condition and with any type of drilling fluid—standard power (T1), extended power (T1XL), and double power (T2). These high-performance turbodrills produce 73 hp at nominal speeds. When compared with typical positive-displacement motors (PDMs), the Neyrfor TTT turbodrills produce 50 hp more.

Specifications		
Max. OD, in [mm]	2.125 [54]	2.88 [73]
Overall length, ft [m]	12.12 [3.69]	15.9 [4.8]
Max. downhole temperature, degF [degC]	500 [260]	572 [300]
Flow rate, galUS/min [m^3/min]	40–65 [0.15–0.24]	100–120 [0.38–0.45]
Stall torque, ft.lbf [N.m]	107 [145]	96 [130]
Operating speed, rpm	2,880–4,680	2,000-2,500
Runaway speed (water), rpm	5,660–8,910	4,000-4,500
Speed per flow rate, rpm/galUS	72	20.4
Overpull capacity,† lbf [N]	41,200 [183,267]	60,000 [26,6893]
Shipping weight, lbm [kg]	233 [106]	284 [129]
Connections		
Top	1½ Reg box	2⅜-in PAC
Bottom	1½ Reg pin	2⅜-in PAC
Max. mud weight, lbm/galUS [kg/m^3]	10 [1,198]	18 [2,157]

† Subsequent service in shop recommended for excess of 30,000 lbf applied to string.



Neyrfor TTT thru-tubing turbodrill for coiled tubing.

Thru-Tubing Turbomill

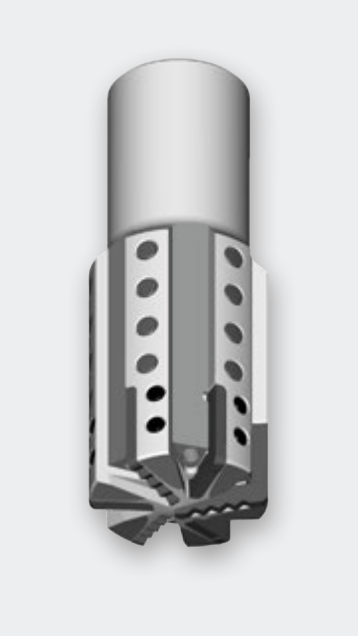
The thru-tubing turbomill is specifically designed for coiled tubing cleanouts and is used with the Neyrfor TTT 2.88-in turbodrill.

Applications

- Scale cleanouts
- Milling Copperhead* drillable bridge and frac plugs
- Milling composite bridge plugs
- High-temperature conditions
- Low-pressure conditions where nitrogen is used to maintain well flow

Features

- Extended gauge protection combats turbodrill's output speed
- Two rows diamond-enhanced insert (DEI) gauge inserts ensures durability
- Limited-depth cutting profile reduces torque demand cuttings production
- Box connection matches Neyrfor TTT 2.88-in turbodrill



Thru-tubing turbomill.

Thru-Tubing Turbomill Specifications

OD, in [mm]	Overall Length, in [mm]	Fishing Neck OD, in [mm]	Fishing Neck Length, in [mm]	Connection
3.25 [83]	10 [254]	2.88 [73]	4 [102]	2.38-in PAC box
3.50 [89]	10 [254]	2.88 [73]	4 [102]	2.38-in PAC box
3.63 [92]	10 [254]	2.88 [73]	4 [102]	2.38-in PAC box
3.75 [95]	10 [254]	2.88 [73]	4 [102]	2.38-in PAC box
3.88 [99]	10 [254]	2.88 [73]	4 [102]	2.38-in PAC box
4.38 [111]	10.50 [257]	2.88 [73]	4 [102]	2.38-in PAC box
4.42 [112]	10.50 [267]	2.88 [73]	4 [102]	2.38-in PAC box
4.63 [118]	10.50 [267]	2.88 [73]	4 [102]	2.38-in PAC box

i-MILL TT Intervention Mill

Applications

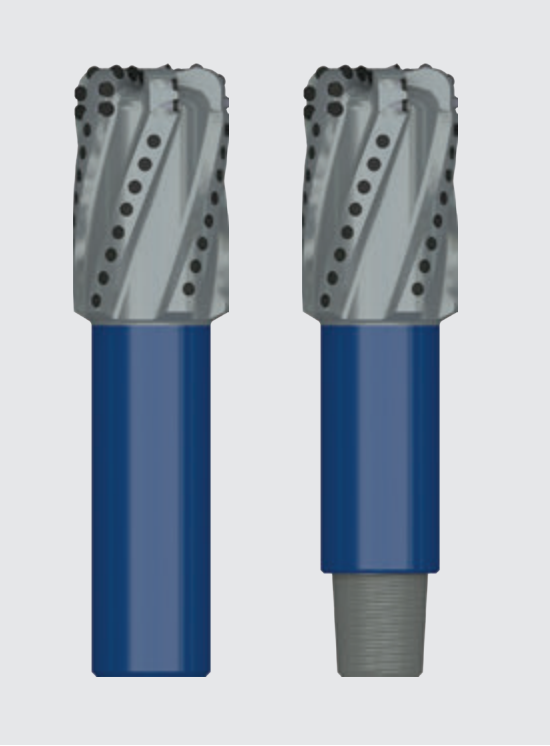
- Cleaning out scale, cement, barium, steel, and bridge and frac plugs in thru-tubing operations
- Thru-tubing underreaming
- Milling gauges that must be customized to desired drift of tubing or liner

Advantages

- Protects completions with extended gauge
- Comes dressed with TCI inserts
- Can be upgraded with PDC inserts for better performance
- Removes manual welding of crushed carbide
- Produces small uniform cuttings
- Requires less torque
- Comes with pin or box connection to match thru-tubing PDMs and Neyrfor TTT turbodrills

The i-MILL TT* intervention mill was developed using IDEAS* integrated dynamic design and analysis platform to ensure a balanced and consistent milling profile capable of efficiently clearing cement and scale from tubing or liners. For application flexibility, the mill can be fitted with the type of insert that will best mill the restricting material.

The diameter of the mill can also be honed to meet specific gauge requirements. It operates at low torque and provides extended gauge protection for completions while producing small and uniform cuttings. The i-MILL TT intervention mill on a thru-tubing PDM is the most effective mill for clearing cement or scale from tubing or liners to advance production or return flow to acceptable levels.



i-MILL TT intervention mill with box connection (left) and pin connection (right).

i-MILL TT Intervention Mill Specifications

OD, in [mm]	Overall Length, in [mm]	Part Number (TCI Inserts)	Fishing Neck OD, in [mm]	Fishing Neck Length, ft [m]	Connection
3.50 [89]	12.2 [310]	80017088	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
3.50 [89]	12.2 [310]	80017085	2.88 [73]	6 [1.83]	2.38 PAC box
3.63 [92]	12.3 [312]	80017084	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
3.63 [92]	12.3 [312]	80017083	2.88 [73]	6 [1.83]	2.38 PAC box
3.75 [95]	12.3 [312]	80017087	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
3.75 [95]	12.3 [312]	80017086	2.88 [73]	6 [1.83]	2.38 PAC box
3.88 [98]	12.4 [315]	80017526	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
3.75 [95]	12.4 [315]	80017523	2.88 [73]	6 [1.83]	2.38 PAC box
3.90 [99]	12.4 [315]	80017525	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
3.90 [99.06]	12.4 [315]	80017522	2.88 [73]	6 [1.83]	2.38 PAC box
4 [102]	12.4 [315]	80017524	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4 [102]	12.4 [315]	80017521	2.88 [73]	6 [1.83]	2.38 PAC box
4.13 [105]	12.6 [320]	80017708	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.13 [105]	12.6 [320]	80017709	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.13 [105]	12.6 [320]	80017704	2.88 [73]	6 [1.83]	2.38 PAC box
4.25 [108]	12.6 [320]	80017707	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.25 [108]	12.6 [320]	80017705	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.25 [108]	12.6 [320]	80017704	2.88 [73]	6 [1.83]	2.38 PAC box
4.40 [112]	12.4 [315]	80017075	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.40 [112]	12.4 [315]	80017076	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.40 [112]	12.4 [315]	80017074	2.88 [73]	6 [1.83]	2.38 PAC box
4.50 [114]	12.4 [315]	80017061	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.50 [114]	12.4 [315]	80017062	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.50 [114]	12.4 [315]	80017060	2.88 [73]	6 [1.83]	2.38 PAC box
4.63 [118]	12.4 [315]	80017058	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.63 [118]	12.4 [315]	80017059	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.63 [118]	12.4 [315]	80017057	2.88 [73]	6 [1.83]	2.38 PAC box
4.75 [121]	12.8 [325]	80017718	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.75 [121]	12.8 [325]	80017717	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.75 [121]	12.8 [325]	80017716	2.88 [73]	6 [1.83]	2.38 PAC box
4.25 [108]	12.6 [320]	80017704	2.88 [73]	6 [1.83]	2.38 PAC box
4.40 [112]	12.4 [315]	80017075	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.40 [112]	12.4 [315]	80017076	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.40 [112]	12.4 [315]	80017074	2.88 [73]	6 [1.83]	2.38 PAC box
4.50 [114]	12.4 [315]	80017061	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.50 [114]	12.4 [315]	80017062	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.50 [114]	12.4 [315]	80017060	2.88 [73]	6 [1.83]	2.38 PAC box
4.63 [118]	12.4 [315]	80017058	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.63 [118]	12.4 [315]	80017059	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.63 [118]	12.4 [315]	80017057	2.88 [73]	6 [1.83]	2.38 PAC box
4.75 [121]	12.8 [325]	80017718	2.88 [73]	6 [1.83]	2.38 PAC DSI pin
4.75 [121]	12.8 [325]	80017717	3.38 [86]	6 [1.83]	2.38 PAC DSI pin
4.75 [121]	12.8 [325]	80017716	2.88 [73]	6 [1.83]	2.38 PAC box

TrackMaster TT Thru-Tubing Whipstock System

The nontrievable TrackMaster TT* thru-tubing whipstock system integrates separate components, including the FasTrack* one-trip mill, to enable exits from standard steel casing below the production tubing and other exits that require 3-ft to 15-ft of rathole.

Applications

- Casing exits below production tubing
- Casing exits that require extended ratholes

FasTrack mill advantages

- Ideal for operations requiring conventional or extended ratholes
- Lead-and-follow mill design
- Consistent, fast, and reliable performance
- Optional PDC cutters for enhanced wear resistance

Thru-tubing whipstock advantages

- Accomodates relative size difference between whipstock and casing diameters
- Hydraulic kick-over hinge for positioning and stabilization

Expandable anchor advantages

- Spans multiple casing sizes and weights
- Hydraulically actuated
- Designed to prevent rotation and high-axial load slip

Running tools and accessories advantages

- Works with all hydraulically actuated anchor systems
- Provides clean hydraulic oil for to set anchors and packers
- Actuated with pump pressure

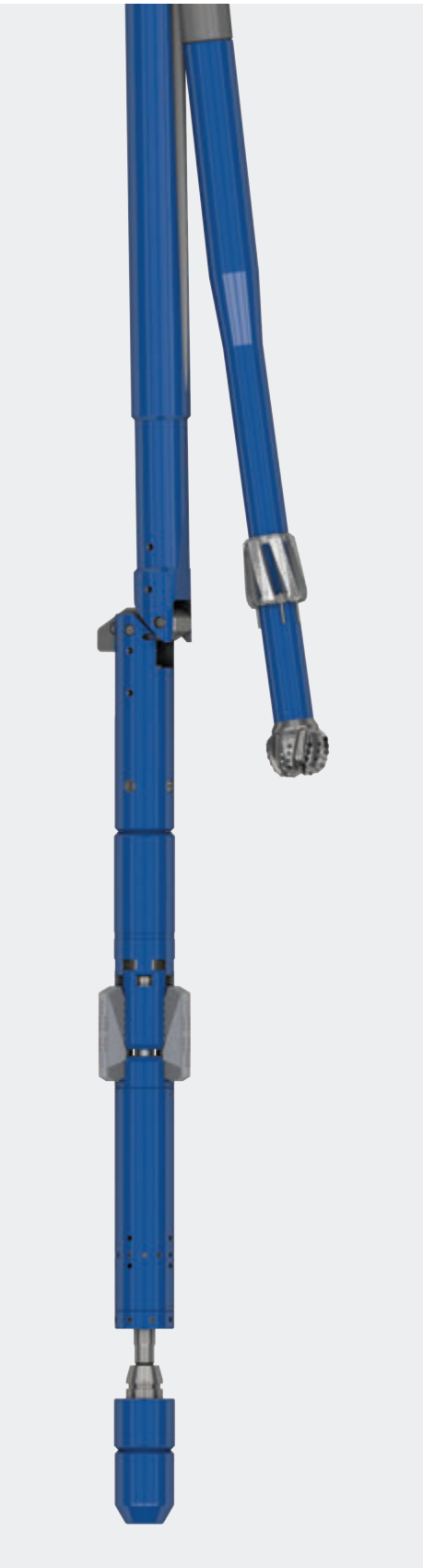
Multicycle bypass valve advantages

- Facilitates flow rates sufficient to operate MWD and other telemetry tools
- Provides multiple open cycles

Debris barrier advantages

- Prevents debris from settling around anchors and packers

TrackMaster TT System Specifications	
Tool Size	4.50 in × 7 in [114.3 mm × 177.8 mm]
System OD, in [mm]	3.63 [92]
Mill OD, in [mm]	3.63–3.88 [92–99]
Whip setting pressure, psi [MPa]	939 [6.5]
Anchor setting pressure, psi [MPa]	3,000 [20.7]
Whip release load, lbf [N]	14,400 [64,000]
Anchor release load, lbf [N]	32,400 [144,100]
Torque, ft.lbf [N.m]	6,000 [8,135]



TrackMaster TT thru-tubing whipstock system.

Thru-Tubing Underreamer

Applications

- Cement cleanout
- Scale removal

Advantages

- Mechanically assisted knife retraction
- Self-stabilizing knife configuration
- Durable construction for downhole reliability
- Available with various dressings and carbide inserts
- Configurable as an anchor for pipe-cutting applications
- Field-changeable jet nozzles to meet application demands

The underreamer passes through borehole restrictions and opens by hydraulic activation to a preset diameter. It effectively removes cement, scale, and hard debris from the liner below the production string. The underreamer blades and mills are available with tungsten carbide dressing for scale or cement removal, PDC dressing for scale or cement removal where protection of gauges and tubulars is essential, and carbide inserts for various applications, including those with high ROP.

Underreamer Specications

Size, in [mm]	Opening Diameter (1), in [mm]	Min flow Area (2), in²	Connections Pin × Box
1.750 [44.5]	4 [101.6]	0.237	1-in AMMT
2.125 [54.0]	6.25 [158.8]	0.181	1½-in AMMT or 1¼-in API REG
3.125 [79.4]	8.50 [215.9]	0.110	2⅜-in API REG or 2⅜-in PAC DS

(1) Opening diameter represents current blade designs.
(2) This minimum flow area is the minimum by-pass area through the tool and in each case is the communication channels along the tool OD.

Thru-tubing underreamer.

Thru-Tubing Hydraulic Pipe Cutter

Applications

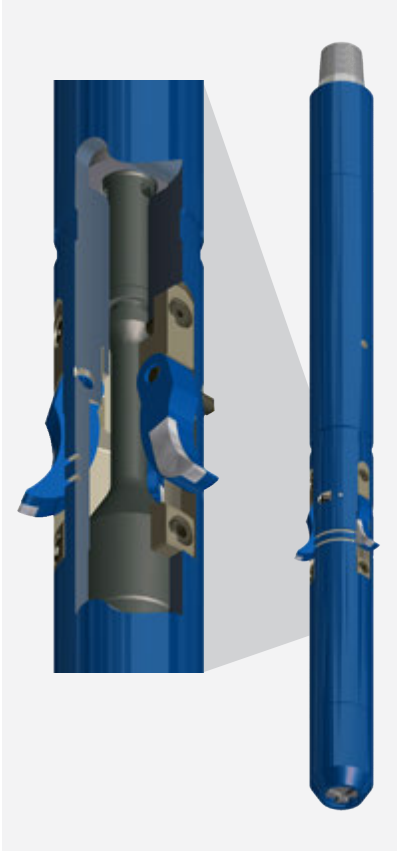
- Recovering tubing
- Severing tubing or drillpipe above stuck point
- Severing packer mandrels and tail pipes

Advantages

- Low-point loading across cutting surface to enable one-trip pipe cutting
- Profiled cutters to provide greater cutting efficiency
- Carbide inserts to increase knife cutting durability
- Rigsite blade changes for efficiency in cutting tubulars of various diameters
- Field-changeable jet nozzles to optimize performance

The thru-tubing hydraulic pipe cutter's knives produce low point-loading across the cutting surface for the durability to complete cutting in one trip. The pipe cutter can be run on coiled tubing or jointed pipe. When deployed on coiled tubing, an anchoring system, stabilizer, and PDM can be incorporated to ensure the most efficient operation.

To engage and quickly sever tubing or drillpipe, the hydraulic pipe cutter features three knives dressed with carbide inserts. A variety of cutting structures is available, and the amount of hydraulic pressure required to open the knives can be reset at the rig site in minutes. Knife blades can also be changed at the rig site, enabling multiple cuts and increased efficiency when cutting tubulars of different diameters.



Thru-tubing hydraulic pipe cutter.

TT Hydraulic Pipe Cutter Specifications

Tool Size, in [mm]	Tubing OD, in [mm]									
	2.38 [60]	2.88 [73]	3.50 [89]	4 [102]	4.50 [114]	5 [127]	5.50 [140]	6 [152]	6.63 [168]	7 [178]
1.69 [43]	■	■	■							
2.25]57]		■	■	■						
2.50 [64]			■	■	■	■	■			
2.68 [68]					■	■	■			
3.38 [86]						■	■	■	■	■

■ Recommended pipe cutter range for maximum performance
■ Extended pipe cutter range for special cases

Thru-Tubing Double-Acting Hydraulic Jar

Applications

- Small-diameter milling, rotary drilling, workover, remedial, and completion operations
- Vertical, deviated, ultradeep, and ultrahot wellbores
- Coiled tubing, snubbing, and concentric tubing workstrings

Advantages

- Jarring force delivered on up- and downstrokes
- Temperature-compensated detent system for extended operation
- Large bore for accommodation of drop balls and equipment below tool
- Maximum stroke length increases impact to optimize effectiveness
- Temperature rating: 500 degF [260.0 degC]
- Seal rating: 20,000-psi [137.9 MPa] differential
- Circulation system rating: 10,000 psi [68.9 MPa]

The thru-tubing double-acting hydraulic jar is a slimhole impact tool that delivers jarring force on both up- and downstrokes to free equipment stuck downhole. The tool's small diameter makes it ideal for use in coiled tubing operations, snubbing, and slimhole rotary drilling and fishing applications. Its ability to transmit torque enables the use of a downhole motor.

The standard tool has premium seals for use in high-temperature or high-pressure wells. Its robust design and high-quality materials ensure reliable performance in the harshest of downhole conditions.

Thru-Tubing Double-Acting Hydraulic Jar Specifications			
Tool OD, in [mm]	1.81 [46]	2.06 [52]	2.88 [73]
Tool ID, in [mm]	0.56 [14]	0.69 [18]	0.97 [25]
Tool joint connections	1 AMMT	1.50 AMMT	2.38 PAC
Overall extended length, ft [m]	7.83 [2.39]	7.75 [2.36]	8.25 [2.51]
Maximum detent working load, lbf [N]	8,000 [35,600]	11,000 [48,900]	20,000 [89,000]
Tensile yield strength, lbf [N]	56,000 [249,100]	86,000 [382,500]	200,000 [889,600]
Torsional yield strength, ft.lbf [N.m]	850 [1,150]	1,600 [2,170]	5,300 [7,190]
Free stroke up, in [mm]	4 [102]	4 [102]	4 [102]
Free stroke down, in [mm]	4 [102]	4 [102]	4 [102]
Total stroke, in [mm]	12 [305]	12 [305]	12 [305]
Tool weight, lbm [kg]	38 [17]	56 [25]	140 [64]

When ordering, please specify
- hole size
- drillstring component OD where the tool will be used
- connection size and type.

Thru-tubing double-acting hydraulic jar.

Thru-Tubing Double-Acting Accelerator

Applications

- Operations in which a jar is run in the workstring
- Small-diameter milling, rotary drilling, workover, and completion operations
- Small-diameter coiled tubing, snubbing, and fishing operations

Advantages

- Compression chamber stores tool energy and reduces tool length
- Large bore accommodates drop balls and equipment below the tool
- Temperature rating: 500 degF [260.0 degC]
- Seal rating: 20,000 psi [137.9 MPa]
- Circulation system rating: 10,000 psi [68.9 MPa]

The double-acting accelerator is a slimhole tool that multiplies the impact of a double-acting jar by providing or maximizing a stored energy source. A nitrogen compression chamber stores the tool energy while reducing its length, and the tool's large bore accommodates drop balls and flow-release equipment below it.

This tool is ideal for operations requiring small-diameter accelerators, and its ability to transmit torque enables the use of downhole motors. It also functions as a shock absorber to prevent impact damage to BHA components such as coiled tubing connectors and backpressure valves.

Thru-Tubing Double-Acting Accelerator Specifications

Tool OD, in [mm]	1.69 [43]	2.06 [52]	2.88 [73]
Tool ID, in [mm]	0.56 [14]	0.69 [18]	0.97 [25]
Tool joint connections	1 AMMT	1.50 AMMT	2.38 PAC
Overall extended length, ft [m]	8.50 [2.59]	8.75 [2.67]	9.08 [2.77]
Maximum detent working load, lbf [N]	8,000 [35,600]	11,000 [48,900]	20,000 [89,000]
Tensile yield strength, lbf [N]	56,000 [249,100]	86,000 [382,500]	200,000 [889,600]
Torsional yield strength, ft.lbf [N.m]	850 [1,150]	1,600 [2,170]	5,300 [7,190]
Free stroke up, in [mm]	6 [152]	6 [152]	6 [152]
Free stroke down, in [mm]	6 [152]	6 [152]	6 [152]
Tool weight, lbm [kg]	43 [20]	66 [30]	156 [71]

When ordering, please specify
- hole size
- drillstring component OD where the tool will be used
- connection size and type
- hole temperature
- desired working loads.

Thru-tubing double-acting accelerator.

Motors and Power Sections

Diamond-Enhanced Insert Reamer

The DEI reamer delivers effective hole reaming across a broad range of applications. Its advanced integral body incorporates rugged, state-of-the-art synthetic DEIs that shear the hole wall, providing a quality, full-gauge wellbore in soft to medium-hard formations.

Flexible design

Each insert is securely brazed into the tool body, so there are no moving parts to wear or fail. Consequently, the tool is not affected by hot hole conditions. It can be placed at any point in the BHA. The tapered body profile enables reaming both downward and upward.

Improved circulation rates

The dual-spiral and tapered design facilitates high circulation rates and the efficient transport of cuttings past the tool. The larger circulation area can be an advantage when annular restriction is a concern.

Applications

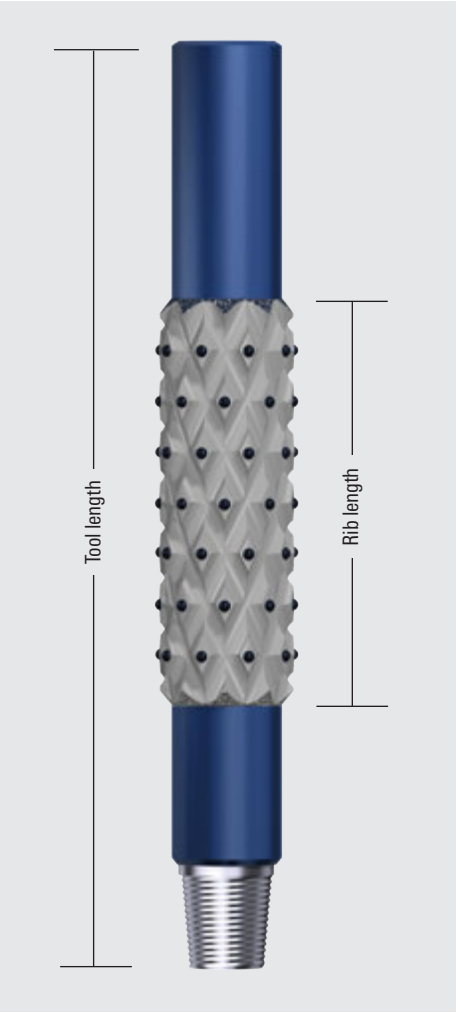
- Removing ledges and opening undergauge portions of build sections for directional work
- Removing keyseats
- High-temperature reaming

Benefits

- Produces high-quality, full-gauge wellbores
- Allows greater circulation

Features

- No moving or sealed components guards against downhole failures caused by heat or other severe downhole conditions
- Assembling flexibility enables placement in BHA at any point
- Durable cutting structures maintain full-gauge hole in soft to medium-hard formations
- Spiral body facilitates high circulation rates and efficient evacuation of cuttings
- Tapered body enables reaming downward and upward



DEI reamer.

DEI Reamer Specifications

Hole Size, in [mm]	Rib Length, in [mm]	Bore Diameter, in [mm]	Neck Diameter, in [mm]	Tool Length, ft [m]	Weight, lbm [kg]
6 [152]	18 [457]	2 [51]	4.75 [121]	5 [1.52]	265 [120]
7.83 [199]	22 [559]	2.25 [57]	6.25 [159]	5.33 [1.63]	530 [240]
8.50 [216]	22 [559]	2.25 [57]	6.75 [171]	5.33 [1.63]	635 [288]
8.75 [222]	22 [559]	2.25 [57]	6.75 [171]	5.33 [1.63]	655 [297]
9.83 [250]	22 [559]	2.81 [71]	7 [178]	5.50 [1.68]	755 [342]
12.25 [311]	22.50 [572]	3 [76]	8 [203]	6 [1.83]	1,190 [540]

Additional sizes available upon request. Available in nonmagnetic material by special order.

Gauge Indicator Sub

The gauge indicator sub generates an increase in torque when the drill bit wears below nominal gauge specification. This cost-effective capability enables the driller to detect drillbit gauge wear by a torque increase as the indicator sub's wear-resistant blades make contact with the hole wall, reducing reaming time and maximizing ROP. A short, efficient body design enables the sub to be made up between the drill bit and drilling mud motor or RSS. The gauge indicator sub is available in a broad range of sizes.

Applications

Directional or straight hole, motor or rotary steerable applications where monitoring drillbit wear is necessary to prevent undergauge holes.

Benefits

- Reduces reaming time
- Extends bit life

Features

- Configuration extends bit life by centering bit in wellbore
- Cutting design delivers a smoother, high-quality wellbore
- Short design facilitates placement at the bit, regardless of directional system
- Type 300 hardfacing ensures long life in abrasive environments
- Insert profile reduces drillstring torque and drag

Gauge Indicator Sub Specifications

Hole Size, in [mm]	Connection Size and Type	Bore Diameter, in [mm]	Shoulder-to-Shoulder Length, in [mm]	Rib Length, in [mm]	Weight, lbm [kg]
4.75 [121]	2.88 Reg	1.25 [32]	6.50 [165]	5.83 [148]	39 [18]
5.88 [149]	3.50 Reg	1.25 [32]	7.38 [187]	6.44 [164]	51 [23]
6 [152]	3.50 Reg	1.25 [322]	7.38 [187]	6.38 [162]	54 [25]
6.13 [156]	3.50 Reg	1.25 [32]	7.50 [191]	6.44 [164]	57 [26]
6.25 [159]	3.50 Reg	1.25 [32]	7.50 [191]	6.44 [164]	61 [28]
6.50 [165]	3.50 Reg	1.25 [32]	7.83 [200]	6.63 [168]	66 [30]
6.75 [171]	3.50 Reg	1.25 [32]	8.13 [206]	6.63 [168]	71 [32]
7.38 [187]	4.50 Reg	2.25 [57]	8.25 [210]	6.63 [168]	64 [29]
7.50 [191]	4.50 Reg	2.25 [57]	7.38 [187]	6.38 [162]	79 [36]
7.88 [200]	4.50 Reg	2.25 [57]	8 [203]	6.63 [168]	88 [40]
8.25 [210]	4.50 Reg	2.25 [57]	8.38 [213]	6.83 [174]	95 [43]
8.38 [213]	4.50 Reg	2.25 [57]	8.38 [213]	7.13 [181]	102 [46]
8.44 [214]	4.50 Reg	2.25 [57]	8.38 [213]	7 [178]	107 [49]
8.50 [216]	4.50 Reg	2.25 [57]	8.38 [213]	7 [178]	111 [50]
8.75 [222]	4.50 Reg	2.25 [57]	8.69 [221]	7.25 [184]	115 [52]
9 [229]	4.50 Reg	2.25 [57]	9.50 [241]	6.83 [175]	110 [50]
9.50 [241]	6.63 Reg	3 [76]	8.63 [219]	7.83 [200]	112 [51]
9.88 [251]	6.63 Reg	3 [76]	9.13 [232]	7.75 [197]	159 [72]
10.63 [270]	6.63 Reg	3 [76]	9.83 [251]	8.13 [206]	181 [82]
11 [279]	6.63 Reg	3 [76]	10.38 [264]	8.38 [213]	187 [85]
11.63 [295]	6.63 Reg	3 [76]	10.50 [267]	8.83 [224]	174 [79]
12.13 [308]	6.63 Reg	3 [76]	11.50 [292]	7 [178]	214 [97]
12.13 [308]	6.63 Reg	3 [76]	11.38 [289]	9 [229]	206 [93]
14.75 [375]	7.63 Reg	3.38 [86]	21.83 [554]	9.75 [248]	563 [255]
15.50 [394]	7.63 Reg	3.38 [86]	22.25 [565]	7.25 [184]	523 [237]
16 [406]	7.63 Reg	3.38 [86]	22.63 [575]	10.13 [257]	578 [262]
17.50 [445]	7.63 Reg	3 [76]	24.13 [613]	10.63 [270]	706 [320]
20 [508]	7.63 Reg	3 [76]	26.75 [680]	8.60 [218]	980 [445]
22 [559]	7.63 Reg	3 [76]	28.83 [732]	9 [229]	1,122 [509]

Gauge indicator sub.

DOG Drilling on Gauge Sub

The DOG* drilling on gauge sub delivers at-the-bit reaming. Its short body design and durable cutting structure enables placement between the bit and motor for directional applications. This results in a smoother build section and reduced hole drag, enabling better weight transfer to the drill bit. The cutting structure is composed of synthetic DEIs, which gives the DOG sub its continuous reaming capability. Each insert is brazed into the body, eliminating moving parts, which are found in conventional reamers.

Applications

- Directional projects where maintaining hole gauge is critical
- Directional wells where doglegs demand reaming runs through build sections
- Near-bit reaming in packed-hole assemblies

Benefits

- Can be placed between bit and mud motor for directional applications
- Provides reaming and contact behind bit, wiping out ledges as drilling progresses
- Maintains hole size when drill bit loses gauge by reducing or eliminating the need to ream back to bottom
- Stabilizes BHA assembly
- Increases drilling performance

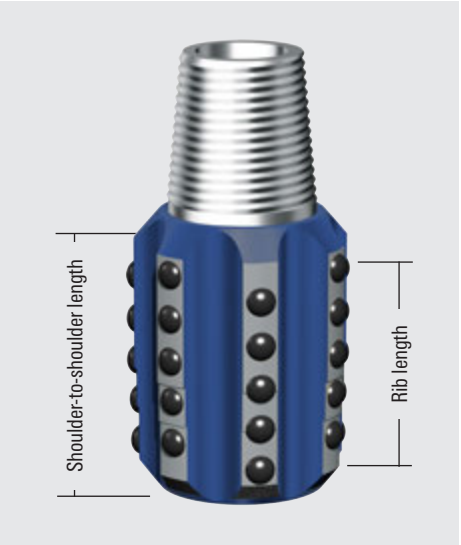
Features

- Durable cutting structure composed of synthetic DEIs maintains full-gauge hole in soft to medium-hard formations
- No moving parts to wear or fail ensures reliability
- Short body facilitates reaming directly at bit

DOG Drilling On Gauge Sub Specifications

Hole Size, in [mm]	Connection Size and Type	Bore Diameter, in [mm]	Shoulder-to-Shoulder Length, in [mm]	Rib Length, in [mm]	Weight, lbm [kg]
4.75 [121]	2.88 Reg	1.25 [32]	6.50 [165]	5.83 [148]	39 [18]
5.88 [149]	3.50 Reg	1.25 [32]	7.38 [187]	6.44 [164]	51 [23]
6 [152]	3.50 Reg	1.25 [322]	7.38 [187]	6.38 [162]	54 [25]
6.13 [156]	3.50 Reg	1.25 [32]	7.50 [191]	6.44 [164]	57 [26]
6.25 [159]	3.50 Reg	1.25 [32]	7.50 [191]	6.44 [164]	61 [28]
6.50 [165]	3.50 Reg	1.25 [32]	7.83 [200]	6.63 [168]	66 [30]
6.75 [171]	3.50 Reg	1.25 [32]	8.13 [206]	6.63 [168]	71 [32]
7.38 [187]	4.50 Reg	2.25 [57]	8.25 [210]	6.63 [168]	64 [29]
7.50 [191]	4.50 Reg	2.25 [57]	7.38 [187]	6.38 [162]	79 [36]
7.88 [200]	4.50 Reg	2.25 [57]	8 [203]	6.63 [168]	88 [40]
8.25 [210]	4.50 Reg	2.25 [57]	8.38 [213]	6.83 [174]	95 [43]
8.38 [213]	4.50 Reg	2.25 [57]	8.38 [213]	7.13 [181]	102 [46]
8.44 [214]	4.50 Reg	2.25 [57]	8.38 [213]	7 [178]	107 [49]
8.50 [216]	4.50 Reg	2.25 [57]	8.38 [213]	7 [178]	111 [50]
8.75 [222]	4.50 Reg	2.25 [57]	8.69 [221]	7.25 [184]	115 [52]
9 [229]	4.50 Reg	2.25 [57]	9.50 [241]	6.83 [175]	110 [50]
9.50 [241]	6.63 Reg	3 [76]	8.63 [219]	7.83 [200]	112 [51]
9.88 [251]	6.63 Reg	3 [76]	9.13 [232]	7.75 [197]	159 [72]
10.63 [270]	6.63 Reg	3 [76]	9.83 [251]	8.13 [206]	181 [82]
11 [279]	6.63 Reg	3 [76]	10.38 [264]	8.38 [213]	187 [85]
11.63 [295]	6.63 Reg	3 [76]	10.50 [267]	8.83 [224]	174 [79]
12.13 [308]	6.63 Reg	3 [76]	11.50 [292]	7 [178]	214 [97]
12.13 [308]	6.63 Reg	3 [76]	11.38 [289]	9 [229]	206 [93]
14.75 [375]	7.63 Reg	3.38 [86]	21.83 [554]	9.75 [248]	563 [255]
15.50 [394]	7.63 Reg	3.38 [86]	22.25 [565]	7.25 [184]	523 [237]
16 [406]	7.63 Reg	3.38 [86]	22.63 [575]	10.13 [257]	578 [262]
17.50 [445]	7.63 Reg	3 [76]	24.13 [613]	10.63 [270]	706 [320]
20 [508]	7.63 Reg	3 [76]	26.75 [680]	8.60 [218]	980 [445]
22 [559]	7.63 Reg	3 [76]	28.83 [732]	9 [229]	1,122 [509]

Unless otherwise requested, nominal gauge diameter for this product is OD +0 in, –0.03 in.



DOG drilling on gauge sub.

Diamond-Enhanced Insert Stabilizer

The DEI stabilizer is purpose built to stabilize the BHA in hard or abrasive formations. Synthetic DEI technology combines with proven Type 300 hardfacing for maximum stability and abrasion resistance. The strategically placed inserts ream ahead of the stabilizer blades, maintaining a full gauge and extending service life. The DEI stabilizer is made for packed-hole, directional, and pendulum BHAs.

Applications

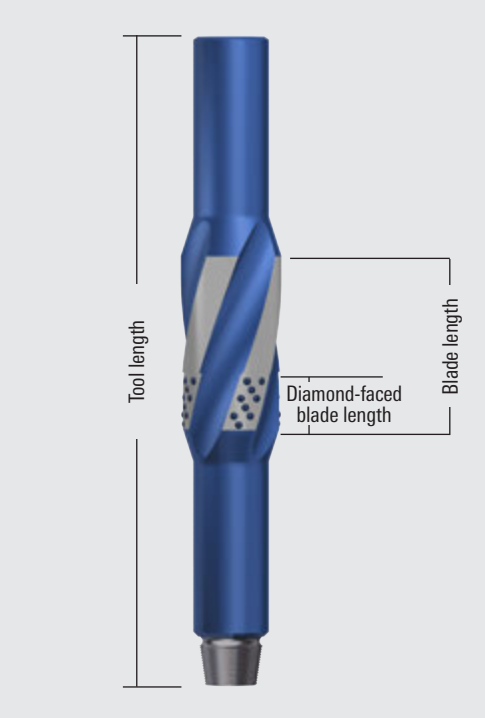
- BHA stabilization for hard or abrasive formations
- Increased drilling performance of packed-hole, directional, and pendulum BHAs

Benefits

- Dependably reams in hard or abrasive formations
- Maintains full-gauge borehole

Features

- DEI inserts maintain hole gauge, extend stabilizer life, and improve BHA performance
- Insert profile reduces drillstring torque and drag



DEI stabilizer.

Diamond-Enhanced Insert Stabilizer Specifications

Hole Size, in [mm]	Overall Length, ft [m]	Neck OD, in [mm]	Top Neck Length, in [mm]	Bottom Neck Length, in [mm]	Total Stabilizer Blade Length, in [mm]	Diamond-Faced Blade Length, in [mm]
8.38 [213]	6.25 [1.91]	6.50 [165]	30 [762]	24 [610]	16 [406]	6 [152]
8.50 [216]	6.25 [1.91]	6.50 [165]	30 [762]	24 [610]	16 [406]	6 [152]
10.63 [270]	6.42 [1.96]	8 [203]	30 [762]	24 [610]	16 [406]	6 [152]
12.25 [311]	6.75 [2.06]	8 [203]	30 [762]	24 [610]	16 [406]	6 [152]
12.25 [311]	6.75 [2.06]	9.50 [241]	30 [762]	24 [610]	16 [406]	6 [152]

Double-Diamond Combo Tool

The double-diamond combo tool is manufactured from high-strength alloy steel as a one-piece tool. It is an extremely effective bottomhole stabilizer in wells where severe crooked hole tendencies are encountered.

High-quality borehole

The unitized construction features two sets of three-blade spiraled ribs that reduce damage to the hole wall and ensure maximum fluid circulation. Optimally spaced DEIs provide the reaming action to keep the hole in gauge.

Rugged construction

The inserts are brazed into the tool body, ensuring dependable service and complete repairability. Type 300 hardfacing provides optimal wear resistance and stabilizer blade life.

Improved ROP

The increased hole wall contact area allows more drilling weight to be applied, thereby improving penetration rates while staying within acceptable deviation limits.

Applications

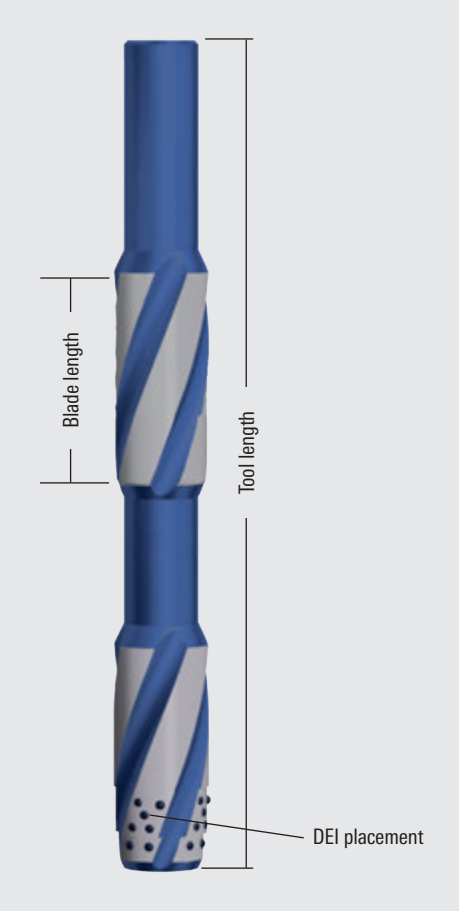
- Drilling crooked holes that call for packed-hole assemblies
- Maintaining the tangent section of a well during directional drilling

Benefits

- Serves as first point of hole-wall contact directly at bit, improving BHA efficiency
- Stabilizes BHA in holes with severe crooked-hole tendencies
- Reduces hole-wall damage and ensures maximum circulation
- Endures high drilling weight

Features

- Manufactured from high-strength alloy steel as a one-piece tool for reliability
- Optimally spaced DEIs deliver reaming action to keep hole in gauge
- Inserts brazed into tool body to ensure durability
- Type 300 hardfacing provides optimal wear resistance and stabilizer blade life
- Tong area between stabilizers enables bottom stabilizer blades to cover box connection



Double-diamond combo tool.

Double-Diamond Combo Tool Specifications

Hole Size, in [mm]	Blade Length, in [mm]	Bore Diameter, in [mm]	Neck Diameter, in [mm]	Tool Length, ft [m]	Weight, lbm [kg]
7.83 [199]	12 [305]	2.25 [57]	6.25 [159]	5.42 [1.65]	900 [408]
8.50 [216]	12 [305]	2.25 [57]	6.75 [172]	5.42 [1.65]	980 [445]
8.75 [222]	12 [305]	2.81 [71]	6.75 [172]	5.42 [1.65]	990 [449]
12.25 [311]	18 [457]	3 [76]	9.25 [235]	6.33 [1.93]	2,000 [907]

Other types of hard metal wear surfaces available upon request. Nominal rib diameter +0 in, –1/32 in.

Ezy-Change Type II Rig-Replaceable Sleeve-Type Stabilizer

The Ezy-Change Type II stabilizer is designed around a rugged, one-piece mandrel constructed of high-strength alloy steel, with ample tong space for handling ease and extra length for recutting connections. The rig-replaceable, integral blade sleeves are available in two different hardfacing options or with TCIs.

Versatile and space-saving stabilizer

The Ezy-Change stabilizer is a popular choice for remote areas or where storage problems exist. One mandrel series can be used for several different hole sizes, reducing the need for a large mandrel inventory on location. The sleeves are easily changed on the rig floor, either when changing hole size or when the sleeves have worn under gauge. This versatility also serves as a convenient way to change the type of stabilizer wear surface to match drilling conditions.

Applications

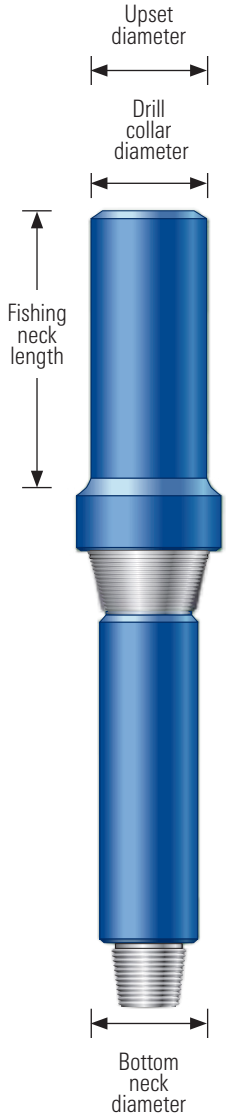
- Mild- to medium-packed hole assemblies
- Pendulum assemblies
- Directional drilling assemblies
- Harmonic vibration control

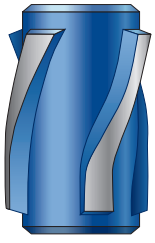
Benefits

- Reduces the need to maintain large mandrel inventory on location
- Enables placement in remote or space-constrained locations

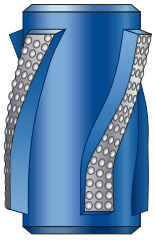
Features

- Sleeves 17.50 in and smaller feature three spiral blades (four straight blades for larger sizes)
- Large flow-by area for maximum flow
- Multiple hardfacing options
- Robust one-piece mandrel design
- Ample length for multiple recuts

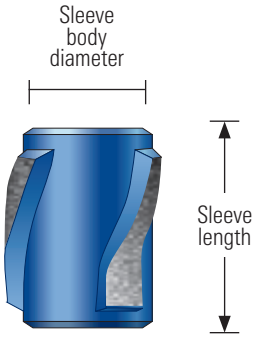




Sleeve dressed with Type 300 hardfacing.



Sleeve dressed with Type 200 TCIs.



Sleeve dressed with Type W hardfacing.

Ezy-Change Type II Rig-Replaceable Sleeve-Type Stabilizer

Sleeves Specifications

Hole Size, in [mm]	Tool Series	Drill Collar Size Range, in [mm]	Length, ft [m]	Body Diameter, in [mm]	Blade Length, ft [m]	Weight, lbm [kg]	Recommended Makeup Torque, ft.lbf
8.50 [216]	62	6.25–6.75 [159–171]	1.17 [0.36]	7.50 [191]	1 [0.31]	70 [32]	4,500–5,500 [3,319–4,057]
	65	6.50–7.25 [165–184]	1.17 [0.36]	7.50 [191]	1 [0.31]	80 [36]	3,500–4,500 [2,581–3,319]
8.75 [222]	62	6.25–6.75 [159–171]	1.17 [0.36]	7.50 [191]	1 [0.31]	75 [34]	4,500–5,500 [3,319–4,057]
	65	6.50–7.25 [165–184]	1.17 [0.36]	7.50 [191]	1 [0.31]	85 [38]	3,500–4,500 [2,581–3,319]
9.88 [251]	62	6.25–6.75 [159–171]	1.17 [0.36]	7.75 [197]	0.92 [0.28]	85 [38]	4,500–5,500 [3,319–4,057]
	65	6.50–7.25 [165–184]	1.17 [0.36]	7.75 [197]	0.92 [0.28]	95 [43]	3,500–4,500 [2,581–3,319]
12.25 [311]	77	7.75–8.25 [197–210]	1.17 [0.36]	9.25 [235]	0.92 [0.28]	140 [64]	7,000–8,000 [5,163–5,901]
	85	8.50–9 [216–229]	1.17 [0.36]	10 [254]	0.92 [0.28]	130 [59]	9,000–10,000 [6,638–7,376]
	96	9–10 [229–254]	1.17 [0.36]	11 [279]	0.92 [0.28]	110 [50]	10,000–12,000 [7,376–8,851]
14.75 [375]	77	7.75–8.25 [197–210]	1.50 [0.46]	11 [279]	1.17 [0.36]	330 [150]	7,000–8,000 [5,163–5,901]
	85	8.50–9 [216–229]	1.50 [0.46]	11 [279]	1.17 [0.36]	300 [136]	9,000–10,000 [6,638–7,376]
	96	9–10 [229–254]	1.50 [0.46]	11 [279]	1.17 [0.36]	270 [122]	10,000–12,000 [7,376–8,851]
17.50 [445]	77	7.75–8.25 [197–210]	1.50 [0.46]	11 [279]	1 [0.31]	370 [168]	7,000–8,000 [5,163–5,901]
	85	8.50–9 [216–229]	1.50 [0.46]	11 [279]	1 [0.31]	340 [154]	9,000–10,000 [6,638–7,376]
	96	9–10 [229–254]	1.50 [0.46]	11 [279]	1 [0.31]	310 [141]	10,000–12,000 [7,376–8,851]
22 [559]	96	9–10 [229–254]	1.83 [0.56]	12 [305]	1 [0.31]	1,780 [808]	10,000–12,000 [7,376–8,851]
24 [610]	96	9–10 [229–254]	2.67 [0.81]	12 [305]	1.33 [0.41]	2,050 [930]	10,000–12,000 [7,376–8,851]
26 [660]	96	9–10 [229–254]	2.67 [0.81]	12 [305]	1.33 [0.41]	2,110 [957]	10,000–12,000 [7,376–8,851]
28 [711]	96	9–10 [229–254]	2.67 [0.81]	12 [305]	1.33 [0.41]	2,190 [993]	10,000–12,000 [7,376–8,851]

Mandrels Specifications

Tool Series	Sleeve Hole Size Range, in [mm]	Drill Collar (Fishing Neck) Diameter, in [mm]	Upset Diameter, in [mm]	Bottom Neck Diameter, in [mm]	Overall Length, ft [m]	Fishing Neck Length		Weight, lbm [kg]
						String (Box Up), in [mm]	Bottomhole (Pin up), in [mm]	
62	8.50–9.88 [216–251]	6.25–6.75 [159–171]	7.50 [191]	6.25 [159]	5.42 [1.65]	27 [686]	22 [559]	475 [215]
65	8.50–9.88 [216–251]	6.50–7.25 [165–184]	7.75 [197]	6.50 [165]	5.42 [1.65]	27 [686]	22 [559]	575 [261]
77	12.25–17.50 [311–445]	7.75–8.25 [197–210]	9.25 [235]	7.75 [197]	5.50 [1.68]	27 [686]	22 [559]	800 [363]
85	12.25–17.50 [311–445]	8.50–9 [216–229]	9.88 [251]	8.50 [216]	5.50 [1.68]	27 [686]	22 [559]	1,000 [454]
96	14.75–20 [375–508]	9.50–10 [241–254]	11 [280]	9.63 [245]	5.50 [1.68]	27 [686]	22 [559]	1,200 [544]
	22–28 [559–711]	9.50–10 [241–254]	11 [280]	9.63 [245]	7.50 [2.29]	27 [686]	22 [559]	1,780 [807]

Integral Blade Stabilizer

The integral blade stabilizer dampens lateral vibrations acting on the BHA. It also stiffens the BHA in a packed assembly to build an angle, drop an angle, or both in a pendulum assembly. It is a single-piece tool made from high-strength alloy steel and features integral blades and tool body, eliminating the risk of leaving components downhole.

Reliably high hole quality

Featuring three spiraled ribs, the stabilizer's unitized construction minimizes downhole torque, reduces damage to the hole wall, and ensures maximum fluid circulation.

Wide range of applications

The stabilizer is well suited for use in most formations, from soft and sticky to hard and abrasive. Type 200 and Type 300 wear surfaces are available. The tool can be supplied in both open-wrap and full-wrap designs for optimal hole-wall contact. In addition, it is available in both bottomhole and string designs, providing the flexibility to run it anywhere in the BHA.

Applications

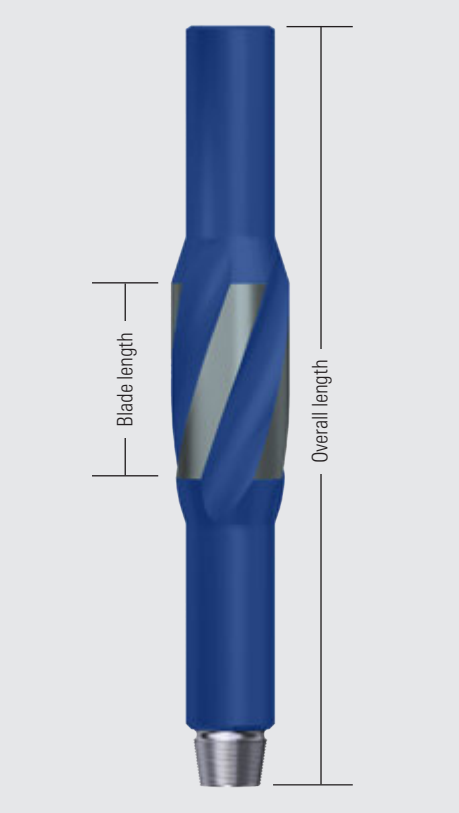
- Packed-hole assemblies that require the placement of multiple stabilizers throughout the three zones of stabilization
- Pendulum assemblies
- Applications requiring the placement of stabilizers in the BHA and upper drill collar string to reduce vibration in drill collars

Benefits

- Works in most formations
- Enables running anywhere in BHA
- Ensures maximum circulation while preventing wall damage

Features

- Integral blades and tool body, eliminating the risk of leaving components or pieces in the hole
- Available in both open- and full-wrap designs, providing optimal hole-wall contact while ensuring maximum fluid bypass area
- Available in Type 200 and Type 300 wear surfaces, improving operational flexibility



Integral blade stabilizer with Type 300 wear surface.

Integral Blade Stabilizer Specifications

Hole Size Range, in [mm]	Drill Collar OD Range, in [mm]	Bore, in [mm]	Overall Length, ft [m]	Blade Length, in [mm]
4.75 [121]	3.75 [95]	1.50 [38]	5.17 [1.58]	10 [254]
5.83 [148]	4.75 [121]	1.75 [45]	5.17 [1.58]	10 [254]
6.75 [172]	5.50 [140]	2.25 [57]	5.33 [1.63]	12 [305]
7.83 [199]	6.50 [165]	2.83 [72]	5.33 [1.63]	12 [305]
8.50–8.75 [216–222]	6.75–7 [171–178]	2.83 [72]	5.42 [1.65]	13 [330]
9.25–9.83 [235–250]	7.25–8.25 [184–210]	2.83 [72]	5.50 [1.68]	13 [330]
10.63 [270]	8.25 [210]	2.83 [72]	5.50 [1.68]	13 [330]
12–12.25 [305–311]	8.25–9.50 [210–241]	3 [76]	6 [1.83]	15 [381]
17.50 [445]	10 [254]	3 [76]	6.33 [1.93]	15 [381]
24 [610]	10 [254]	3 [76]	7.58 [2.31]	20 [508]
28 [711]	10 [254]	3 [76]	7.92 [2.41]	20 [508]

Nominal rib diameter as follows:
- 4.75–12.25 in: +0 in, –0.03 in
- 13.75–17.50 in: +0 in, –0.06 in
- 18–28 in: +0 in, –0.13 in.

Nonstandard tolerances are available upon request.

Shock Sub

The Shock Sub* impact and deviation reduction tool is a drillstring component that absorbs and dampens the variable-axial dynamic loads produced by the drill bit during normal drilling operations. If left unchecked, a roller cone bit produces a pattern of peaks and valleys on the bottom of the borehole as it rotates. With each revolution of the bit, the cones tend to follow this sinusoidal contour, producing a cyclical oscillation of the drillstring.

The Shock Sub tool interrupts this harmonic cycle by using a bidirectional spring action, enabling it to automatically adjust to a wide range of values for WOB. As axial loads are produced, energy is absorbed through the use of its Belleville spring assembly, and force dampening is accomplished by mechanical friction.

Applications

- Drilling competent sediments in straight holes with roller cone or hammer bits
- Directional drilling—hard formations, horizontal sections, and directionally drilled crossings
- Milling operations—sections, windows, and casing
- Underreaming and hole opening
- Coiled tubing drilling operations

Benefits

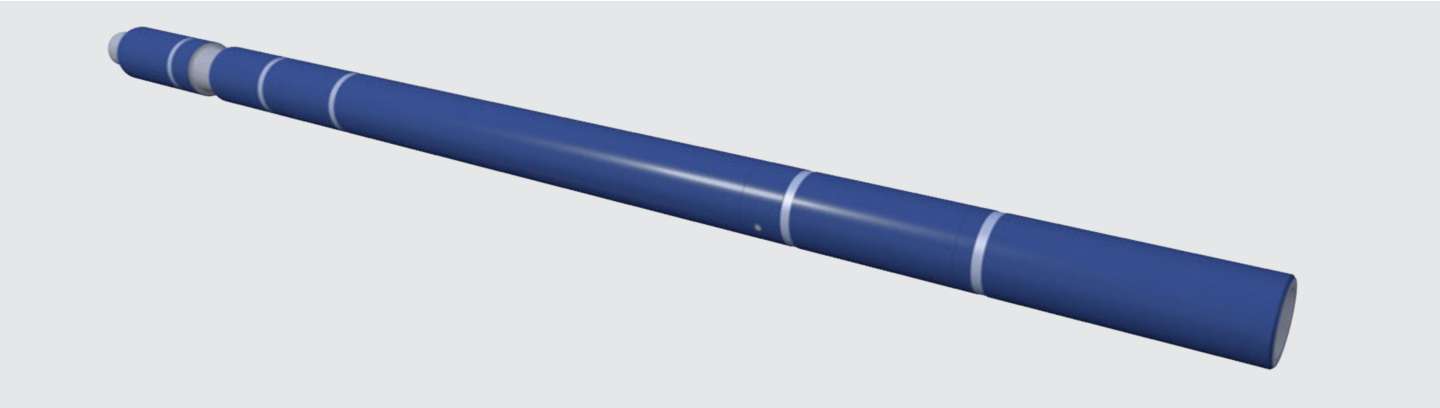
- Increased ROP
- Longer life for the cutting structure and bearings because of reduced impact loads
- Extended connection life
- Reduced shock loads on surface equipment
- Lower drilling cost per foot

Features

- High-quality, hardened-steel tool body enhances durability
- Rotary shoulder connections incorporate API stress-relief groove and bore-back box
- Seals endure temperatures to 450 degF [232.2 degC]
- Compression/extension spring action counters axial loads and maintains near-constant WOB
- Belleville spring stack optimizes WOB
- Spring rate adjusts to meet application-specific requirements
- Seals isolate internal components from drilling fluid
- Tool needs no activation

Shock Sub Impact and Deviation Reduction Tool Specifications

Tool OD, in [mm]	Tool ID, in [mm]	Tool Joint Connection	Tensile Yield, lbf [N]	Torsional Yield, ft.lbf [N.m]	Weight, lbm [kg]	Length, ft [m]
4.75 [121]	1.75 [45]	3.50 IF	415,000 [1,846,000]	17,500 [23,700]	600 [270]	11.52 [3.51]
5 [127]	1.75 [45]	XT39	589,000 [2,620,000]	31,000 [42,000]	800 [360]	11.52 [3.51]
6.50 [165]	2.25 [57]	4.50 IF; 4.50 XH	800,000 [3,558,500]	57,000 [77,300]	1,300 [590]	12 [3.66]
8 [203]	3 [76]	6.63 Reg	1,100,000 [4,893,000]	84,000 [113,900]	1,800 [817]	13.52 [4.12]
9.50 [241]	3 [76]	7.63 Reg	1,800,000 [8,007,000]	150,000 [203,400]	2,700 [1,225]	13.52 [4.12]
12 [305]	3.25 [83]	7.63 H90	2,300,000 [10,231,000]	250,000 [339,000]	4,500 [2,041]	13.81 [4.21]
14 [356]	3.25 [83]	8.63 H90	2,300,000 [10,231,000]	400,000 [542,300]	6,200 [2,812]	14.30 [4.36]



Shock Sub impact and deviation reduction sub tool.

Neyrfor Traditional Standard Turbodrill

The Neyrfor Traditional* standard turbodrill's innovative design incorporates stabilizers and straight- or bent-bearing sections for directional-steerable applications, vertical performance, and rotary drilling. The turbodrill's design allows the driveshaft to rotate at a higher rpm while remaining dynamically stable, producing unsurpassed ROP without the negative effects of excess torque.

Power and bearing section

The Neyrfor Traditional turbodrill is based on a concentric design with a fluid connect rotor and stator-power drive system. These two components are offered in different configurations to produce a range of power characteristics enabling turbodrills to be designed for specific applications, and an all-metallic option is available for HPHT conditions. Extended- and high-flow power sections are available in standard tool sizes and configurations. Additionally, a diamond-bearing pack design reduces vibration and noise, which can interfere with downhole measurement tools.

With an unmatched capability to convert hydraulic energy from the mud column to mechanical energy at the bit, the Neyrfor Traditional turbodrill drive system delivers greater mechanical drilling power than any other system under equal hydraulic conditions.

The Neyrfor Traditional turbodrill had set the benchmark for downhole drive system reliability; run times of up to 800 hours minimize NPT caused by downhole tool failures and problems related to HPHT applications.

Applications

- Directional drilling
- HPHT drilling
- Straight-hole drilling
- Geothermal drilling
- Underbalanced drilling
- Single- or two-phase fluids

Benefits

- High-power performance
- Mitigation of vibration
- High-temperature capabilities
- Excellent borehole quality
- Consistent and predictable toolface control
- Unsurpassed reliability and operating life
- Reduced NPT

Features

- Rig-adjustable or fixed-bent housing section
- Rig interchangeable stabilizers
- Concentric-balanced design
- Fluid-connect drive system

Components

- Power section
- Rig-interchangeable stabilizers
- Pin-down straight or steerable bearing section

Available tool sizes

- 2.88 in
- 3.38 in
- 4.75 in
- 6.63 in
- 7.25 in
- 9.50 in

Neyrfor Traditional standard turbodrill.

Neyrfor Delta High-Performance Directional Turbodrill

Applications

- Curve, horizontal, and tangent directional drilling
- High-pressure, high-temperature (HPHT) directional drilling
- Openhole, cement-plug and whipstock sidetracks
- PDC and impregnated diamond bit applications
- Geothermal drilling

Benefits

- Extended downhole operating life
- 60% increase in dogleg capabilities
- Reduction in slide time over the Neyrfor Traditional* standard turbodrill
- High-temperature capabilities, 500 degF [260 degC]
- Improved hole quality over other drive systems
- Consistent and predictable tool face control
- Low BHA vibration characteristics

Features

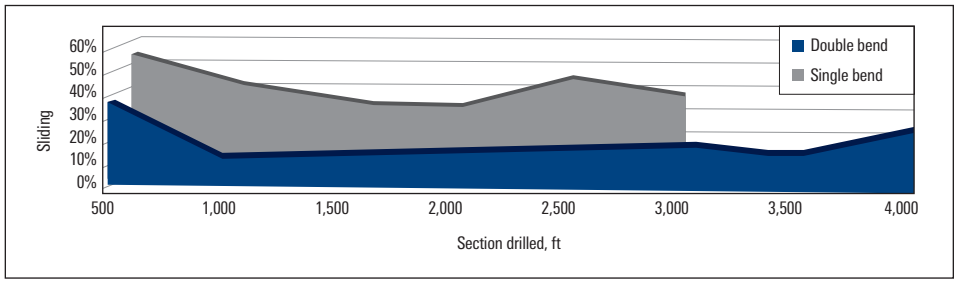
- Shortest bit to bend in class
- Proprietary engineered stabilizer placement and profile software
- Concentric-balanced design
- Fluid-connect drive system
- Bearing housing contact and wear pads to eliminate left hand walk tendencies

Neyrfor Delta high-performance directional turbodrills are the second generation steerable turbodrill, designed specifically to meet demanding directional and precision horizontal drilling applications. The Neyrfor Delta turbodrill incorporates the shortest bit to bend in its class and the specifically engineered stabilizers enhance weight transfer to the bit for improved hole cleaning.

More efficient sliding

The Neyrfor Delta turbodrill is designed with a shorter bit-to-bend design versus the Neyrfor Traditional turbodrill system, enabling shorter radius-curve drilling and reducing time spent on course corrections while drilling horizontal and tangent sections, thereby increasing footage drilled in the targeted zone.

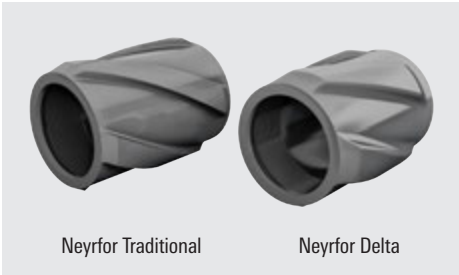
To eliminate the left hand walk tendencies of the high RPM bit speeds and low depth of cut typically seen with turbodrill systems, the Neyrfor Delta features a specifically designed bearing housing wear and contact pads, providing wellbore contact without the increase in torque normally associated with BHA components. This results in a lower percentage of slide time versus rotating time, increasing the overall rate of penetration.

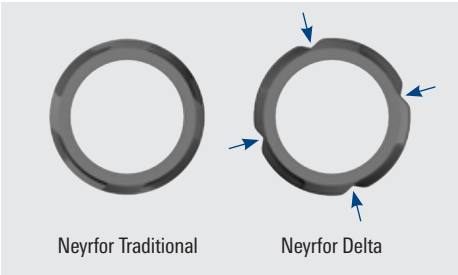


Reduced slide time for walking tendencies.

Stabilizer Design

The Neyrfor Delta stabilizers are engineered with a reduced spiral wrap design, deceased wellbore contact surface area and wider blades. The stabilizers are also designed with an optimal directional taper on the leading and trailing edge improving weight transfer to the bit while reducing hang-ups sliding. The concentric drive system coupled with the use of specifically engineered designed directional stabilizers deliver a wellbore with minimal rugosity, which enhances wellbore evaluation, casing running, running of production packers, cementing, and minimizes problems drilling ahead. The Neyrfor Delta stabilizers have an increased flow-by area over standard industry stabilizer designs, improving mud-flow and hole cleaning essential in high angle directional wells.





Neyrfor Delta stabilizers offer greater flow-by area and less surface contact area than standard turbodrill stabilizers.

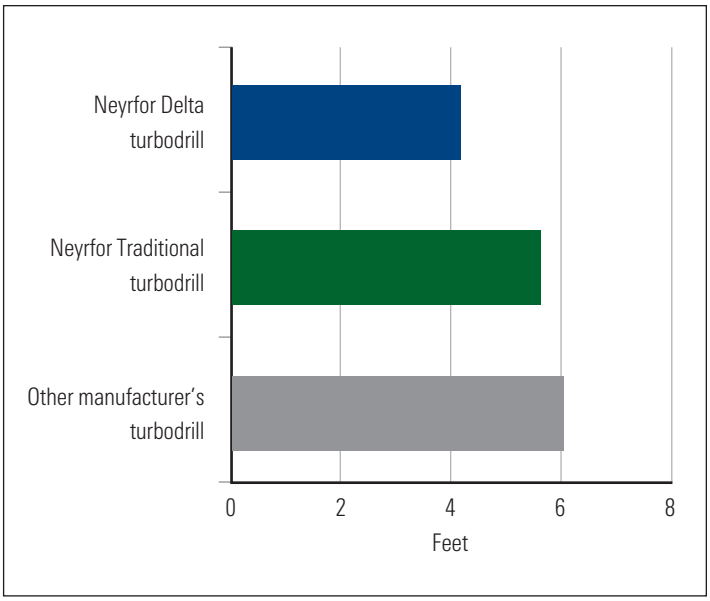
Neyrfor Delta High-Performance Directional Turbodrill

Consistent and predictable tool face control and increased dogleg capabilities make the Neyrfor Delta turbodrill the premier tool for directional applications, as well for openhole sidetracking off cement plugs or whipstocks.

Neyrfor Delta BHAs are modeled with proprietary software to ensure stabilizer placement maximizes directional performance while minimizing BHA vibrations that could lead to NPT caused by downhole tool failures and other problems related to HPHT applications. Each application is modeled to optimize stabilizer diameter based on hole size and directional requirements. A lower bend setting can often be run to achieve the directional objectives, thus allowing the BHA to be rotated ahead after landing in the target zone, resulting in fewer trips seen when running larger bend setting positive displacement motors.

Power and Bearing Section

The power section of the tool converts hydraulic energy—delivered to the motor in the form of drilling fluid—to mechanical energy. The turbodrill is based on a concentric design with a fluid connect rotor and stator-power drive system. Additionally, a PDC thrust-bearing pack design reduces vibration and noise, which could interfere with downhole measurement tool mud-pulse signals. The power section consists of two components: the rotor and the stator, along with a specified number of stages dependent on the application. Neyrfor Delta turbodrill offers these components in different configurations to produce a range of power characteristics enabling turbodrills to be designed for specific applications. An all metallic option is available for HPHT environments. Extended- and high-flow power sections are available in standard tool sizes and configurations.



Bit to bend plot.

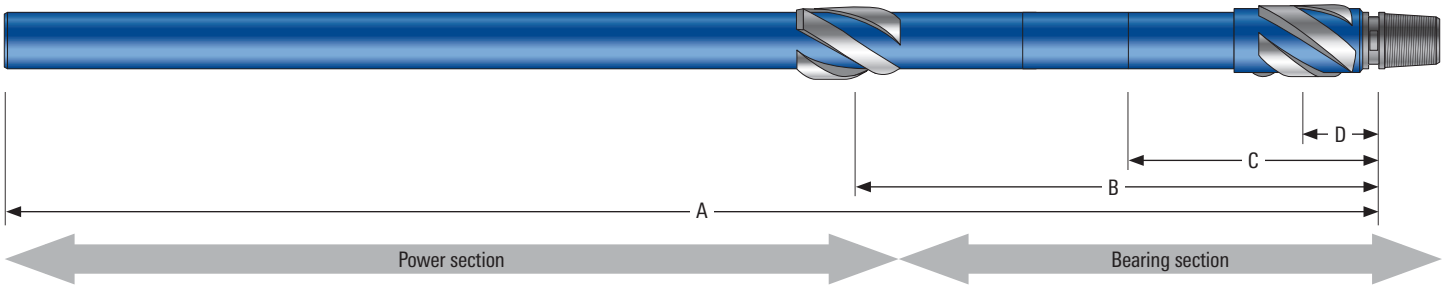
Turbodrill components

- Customized power section
- Engineered Neyrfor Delta directional stabilizers
- Pin down steerable-bearing section

Available tool sizes

- 4¾ in
- 6⅝ in
- 9½ in

Neyrfor Delta High-Performance Directional Turbodrill



Neyrfor Delta Series					
Tool Specifications	**Delta Series**	**T1XL MK1 FBS**	**T1 MK2 FBS**	**T1XL MK2 FBS**	**T1 MK3 FBS**
Turbine section diameter	4.75 in [120.65 mm]	4.75 in [120.65 mm]	4.75 in [120.65 mm]	4.75 in [120.65 mm]	4.75 in [120.65 mm]
(A) Overall length	30.2 ft [9.20 m]	36.64 ft [9.20 m]	30.2 ft [9.20 m]	36.3 ft [11.17 m]	30.2 ft [9.20 m]
(B) Bit to center of stabilizer B	13.1 ft [4.02 m]	13.18 ft [4.02 m]	13.1 ft [4.02 m]	13.1 ft [4.02 m]	13.1 ft [4.02 m]
(C) Bit to bend	4.18 ft [1.27 m]	4.18 ft [1.27 m]	4.18 ft [1.27 m]	4.18 ft [1.27 m]	4.18 ft [1.27m]
(D) Bit to center of stabilizer D	0.6 ft [0.2 m]	0.6 ft [0.2 m]	0.6 ft [0.2 m]	0.6 ft [0.2 m]	0.6 ft [0.2 m]
Top connection	3½ IF box	3½ IF box	3½ IF box	3½ IF box	3½ IF box
Bit connection	3½ API Reg pin	3½ API Reg pin	3½ API Reg pin	3½ API Reg pin	3½ API Reg pin
Total tool weight	1,537 lbm [697.2 kg]	1,662 lbm [697.2 kg]	1,552 lbm [704.0 kg]	1,684 lbm [763.8 kg]	1,537 lbm [697.2 kg]
Bend settings	1.0° to 2.0°	1.0° to 2.0°	1.0° to 2.0°	1.0° to 2.0°	1.0° to 2.0°
Recommended bit sizes	5⅝ in to 6¾ in [143 to 171 mm]	5⅝ in to 6¾ in [143 to 171 mm]	5⅝ in to 6¾ in [143 to 171 mm]	5⅝ in to 6¾ in [143 to 171 mm]	5⅝ in to 6¾ in [143 to 171 mm]
Operational Data					
RPM range/revolution per gallon	1,200 to 2,050 rpm [7.44 rev/gal]	617 to 1,866 rpm [7.44 rev/gal]	860 to 1,600 rpm [6.357 rev/gal]	760 to 1,420 rpm [6.357 rev/gal]	950 to 1,660 rpm [7.785 rev/gal]
Pressure drop range	1,150 to 3,000 psi	1,250 to 3,200 psi	1,250 to 3,000 psi	1,400 to 3,000 psi	1,250 to 3,000 psi
Max power output	212 hp [152 kw]	250 hp [186 kw]	197 hp [147 kw]	191 hp [142 kw]	158 hp [116 kw]
Max stall torque	1,270 ft/lbf [1,722 nm]	1,500 ft/lbf [2,034 nm]	1,405 ft/lbf [1,905 nm]	1,491 ft/lbf [2,022 nm]	1,215 ft/lbf [1,647 nm]

Neyrfor Delta Series					
Tool Specifications	**T1 MK1 FBS**	**T1XL MK1 FBS**	**T1 MK2 FBS**	**T1XL MK2 FBS**	**TSH MK2 FBS**
Turbine section diameter	6.625 in [168.28 mm]	6.625 in [168.27 mm]	6.625 in [168.28 mm]	6.625 in [168.28 mm]	6.625 in [168.28 mm]
(A) Overall length	32.79 ft [10.0 m]	39.35 ft [11.99 m]	30.9 ft [9.42 m]	39.35 ft [11.99 m]	38.56 ft [11.75 m]
(B) Bit to center of stabilizer B	15.69 ft [4.78 m]	15.69 ft [4.78 m]	13.2 ft [4.02 m]	15.69 ft [4.78 m]	15.69 ft [4.78 m]
(C) Bit to bend	5.25 ft [1.60 m]	5.25 ft [1.62 m]	5.25 ft [1.65 m]	5.25 ft [1.60 m]	5.25 ft [1.60m]
(D) Bit to center of stabilizer D	0.77 ft [0.24 m]	0.77 ft [0.24 m]	1.0 ft [0.3 m]	0.77 ft [0.24 m]	0.77 ft [0.24 m]
Top connection	4½ IF box	4½ IF box	4½ IF box	4½ IF box	4½ IF box
Bit connection	4½ API Reg pin	4½ API Reg pin	4½ API Reg pin	4½ API Reg pin	4½ API Reg pin
Total tool weight	3,099 lbm [1405.7 kg]	3,650 lbm [1,656 kg]	3,135 lbm [1,422.0 kg]	3,716 lbm [1,430.6 kg]	3,750 lbm [1,701.0 kg]
Bend settings	1.0° to 1.8°	1.0° to 1.8°	1.0° to 1.8°	1.0° to 1.8°	1.0° to 1.8°
Recommended bit sizes	7½ in to 9⅞ in [191 to 251 mm]	7½ in to 9⅞ in [191 to 251 mm]	7½ in to 9⅞ in [191 to 251 mm]	7½ in to 9⅞ in [191 to 251 mm]	7½ in to 9⅞ in [191 to 251 mm]
Operational Data					
RPM range/ revolution per gallon	980 to 1,580 rpm [2.604 rev/gal]	900 to 1,550 rpm [2.604 rev/gal]	760 to 1,350 rpm [2.222 rev/gal]	645 to 1,160 rpm [2.222 rev/gal]	690 to 1,550 rpm [2.222 rev/gal]
Pressure drop range	980 to 2,200 psi	1,300 to 3,000 psi	960 to 2,210 psi	1,110 to 2,600 psi	1,050 to 3,000 psi
Max power output	367 hp [274 kw]	580 hp [320 kw]	328 hp [245 kw]	330 hp [246 kw]	622 hp [464 kw]
Max stall torque	2,721 ft/lbf [3,689 nm]	3,305 ft/lbf [4,481 nm]	3,047 ft/lbf [4,131 nm]	3,582 ft/lbf [4,857 nm]	4,142 ft/lbf [5,616 nm]

Hydra-Stroke Bumper Sub

The Hydra-Stroke* bumper sub is a key drillstem component for deepwater drilling operations, where drillstring oscillation can be a problem. This tool provides 6 ft [1.83 m] of reliable telescopic movement without placing any limitations on drillstring torque capacity, tensile strength, or hydraulic capability.

Sub designed for reliability

The Hydra-Stroke bumper sub is fully balanced to the annulus and the mud pumps, making it completely reliable at any depth and in any drilling environment. The fully balanced feature eliminates the pump-open effect caused by internal pressure. The tool is rated for high temperature and pressure. Wellbore fluid cannot enter the drive section, improving reliability.

Applications

- Isolating drillstring assemblies from effects of wave motion on floating and semisubmersible rigs
- Providing drillstring travel in plug and abandonment operations when low-level jarring or bumping is necessary
- Providing travel necessary to deploy knives for casing cutting operations

Benefits

- Enables jarring for recovery of tools at any depth offshore
- Operates dependably in HPHT well conditions

Features

- Delivery of up to 6 ft of stroke to compensate for drillstring oscillation in offshore operations
- Temperature rating of 500 degF [260.0 degC]
- Seal pressure rating of 20,000-psi [137.9-MPa] differential pressure
- Circulation pressure rating of 10,000 psi [68.9 MPa]
- Closed drive prevents ingress of wellbore fluid into drive section, improving reliability
- Full balance to eliminate pump-open effect caused by internal pressure

Hydra-Stroke bumper sub.

Hydra-Stroke Bumper Sub Specifications, Full Balance

Overall Diameter, in [cm]	Internal Diameter, in [cm]	Tool Joint Connection	Tensile Yield, lbf [N]	Torsional Yield, ft.lbf [N.m]	Total Stroke, in [cm]	Closed Length, ft [m]	Closed Length, ft.in
5.25 [13.34]	2.25 [5.72]	3 ½ API IF	600,000 [2,668,933.2]	28,000 [37,962.9]	72 [182.88]	35.25 [10.744]	1,500
6.75 [16.51]	2.75 [6.99]	4 ½ API IF	964,207 [4,289,006.79]	58,300 [79,044.19]	72 [182.88]	32.67 [9.96]	3,200
8 [20.32]	3 [7.62]	6 ⅝ Reg	1,571,980 [6,992,516]	114,000 [154,563.25]	72 [182.88]	36.16 [11.02]	3,340

Ordering instructions, please specify:

- Hole size
- Drillstring component OD where tool will be used
- Connection size, type, right- or left-hand threads
- Hole temperature
- Tool diameter

Nonstandard tolerances are available upon request.

Hydra-Jar AP Double-Acting Hydraulic Drilling Jar

The Hydra-Jar AP* double-acting hydraulic drilling jar is used to amplify the force applied at surface to free stuck drillstring components during drilling or workover operations. The direction of jarring can be both up and down. The jar uses a unique temperature-compensation process to provide consistent impact, blow after blow, and high-temperature seals that make it the best choice for hostile drilling conditions.

In most applications, the tool should be run in conjunction with the Accelerator AP tool to increase impact while protecting the drillstring and surface equipment from shock.

Consistent performance controlled by driller

The Hydra-Jar AP jar gives the driller the operational flexibility of controlling the direction (up or down), force, and frequency of impact. The tool is balanced to hydrostatic pressure through ports open to the wellbore, ensuring consistent hitting performance regardless of changes in downhole pressure. It is also temperature-compensated through the use of a unique detent system. This provides more consistent loading and firing of the jar over a broad range of borehole temperatures. These features—combined with carefully selected materials and field-proven engineering—deliver a uniquely rugged downhole impact system.

Suitability for all drilling environments

The Hydra-Jar AP drilling jar performs effectively in every drilling environment—land or offshore, vertical or deviated wells, and ultradeep or ultrahot boreholes. Because the system works without applied torque, directional drilling tools maintain their orientation throughout the jarring operation. The jar may be run in compression or tension, enabling optimized placement in the string.

Flexibility and efficiency

The fullbore design minimizes pressure losses and provides wireline tool compatibility. The jar makes up, racks, and handles like a standard-length drillpipe, reducing trip time. It provides up, down, or up-and-down impact without torquing or tripping for adjustments. The Hydra-Jar AP jar expands options for drilling, coring, cementing, testing, fishing, workover, and remedial operations.

Applications

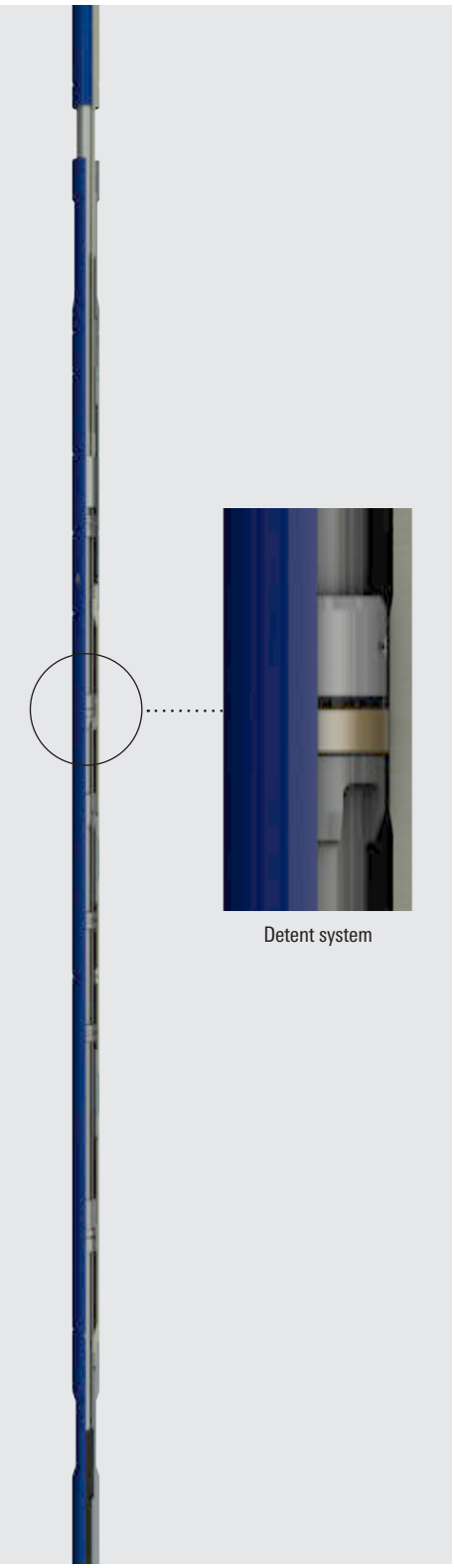
- Drilling or workover operations
- HPHT drilling conditions

Benefits

- Operates in all drilling environments
- Expands options for drilling, coring, cementing, testing, fishing, workover and remedial operations

Features

- Jarring direction, duration, and impact intensity are controlled from rig floor
- Fullbore design minimizes pressure losses and provides wireline tool compatibility
- Optimal placement in compression or tension for best impact and impulse
- Safety clamp and tool length enable jar to be made up, racked, and handled like drillpipe joint, reducing trip time
- Optional safety lock prevents jar from accidental firing
- Jar provides up and down impact without torque or tripping for adjustments
- Temperature rated to 500 degF [260.0 degC]; optional ultrahigh-temperature seals rated to 650 degF [343.3 degC]
- Seals rated to 20,000 psi [137.9 MPa]
- Circulation rated to 10,000 psi [68.9 MPa]



Hydra-Jar AP double-acting hydraulic drilling jar.

Hydra-Jar AP Double-Acting Hydraulic Drilling Jar

Hydra-Jar AP Specifications

Tool OD, in [cm]	Tool ID, in [cm]	Tool Joint Connection	Overall Length Extended, ft [m]	Maximum Detent Working Load, lbf [N]	Tensile Yield Strength, lbf [N]	Torsional Yield Strength, ft.lbf [N.m]	Upstroke, in [cm]	Downstroke, in [cm]	Total Stroke, in [cm]	Tool Weight, lbm [kg]
3.375 [8.57]	1.5 [3.81]	2⅜ API IF	24.42 [7.44]	44,000 [195,712]	236,062 [1,050,004]	6,842 [9,276]	7 [17.78]	7 [17.78]	21 [53.34]	500 [227]
4.25 [10.80]	2 [5.08]	2⅞ API IF	29.83 [9.09]	70,000 [311,360]	377,871 [1,680,770]	15,381 [20,853]	8 [20.32]	7 [17.78]	25 [63.50]	800 [362]
4.75 [12.07]	1.25 [5.72]	3½ API IF	29.83 [9.09]	95,000 [422,560]	492,284 [2,189,679]	19,126 [25,930]	8 [20.32]	7 [17.78]	25 [63.50]	1,050 [476]
5.125 [13.02]	2.25 [5.72]	WT 38	29.83 [9.09]	95,000 [422,560]	492,284 [2,189,679]	30,000 [40,650]	8 [20.32]	6.8125 [17.308]	25 [63.50]	1,155 [524]
6.25 [15.88]	2.75 [6.99]	4½ XH	31.17 [9.50]	150,000 [667,200]	730,324 [3,248,481]	40,505 [54,915]	8 [20.32]	7 [17.78]	25 [63.50]	1,600 [725]
6.25 Mod [15.88]	2.75 [6.99]	4½ XH	31.17 [9.50]	150,000 [667,200]	964,207 [4,288,792]	50,757 [68,814]	8 [20.32]	7 [17.78]	25 [63.50]	1,600 [725]
6.5 [16.51]	2.75 [6.99]	4½ API IF	31.17 [9.50]	175,000 [778,400]	964,207 [4,288,792]	54,796 [74,290]	8 [20.32]	7 [17.78]	25 [63.50]	1,850 [839]
7 [17.78]	2.75 [6.99]	5 H 90	31.5 [3.60]	230,000 [1,023,040]	1,179,933 [5,248,342]	67,396 [91,372]	8 [20.32]	8 [20.32]	25 [63.50]	2,600 [1,179]
7.25 [18.42]	2.75 [6.99]	5½ H 90	31.5 [3.60]	240,000 [1,067,520]	1,261,162 [5,337,600]	84,155 [114,093]	8 [20.32]	8 [20.32]	25 [63.50]	3,000 [1,360]
7.75 [19.69]	3 [7.62]	6⅝ Reg	32 [9.75]	260,000 [1,156,480]	1,315,225 [5,850,121]	86,848 [117,744]	8 [20.32]	7 [17.78]	25 [63.50]	3,200 [1,451]
8 [20.32]	3 [7.62]	6⅝ Reg	32 [9.75]	300,000 [1,334,400]	1,621,565 [7,212,721]	98,490 [133,528]	8 [20.32]	7 [17.78]	25 [63.50]	3,550 [1,610]
8.25 [20.96]	3 [7.62]	6⅝ Reg	32 [9.75]	350,000 [1,556,800]	1,819,384 [8,092,620]	115,418 [156,478]	8 [20.32]	8 [20.32]	25 [63.50]	4,000 [1,814]
8.5 [21.59]	3 [7.62]	6⅝ Reg	32 [9.75]	350,000 [1,556,800]	1,846,269 [8,212,205]	115,418 [156,478]	8 [20.32]	8 [20.32]	25 [63.50]	4,500 [2,041]
9.5 [24.13]	3 [7.62]	7⅝ Reg	32.5 [9.16]	500,000 [2,224,000]	1,654,172 [7,357,757]	152,802 [207,161]	8 [20.32]	8 [20.32]	25 [63.50]	5,600 [2,540]

Accelerator AP Impact Tool

The Accelerator AP* impact tool is recommended whenever a Hydra-Jar AP jar is placed in the string. It operates automatically with the jar, increasing reliability and ease of use while protecting the drillstring and surface equipment from damaging shock waves.

Maximum jarring impact in any hole profile

Used in conjunction with the Hydra-Jar AP double-acting hydraulic drilling jar, the Accelerator AP tool combines the advantage of jarring up, down, or up and down with hydraulic fluid for maximum jarring impact. By increasing the velocity of the mass applied to the jar, the Accelerator AP tool ensures optimal impact force from the Hydra-Jar AP jar. Fluid compression inside the Accelerator AP tool compensates for limited drillpipe stretch in shallow or crooked holes, providing stored energy so that the fish is hit hard regardless of depth. The tool also enhances jar performance in extended-reach, directional, and horizontal wells where the stored energy in the drillpipe is lost because of hole drag.

Efficient energy transfer

The Accelerator AP tool provides the same impact with less overpull at the jar. The hammer mass receives 100% transfer of the overpull.

Applications

- Extended-reach, directional, and horizontal wells when drillpipe loses stored energy to hole drag
- HPHT well conditions
- BHAs that include a Hydra-Jar AP double-acting drilling jar

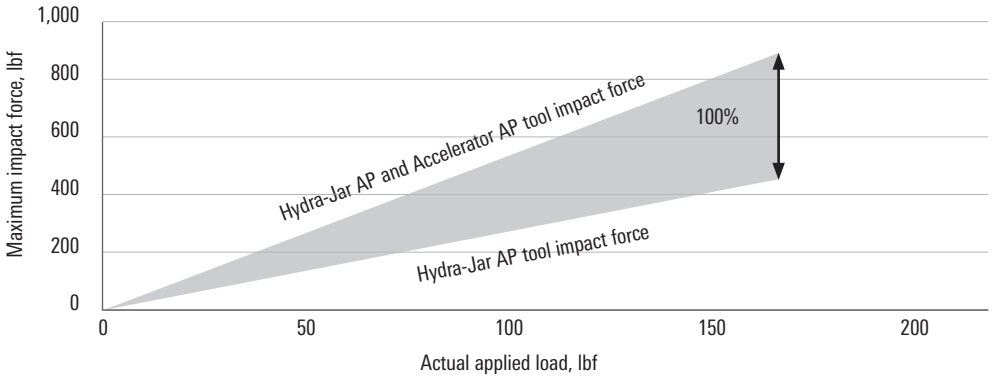
Benefits

- Improved jar performance for recovery in shallow or crooked holes
- Impact force independent of hole condition
- Twice as much impact force compared with other tools for jarring up, down, or up and down
- Drillstring and surface equipment protection from damaging shock waves

Features

- Fluid compression inside tool compensates for limited drillpipe stretch in shallow wells, providing stored energy and maximizing impact
- Fullbore design minimizes pressure losses and provides wireline tool compatibility
- Automatic operation with the jar, increasing reliability and ease of use
- Efficient design ensures that full overpull force is delivered to the hammer section, creating maximum positive impact
- Temperature rating of 500 degF [260.0 degC] (optional ultrahigh-temperature rating of 650 degF [343.3 degC)
- Seal pressure rating of 20,000 psi [137.9 MPa]
- Circulation pressure rating of 10,000 psi [68.9 MPa]

Note: Accelerator AP tool offered in same size configurations as the Hydra-Jar AP drilling jar.



When run in combination with the Hydra-Jar AP jar or the HydraQuaker hydraulic drilling jar, the Accelerator AP tool more than doubles the available impact force.*

Accelerator AP impact tool.

Accelerator AP Specifications

Outer Diameter, in [mm]	Inner Diameter, in [mm]	Tool Joint Connection	Overall Length Extended, ft.in [mm]	Maximum Detent Working Load, lbf [N]	Tensile Yield Strength, lbf [N]	Torsional Yield Strength, lbf.ft [N.m]	Up Stroke, in [mm]	Down Stroke, in [mm]	Total Stroke, in [mm]	Tool Weight, lbm [kg]
3⅜ [85.73]	1½ [38.10]	2⅜ API IF	24.42 [7,442]	44,000 [195,712]	236,062 [1,050,004]	6,842 [9,276]	7 [178]	7 [178]	21 [533]	500 [227]
4¼ [107.95]	2 [50.80]	2⅞ API IF	29.83 [9,093]	70,000 [311,360]	377,871 [1,680,770]	15,381 [20,853]	8 [203]	7 [178]	25 [635]	800 [362]
4¾ [120.65]	2¼ [57.15]	3½ API IF	29.83 [9,093]	95,000 [422,560]	492,284 [2,189,679]	19,126 [25,930]	8 [203]	7 [178]	25 [635]	1,050 [476]
5⅛ [130.18]	2¼ [57.15]	WT 38	29.83 [9,093]	95,000 [422,560]	492,284 [2,189,679]	30,000 [40,650]	8 [203]	6 13⁄16 [173.08]	25 [635]	1,155 [524]
6¼ [158.75]	2¾ [69.85]	4½ XH	31.17 [9,499]	150,000 [667,200]	730,324 [3,248,481]	40,505 [54,915]	8 [203]	7 [178]	25 [635]	1,600 [725]
6¼ Mod [158.75]	2¾ [69.85]	4½ XH	31.17 [9,499]	150,000 [667,200]	964,207 [4,288,792]	50,757 [68,814]	8 [203]	7 [178]	25 [635]	1,600 [725]
6½ [165.10]	2¾ [69.85]	4½ Reg IF	31.17 [9,499]	175,000 [778,400]	964,207 [4,288,792]	54,796 [74,290]	8 [203]	7 [178]	25 [635]	1,850 [839]
7 [177.80]	2¾ [69.85]	5 H 90	31.50 [3,601]	230,000 [1,023,040]	1,179,933 [5,248,342]	67,396 [91,372]	8 [203]	8 [203]	25 [635]	2,600 [1,179]
7¼ [184.15]	2¾ [69.85]	5½ H 90	31.50 [3,601]	240,000 [1,067,520]	1,261,162 [5,337,600]	84,155 [114,093]	8 [203]	8 [203]	25 [635]	3,000 [1,360]
7¾ [196.85]	3 [76.20]	6⅝ Reg	32.00 [9,754]	260,000 [1,156,480]	1,315,225 [5,850,121]	86,848 [117,744]	8 [203]	7 [178]	25 [635]	3,200 [1,451]
8 [203.20]	3 [76.20]	6⅝ Reg	32.00 [9,754]	300,000 [1,334,400]	1,621,565 [7,212,721]	98,490 [133,528]	8 [203]	7 [178]	25 [635]	3,550 [1,610]
8¼ [209.55]	3 [76.20]	6⅝ Reg	32.00 [9,754]	350,000 [1,556,800]	1,819,384 [8,092,620]	115,418 [156,478]	8 [203]	8 [203]	25 [635]	4,000 [1,814]
8½ [215.90]	3 [76.20]	6⅝ Reg	32.00 [9,754]	350,000 [1,556,800]	1,846,269 [8,212,205]	115,418 [156,478]	8 [203]	8 [203]	25 [635]	4,500 [2,041]
9½ [241.30]	3 [76.20]	7⅝ Reg	32.50 [9,906]	500,000 [2,224,000]	1,654,172 [7,357,757]	152,802 [207,161]	8 [203]	8 [203]	25 [635]	5,600 [2,540]

Borehole Enlargement Tools

Rhino XS Hydraulically Expandable Reamer

The rugged, precision-engineered Rhino XS* hydraulically expandable reamer has demonstrated superior reliability in thousands of runs worldwide. The reamer effectively enlarges wellbores up to 25% for improved casing running, cementing clearance, and ECD control. The reamer is effective in a variety of formations in which simultaneous drilling and hole enlargement reliability is essential. The reamer's one-piece, balanced design increases torque and load carrying capacity while reducing drilling-generated vibrations that produce undergauge and irregular boreholes.

Efficient, full-gauge reaming

The Rhino XS reamer is hydraulically activated and deactivated by pumping fluid through the drillstring and into the tool's piston bore. A ball-drop activation-deactivation mechanism increases differential pressure when the first ball is dropped by restricting the tool bore, shearing the shear pins and deploying the cutters; pressure indicators at the surface signal full cutter deployment. For applications that require circulation with the cutter blocks in the closed position, an optional double ball drop is available.

In place of cutter arms, the Rhino XS reamer features the patented Z-Drive* reamer cutter block deployment system, which traverses the cutter blocks to a preselected diameter and hydraulically clamps them into position. The parallel tongue and groove actuation design of the Z-Drive system ensures reliable cutter block deployment and retraction.

The Rhino XS reamer has three changeable nozzles to ensure enhanced cleaning and cuttings evacuation. The tool's large bore handles high fluid volumes with optimized distribution between the bit and cutter blocks. This high-fluid capability also accommodates the fluid requirements of RSS and directional assemblies.

Applications

- Deepwater operations
- Drilling extended intervals with advanced RSSs
- Extended-reach drilling (ERD)
- Backreaming in loosely consolidated formations
- Drilling highly abrasive formations
- Close-tolerance and expandable casing programs
- Optimization of tubular programs, achieving higher production rates at lower cost

Benefits

- Ensure full-gauge, concentric wellbores through reliable hydraulic actuation
- Deliver higher ROP in an array of formation types

Features

- Dependable cutter block retraction avoids stuck BHAs and casing damage
- Integral back-reaming capability ensures construction of full-diameter wellbore
- Integrated jet nozzle and flow paths improve cleanout while drilling

Rhino XS Reamer Specifications

Tool Series	Overall Body Diameter, in [mm]	Standard Fishing Neck Diameter, in [mm]	Enlarged Hole Size, in [mm]	Minimum Pilot Hole Size, in [mm]	Internal Bore Diameter, in [mm]	Maximum Thru Flow, galUS/min [L/min]
4000	4 [102]	4 [102]	4.50–5.50 [114–140]	4.25 [108]	0.88 [22]	141 [534]
4500	4.50 [114]	4.50 [114]	4.75–5.75 [121–146]	4.75 [121]	1.13 [29]	230 [871]
5500	5.50 [140]	5.25 [133]	6.50–7 [165–178]	5.75 [146]	1.25 [32]	230 [871]
5625	5.62 [143]	5.25 [133]	6.50–7 [165–178]	5.88 [149]	1.38 [35]	350 [1,325]
5800	5.80 [147]	5.25 [133]	6.50–7.38 [165–187]	6.13 [156]	1.38 [35]	350 [1,325]
6125	6.13 [156]	5.38 [137]	7–7.50 [178–191]	6 [152]	1.38 [35]	350 [1,325]
6375	6.38 [162]	5.38 [137]	7–8 [178–203]	6.75 [172]	1.38 [35]	350 [1,325]
7300	7.25 [184]	6.25 [159]	8–9 [203–229]	7.50 [191]	1.50 [38]	500 [1,893]
8000	8 [203]	7.25 [184]	9–10.25 [229–260]	8.25 [210]	2 [51]	750 [2,839]
9250	9.25 [235]	7.25 [184]	10.25–11.75 [260–300]	9.50 [241]	2 [51]	750 [2,839]
10000	10 [254]	8.50 [216]	11–12.50 [280–318]	10.50 [267]	2.50 [64]	1,200 [4,543]
10375	10.38 [264]	8.50 [216]	11.75–13.50 [299–343]	10.88 [276]	2.50 [64]	1,200 [4,543]
11625	11.63 [295]	10.50 [267]	13–15 [330–381]	12.13 [308]	3 [76]	1,700 [6,435]
13000	13 [330]	10.75 [273]	14.50–16.50 [368–419]	13.50 [343]	3 [76]	1,700 [6,435]
14250	14.25 [362]	11 [279]	15.75–18.25 [400–464]	14.50 [368]	3 [76]	1,700 [6,435]
16000	16 [406]	12 [305]	17.50–20 [445–508]	16.50 [419]	3 [76]	1,700 [6,435]
16000	17.38 [441]	12 [305]	18.50–22 [470–559]	17.50 [445]	3 [76]	1,700 [6,435]
17500	17.50 [445]	12 [305]	21.50–24 [546–610]	18.13 [461]	3 [76]	1,700 [6,435]

Stabilization System for Rhino Integrated Borehole Enlargement System

Running the stabilization system with a Rhino system reamer helps to reduce vibration downhole. The stabilization system's concentric stabilizer increases lateral support in the enlarged wellbore and improves dynamic stability. This impedes vibration that can shorten the service life of downhole tools and surface equipment, slows drilling, results in an irregular borehole and—in severe cases—leads to loss of the entire BHA downhole.

The stabilizer is activated by the same ball-drop mechanism as the Rhino XS reamer and is typically run undergauge 30 ft [9.14 m] above the reamer. Tungsten-carbide DEIs in the stabilizer blocks ensure superior wear resistance.

Applications

- Drilling extended intervals with advanced RSSs
- ERD
- Backreaming in loosely consolidated formations
- Drilling highly abrasive formations

Benefits

- Provides concentric, stable points of contact in the enlarged wellbore, increasing lateral support
- Helps ensure quality wellbores

Features

- Tungsten-carbide DEIs ensure superior wear resistance
- Cutters deployed with patented Z-Drive system

Stabilization system for Rhino integrated borehole enlargement system.

Stabilization System Specifications

Tool Series	Overall Body Diameter, in [mm]	Standard Fishing Neck Diameter, in [mm]	Enlarged Hole Size, in [mm]	Minimum Pilot Hole Size, in [mm]	Internal Bore Diameter, in [mm]	Maximum Through Flow, galUS/min [L/min]
4500	4.50 [114]	4.50 [114]	4.75–5.75 [121–146]	4.75 [121]	1.13 [29]	230 [870]
5625	5.62 [143]	5.25 [131]	6.50–7 [165–178]	5.88 [149]	1.38 [35]	350 [1,330]
6125	6.13 [156]	5.38 [137]	7–7.50 [178–191]	6.38 [162]	1.38 [35]	350 [1,330]
7300	7.25 [184]	6.25 [159]	8–9 [203–229]	7.50 [191]	1.50 [38]	350 [1,330]
8000	8 [203]	7.25 [184]	9–10.25 [229–260]	8.25 [210]	2 [51]	750 [2,840]
9250	9.25 [235]	7.75 [197]	10.25–11.75 [260–299]	9.50 [241]	2 [51]	750 [2,840]
10000	10 [254]	8.50 [216]	11–12.50 [279–318]	10.50 [267]	2.50 [64]	1,200 [4,540]
10375	10.38 [264]	8.50 [216]	11.75–13.50 [299–343]	10.75 [273]	2.50 [64]	1,200 [4,540]
11625	11.63 [295]	10.50 [267]	13–15 [330–381]	12.13 [308]	3 [76]	1,700 [6,440]
13000	13.50 [343]	11 [279]	14.50–16.50 [368–419]	13.50 [343]	3 [76]	1,700 [6,440]
14250	14.25 [362]	11 [279]	15.75–18.25 [400–464]	14.75 [375]	3 [76]	1,700 [6,440]
16000	16.38 [416]	12 [305]	17.50–20 [445–508]	16.50 [419]	3 [76]	1,700 [6,440]
16000	16 [406]	12 [305]	18.50–22 [470–559]	17.50 [445]	3 [76]	1,700 [6,440]

Fixed-Diameter Hole Openers

The fixed-diameter hole opener enlarges boreholes using a range of milled tooth and TCI cutting structures that are available for a variety of formation conditions. The tool features three cleaning jets with replaceable nozzles that continually clean the tool's cutting structure, clearing debris buildup and enabling sustained penetration. This is particularly important in sticky formations where balling can occur. The hole opener also enlarges holes in soft clays and shales, medium to hard shales, and limestones. The tool is available with hand-tool-detachable cutters for efficient redress and minimal downtime.

Applications

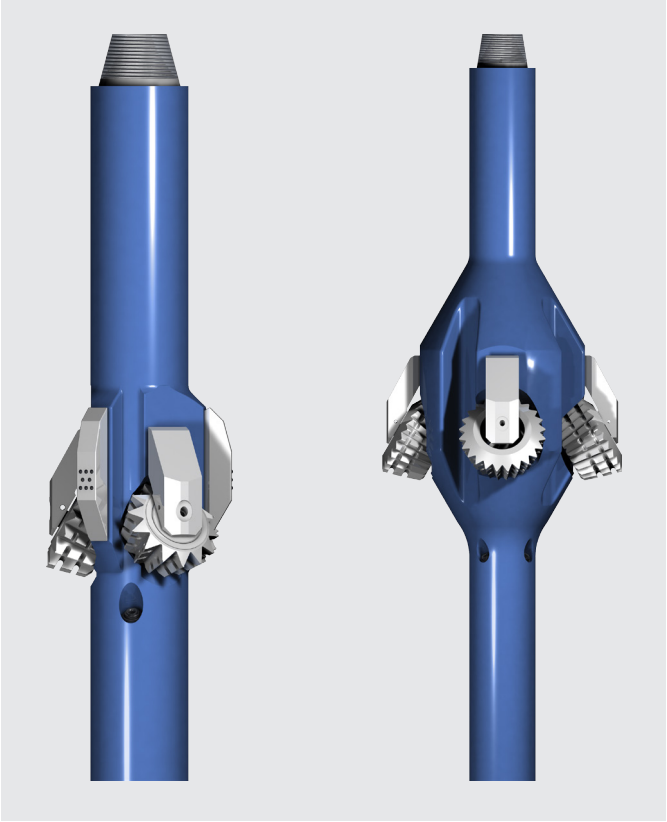
- Top-hole enlargement for accomodation of drive pipe, conductor casings, and large-diameter surface casings
- Hole enlargement at river crossings and other balling-prone formations
- Borehole enlargement in soft to hard formations

Benefits

- Improved operational efficiency with cutting structures available for a variety of formation conditions
- Increased application utility with sealed bearings and TCI cutters in most diameters

Features

- Cutter arms can be changed on rig floor for quick replacement
- Three replaceable jets clean cutting surfaces, prevent balling, ensure fast penetration, and deliver effective hole cleaning
- Upjets aid cuttings removal
- Robust design endures long-interval drilling
- High-velocity oxy-fuel (HVOF) carbide coating reduces tool body erosion



Fixed-diameter hole openers with OD less than 26 in have 3 cutters (left), and those with OD 26 to 36 in have 4 cutters (right).

Fixed-Diameter Hole Opener Specifications

Tool Series	Opening Diameter, in [mm]	Minimum Pilot Hole Size, in [mm]	Length, ft [m]	Body OD, in [mm]	Inner Bore Diameter, in [mm]	Number of Cutters
17500	17.50 [445]	12.01 [305]	5.81 [1.77]	12.25 [311]	1.50 [38]	3
26000	26 [660]	17.50 [445]	7.13 [2.17]	17.50 [445]	2 [51]	4
32000	32 [813]	24 [610]	9.39 [2.86]	24 [610]	2 [51]	4
36000	36 [914]	26 [660]	8.56 [2.61]	26 [660]	2 [51]	4
42000	42 [1,067]	30 [762]	9.56 [2.91]	30 [762]	3 [76]	6

Drilling-Type Underreamer

The drilling-type underreamer (DTU) is a tricone underreamer with cutter arms that deploy in response to hydraulic pressure on a piston-cam system. The underreamer runs in conjunction with a drill bit or a bullnose on a bottom-box connection depending on pilot hole condition or project objectives. The tool's three-arm design can increase the pilot hole diameter up to 75%, depending on tool size.

The underreamer's cutters retract in the absence of hydraulic pressure and the closing force of a piston spring. This enables the tool to be repositioned for selective underreaming or retrieval from the well. The tool allows fluid flow to the bit or bullnose through the bottom connection; flow can be divided depending on the application. Orifice jets can be selected in accordance with existing hydraulics to cool cutters and to maintain annular lift of cuttings.

Applications

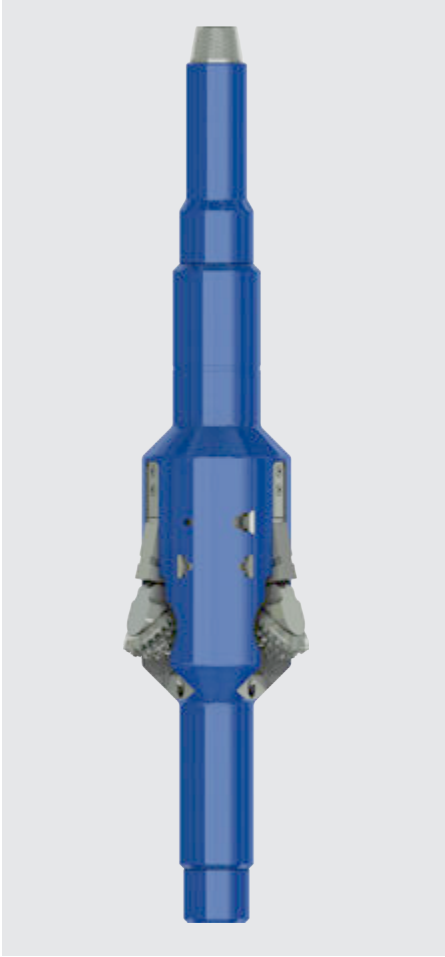
- Wiping out bridges and keyseats
- Drilling and underreaming in fault zones and swelling formations
- Opening reservoir sections for gravel packing
- Underreaming while drilling (UWD)

Benefits

- Increases the pilot hole diameter up to 75%
- Enables selective repositioning for selective underreaming or retrieval

Features

- API Reg box down for makeup to bit or jetted bullnose
- Milled-tooth, TCI, or PDC cutters available for formation demands
- Facilitation of fluid passage to bits or jetted bullnoses to divert flow when necessary
- Cutter arms that can be changed on rig floor for quick replacement



Drilling-type underreamer.

Drilling-Type Underreamer Specifications

Tool Series	Standard Opening Diameter, in [mm]	Optional Opening Diameter, in [mm]	Body Diameter, in [mm]	Collapsed Diameter, in [mm]	Fishing Neck Length, in [mm]	Fishing Neck Diameter, in [mm]	Overall Length, ft [m]	Top Pin/Bottom Box Connection, Reg	Weight, lbm [kg]	Minimum Pilot Hole Diameter, in [mm]
17000	32 [813]	24–32 [610–813]	17 [432]	17 [432]	20 [508]	9 [229]; 10 [254]	10.58 [3.23]	7.63; 8.63	3,800 [1,724]	17.50 [445]
22000	36 [914]	28–42 [711–1,067]	22 [559]	22 [559]	20 [508]	9 [229]; 10 [254]	8.33 [2.54]	7.63; 8.63	4,400 [1,996]	24 [610]

Bullnose Specifications

Top Pin Connection, Reg	Body Diameter, in [mm]	Nominal Length, in [mm]
2.53	3.63 [92]	18 [457]
3.50	4.75 [121]	36 [914]
4.50	6.25 [159]	36 [914]
4.50	7.50 [191]	48 [1,219]
6.53	8 [203]	48 [1,219]
7.53	9 [229]	48 [1,219]
8.53	10 [254]	48 [1,219]

Reamaster-XTU Forged Cutter Arm Underreamer

The Reamaster-XTU* forged cutter arm underreamer has two large, robust cutter arms to facilitate greater cross-sectional cutting at the underreamer cutter pockets. Larger cutters also provide larger sealed bearings and PDC cutters for optimized underreaming performance. The underreamer's ability to increase an existing pilot hole up to 70% makes it ideal for a range of drilling and remedial operations.

Fluid flow has been optimized using gun-drilled ports, which deliver more drilling mud to the underreamer and the drill bit's cutters. This improves hole cleaning efficiency and accommodates the fluid requirements of other downhole tools.

The Reamaster-XTU underreamer has cutting structures that can be customized for a broad range of applications and formation types. The tool's sealed-bearing, milled-tooth, and TCI cutters are designed specifically for underreaming operations with a capability that rivals the penetration rate and cutting structure life of a drill bit.

Applications

- Wellbore enlargement below restrictions
- Minimum clearance and expandable casing programs
- UWD
- Gravel-pack and expandable-screen completions
- Reaming out keyseats and cleaning up downhole ledges

Benefits

- Increases an existing pilot hole up to 70%
- Improves hole cleaning efficiency
- Accommodates the fluid requirements of other downhole tools

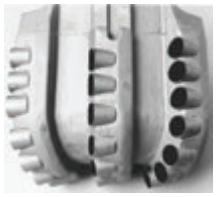
Features

- Forged cutter arms endure high shock and torque loads
- Sealed-bearing cutters extend on-bottom life
- Positive lock keeps arms deployed
- Optimized fluid distribution ensures drilling mud delivery
- Strategically placed nozzles ensure efficient hole cleaning
- Available with milled-tooth, TCI, and PDC cutting structures

Reamaster-XTU forged cutter arm underreamer.

Milled-tooth cutter.

TCI cutter.



PDC cutter.

Reamaster-XTU Underreamer Specifications

Tool Series	Opening Diameter, in [mm]	Pilot Hole Size, in [mm]	Collapsed Body Diameter, in [mm]	Fishing Neck Length, in [mm]	Fishing Neck Diameter, in [mm]	Overall Length, ft [m]	Top Pin/Bottom Box Connection, Reg	Weight, lbm [kg]
5750	8.50; 9 [216; 229]	5.88–6.50 [149–165]	5.75 [146]	18 [457]	4.75 [121]	7.50 [2.29]	3.50	500 [227]
7200	11; 11.75; 12.25 [279; 299; 311]	7.50–11 [191–279]	7.25 [184]	18 [457]	5.75 [146]	8.25 [2.52]	4.50	700 [318]
8250	9.88; 10.63; 11; 12.25; 13.50 [251; 270; 279; 311; 343]	8.50–9.88 [216–251]	8.25 [210]	18 [457]	5.75 [146]	10.25 [3.12]	4.50	900 [408]
9500	12.25; 13.50; 15; 16 [311; 343; 381; 406]	9.88–12.25 [251–311]	9.50 [241]	24 [610]	8 [203]	11.33 [3.45]	6.63	1,100 [499]
11750	14; 15; 16; 17.50 [356; 381; 406; 445]	12.25–14.25 [311–362]	11.75 [299]	20 [508]	8 [203]	10.83 [3.30]	6.63	1,700 [771]
16000	20; 22; 24; 26 [508; 559; 610; 660]	17.50–22 [445–559]	16 [406]	20 [508]	10 [254]	11.67 [3.56]	8.63	3,200 [1,452]

Fishing Tools

TMC Jar Single-Acting Hydraulic Fishing Jar (Up Only)

Applications

- Fishing operations, including stuck pipe, packer retrieval, tubing removal, milling, and debris recovery
- Plug and abandonment operations, including pipe recovery and wellhead removal
- Operations that include harsh downhole conditions

Benefits

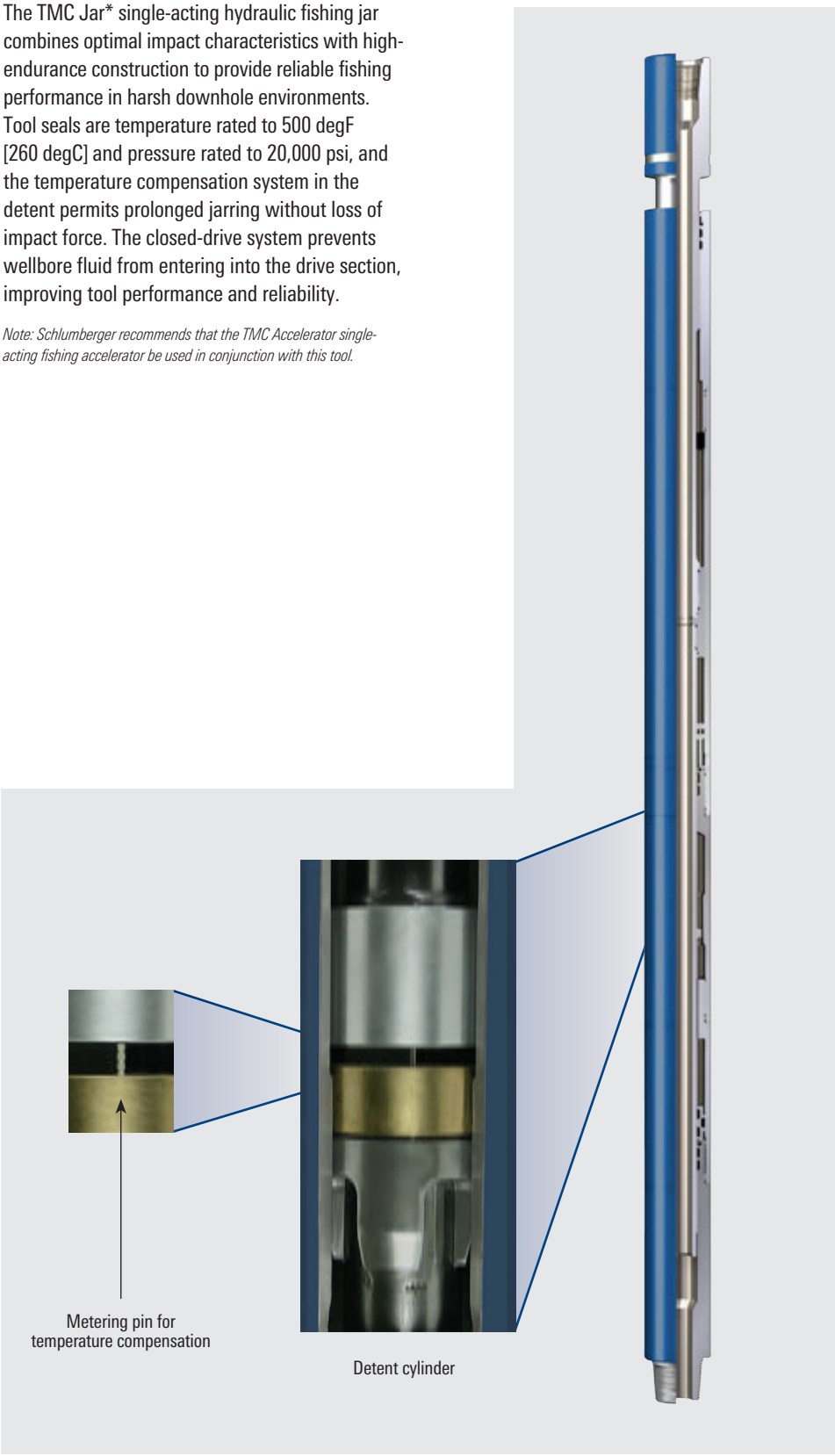
- Advanced impact characteristics
- Capability for prolonged jarring

Features

- Long free-travel design to optimize impact
- Hydraulic metering system that enables variable impact loads controlled by the amount of upward load applied by the operator
- Seals rated to 500 degF [260 degC] and 20,000-psi [137.9-MPa] differential pressure
- Circulation pressure rated to 10,000 psi [68.9 MPa]
- Temperature compensation system to enable prolonged jarring when required
- Closed-drive system that prevents ingress of wellbore fluid into the drive section, improving reliability
- Interchangeable parts that enable conversion between hydraulic jars and accelerator tools

The TMC Jar* single-acting hydraulic fishing jar combines optimal impact characteristics with high-endurance construction to provide reliable fishing performance in harsh downhole environments. Tool seals are temperature rated to 500 degF [260 degC] and pressure rated to 20,000 psi, and the temperature compensation system in the detent permits prolonged jarring without loss of impact force. The closed-drive system prevents wellbore fluid from entering into the drive section, improving tool performance and reliability.

Note: Schlumberger recommends that the TMC Accelerator single-acting fishing accelerator be used in conjunction with this tool.



TMC single-acting hydraulic fishing jar (up only).

TMC Jar Single-Acting Hydraulic Fishing Jar (Up Only)

Specifications								
Tool OD, in [mm]	1.87 [47]	1.87 [47]	2.25 [57]	3.13 [79]	3.13 [79]	3.75 [95]	3.75 [95]	4.25 [108]
Tool ID, in [mm]	0.38 [10]	0.56 [14]	0.50 [13]	1 [25]	1.50 [38]	1.50 [38]	2 [51]	2 [51]
Tool joint connection	1.87 WFJ	1 AM MT	1.25 API Reg	2.38 API Reg	2 EUE	2.38 API IF	2.38 EUE	2.88 API IF
Assembly number	16420	16853	16421	16213	16457	16210	16349	16204
Overall length, ft [m]	7 [2.13]	5 [1.52]	10 [3.05]	12 [3.66]	11 [3.35]	12.17 [3.71]	11 [3.35]	12.83 [3.91]
Recommended max. overpull working load during restricted travel, lbf [N]	19,000 [84,500]	17,000 [75,600]	20,000 [89,000]	51,000 [226,900]	32,400 [144,000]	59,000 [262,400]	38,000 [169,000]	73,000 [324,700]
Total stroke, in [mm]	9.75 [248]	7.25 [184]	12 [305]	16 [406]	14 [356]	16 [406]	16 [406]	16 [406]
Tensile yield, lbf [N]	56,000 [249,100]	69,000 [306,900]	95,800 [426,100]	192,000 [854,100]	185,000 [822,900]	257,000 [1,143,200]	233,000 [1,036,400]	348,000 [1,548,000]
Torsional yield, ft.lbf [N.m]	800 [1,085]	750 [1,020]	1,900 [2,580]	4,100 [5,560]	4,200 [5,695]	6,600 [8,950]	7,400 [10,030]	11,000 [14,910]
Tool weight, lbm [kg]	75 [34]	54 [25]	125 [57]	200 [91]	225 [102]	240 [109]	325 [147]	375 [170]
Tool OD, in [mm]	4.25 [108]	4.75 [121]	4.75 [121]	6.25 [159]	6.50 [165]	7.75 [197]	8 [203]	
Tool ID, in [mm]	2.88 [73]	2 [51]	2.25 [57]	2.25 [57]	2.25 [57]	3.50 [89]	3.50 [89]	
Tool joint connection	2.88 EUE	3.50 API FH	3.50 API IF	4.50 API IF	4.50 API IF	6.88 API Reg	6.88 API Reg	
Assembly number	16348	16155	16143	16318	16363	16320	16366	
Overall length, ft [m]	11 [3.35]	13 [3.96]	13.50 [4.11]	15 [4.57]	15 [4.57]	16 [4.88]	16 [4.88]	
Recommended max. overpull working load during restricted travel, lbf [N]	39,000 [173,500]	90,000 [400,300]	95,000 [422,600]	180,000 [800,700]	195,000 [867,400]	300,000 [1,334,500]	300,000 [1,334,500]	
Total stroke, in [mm]	16 [406]	16 [406]	16 [406]	18 [457]	18 [457]	18 [457]	18 [457]	
Tensile yield, lbf [N]	320,000 [1,423,400]	422,000 [1,877,200]	422,000 [1,877,200]	900,000 [4,003,400]	928,000 [4,128,000]	1,304,000 [5,800,000]	1,304,000 [5,800,000]	
Torsional yield, ft.lbf [N.m]	10,000 [13,560]	14,000 [18,980]	14,000 [18,980]	50,000 [67,790]	50,000 [67,790]	118,000 [159,990]	118,000 [159,990]	
Tool weight, lbm [kg]	400 [181]	425 [193]	375 [170]	950 [431]	1,078 [489]	1,400 [635]	1,570 [712]	

When ordering, please specify

- hole size
- connection size, type, and left- or right-hand threads
- tool diameter
- hole temperature.

TMC Single-Acting Fishing Accelerator (Up Only)

Applications

- Any fishing operation, including stuck pipe, packer retrieval, tubing removal, milling and debris recovery
- Plug and abandonment operations, including pipe recovery and wellhead removal

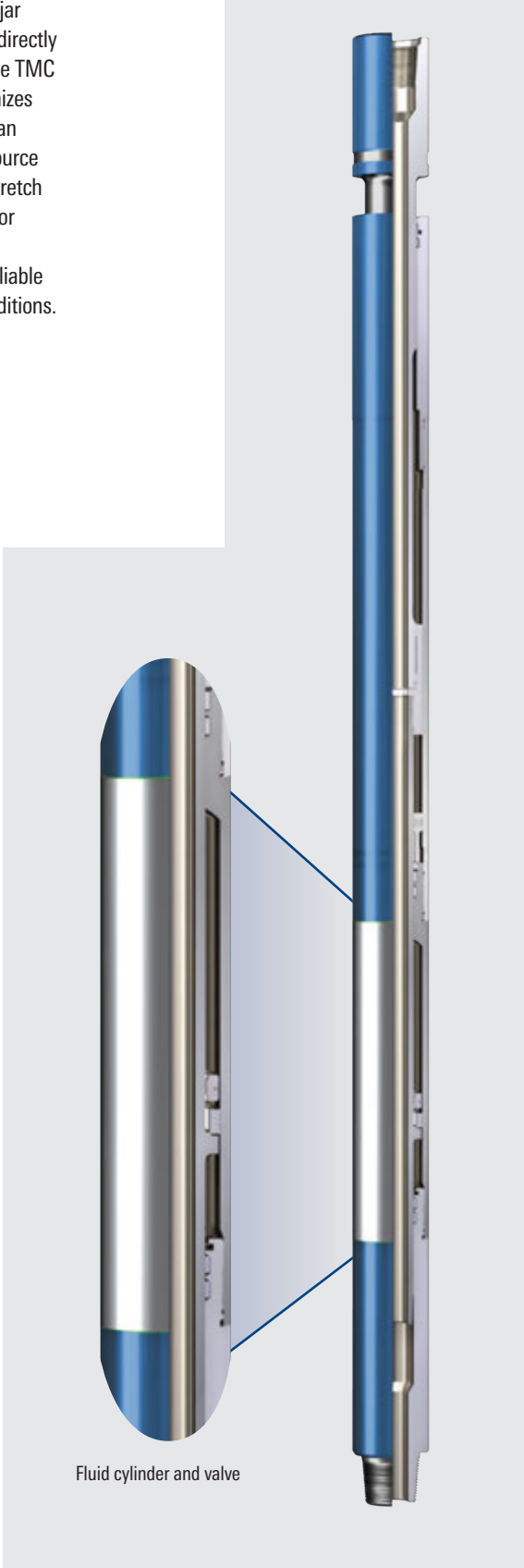
Benefits

- Endures harsh downhole environments
- Works with parts from the TMC fishing jar

Features

- Absorbs shock waves that propagate up the workstring and damage tool joints, top drives, and other surface components
- Temperature rated to 500 degF [260 degC]
- Seals rated to 20,000-psi [137.9-MPa] differential pressure
- Circulation pressure rated to 10,000 psi [68.9 MPa]
- Closed drive system to prevent ingress of wellbore fluid into the drive section, improving reliability
- Interchangeable parts to allow conversion between accelerator tools and hydraulic jars, reducing parts inventories and increasing flexibility

The TMC fishing accelerator tool improves jar impact and provides a supercharged blow directly above the fish. Used in conjunction with the TMC fishing jar, the TMC accelerator tool maximizes jar impact regardless of depth because it can either replace pipe stretch as the energy source in shallow holes, or supplement the pipe stretch energy in deeper wells. The TMC accelerator tool's robust design, materials quality, and comprehensive QA requirements ensure reliable performance in the harshest of fishing conditions.



TMC single-acting fishing accelerator (up only).

TMC Single-Acting Fishing Accelerator (Up Only)

Specifications									
Tool OD, in [mm]		1.08 [27]	1.08 [27]	2.25 [57]	3.13 [79]	3.13 [79]	3.75 [95]	3.75 [95]	4.25 [108]
Tool ID, in [mm]		0.38 [10]	0.56 [14]	0.50 [13]	1 [25]	1.50 [38]	1.50 [38]	2 [51]	2 [51]
Tool joint connection		1.81 WFJ	1 AM MT	1.25 API Reg	2.38 API Reg	2.38 EUE	2.38 API IF	2.38 EUE	2.88 API IF
Assembly number		16422	16854	16423	16214	16459	16211	16384	16206
Overall length, ft [m]		5.83 [1.78]	4.50 [1.37]	8 [2.44]	10 [3.05]	9 [2.74]	10.33 [3.15]	9 [2.74]	10.67 [3.25]
Tensile yield, lbf [N]		56,000 [249,100]	69,000 [306,900]	95,800 [426,100]	192,000 [854,100]	185,000 [822,900]	257,000 [1,143,200]	233,000 [1,036,400]	348,000 [1,548,000]
Torsional yield, ft.lbf [N.m]		800 [1,090]	750 [1,020]	1,900 [2,580]	4,100 [5,560]	4,200 [5,700]	6,600 [8,900]	7,400 [10,000]	11,000 [14,900]
Total distance traveled with stop sleeve,†† in [mm]		8 [203]	7.25 [184]	10 [254]	12 [305]	10.50 [267]	11.38 [289]	12 [305]	11.25 [286]
Rack test in shop at 70 degF [21.1 degC] for a nominal bottomhole temperature of 240 degF [115.6 degC],§ in [mm] at lbf [N]		6.75 [171] at 6,000 [26,700]	4.25 [108] at 5,000 [22,200]	7.50 [191] at 6,000 [26,700]	11 [179] at 29,000 [129,000]	10 [254] at 13,200 [58,700]	10 [254] at 31,000 [137,900]	10.13 [257] at 16,000 [71,200]	9.63 [244] at 32,000 [142,300]
Oil fluid, oz [mL]		2 [59]	2 [59]	2 [59]	3 [89]	2 [59]	3 [89]	3 [89]	4 [118]
Jar and accelerator tool combination loads (downhole at 240 degF), lbf [N]	Min. overpull†	7,500 [33,400]	6,000 [26,700]	5,200 [23,100]	19,000 [84,500]	8,400 [37,400]	22,000 [97,900]	16,000 [71,200]	32,000 [142,300]
	Max. overpull‡	19,000 [84,500]	17,000 [75,600]	20,000 [89,000]	50,000 [222,400]	32,400 [144,100]	59,000 [262,400]	38,000 [169,000]	73,000 [324,700]
Tool weight, lbm [kg]		60 [27]	46 [21]	100 [45]	160 [73]	130 [59]	180 [82]	160 [73]	300 [136]

Specifications (continued)								
Tool OD, in [mm]		4.25 [108]	4.75 [121]	4.75 [121]	6.25 [159]	6.50 [165]	7.75 [197]	8 [203]
Tool ID, in [mm]		2.44 [62]	2 [51]	2.25 [57]	2.25 [57]	2.25 [57]	3.50 [89]	3.50 [89]
Tool joint connection		2.88 EUE	3.50 API FH	3.50 API IF	4.50 API IF	4.50 API IF	6.63 API Reg	6.63 API Reg
Assembly number		15339	16195	16414	16319	16364	16321	16367
Overall length, ft [m]		11.67 [3.56]	11 [3.35]	11.83 [3.61]	12 [3.66]	12 [3.66]	13 [3.96]	13 [3.96]
Tensile yield, lbf [N]		320,000 [1,423,000]	422,000 [1,877,000]	422,000 [1,877,000]	900,000 [4,003,400]	928,000 [4,128,000]	1,304,000 [5,800,000]	1,304,000 [5,800,000]
Torsional yield, ft.lbf [N.m]		10,000 [13,558]	14,000 [18,981]	14,000 [18,981]	50,000 [67,791]	50,000 [67,791]	118,000 [159,987]	118,000 [159,987]
Total distance traveled with stop sleeve,†† in [mm]		12 [305]	12 [305]	10.38 [264]	10.38 [264]	12 [305]	12 [305]	12 [305]
Rack test in shop at 70 degF [21.1 degC] for a nominal bottomhole temperature of 240 degF [115.6 degC],§ in [mm] at lbf [N]		10.88 [276] at 19,000 [84,500]	8 [203] at 36,000 [160,100]	8 [203] at 37,800 [168,100]	8.75 [222] at 46,700 [207,700]	8.75 [222] at 46,700 [207,700]	10 [254] at 72,000 [320,300]	10 [254] at 72,000 [320,300]
Oil fluid, oz [mL]		3 [89]	8 [237]	8 [237]	12 [355]	12 [355]	12 [355]	12 [355]
Jar and accelerator tool combination loads (downhole at 240 degF), lbf [N]	Min. overpull†	15,000 [66,700]	54,000 [240,200]	47,400 [210,800]	66,600 [296,300]	66,600 [296,300]	84,000 [373,700]	84,000 [373,700]
	Max. overpull‡	39,000 [173,500]	90,000 [400,300]	95,000 [422,600]	107,000 [476,000]‡	107,000 [476,000]‡	150,000 [667,200]‡	150,000 [667,200]‡
Tool weight, lbm [kg]		268 [122]	350 [159]	325 [147]	800 [363]	900 [408]	1,200 [544]	1,350 [612]

† Minimum overpull requirement for a jar and accelerator tool combination to obtain an efficient impact.

‡ Maximum overpull can be increased in the shop. As the maximum increases, the minimum increases.

§ Settings for other expected bottomhole temperatures are available.

†† Check stroke before loading the accelerator tool. If stroke varies, stop sleeves must be modified to obtain stroke as listed.

When ordering, please specify
- hole size
- connection size, type, and left- or right-hand threads
- tool diameter
- hole temperature
- desired operating load.

TMC Lubricated Bumper Sub

Applications

- Fishing operations, including stuck pipe, packer retrieving, tubing removal, milling, and debris recovery
- P&A operations, including pipe recovery and wellhead removal
- Backoff operations in which the sub releases spears or overshots, shear pins, dislodges a stuck string, and acts as a feedoff tool

Benefits

- Enables operator to bump up or down until recovery is completed

Features

- Temperature rated to 500 degF [260 degC]
- Seals rated to 20,000-psi differential pressure
- Circulation pressure rated to 10,000 psi
- Closed drive system prevents ingress of wellbore fluid into drive section, improving reliability

The TMC lubricated bumper sub incorporates maximum stroke length and high torque transmission capacity, enabling the operator to bump up or down until fishing objectives are met. The TMC bumper sub's ruggedized design, materials quality, and comprehensive quality requirements ensure reliable performance in the harshest downhole environments.

TMC lubricated bumper sub.

Specifications								
Tool OD, in [mm]	1.81 [46]	1.81 [46]	2.25 [57]	3.13 [79]	3.13 [79]	3.75 [95]	3.75 [95]	4.25 [108]
Tool ID, in [mm]	0.38 [10]	0.56 [14]	0.50 [13]	1 [25]	1.50 [38]	1.50 [38]	2 [51]	2 [51]
Tool joint connection	1.81 WFJ	1 AM MT	1.25 API Reg	2.38 API Reg	2.38 EUE	2.38 API IF	2.38 EUE	2.88 API IF
Assembly number	16435	N/A	16471	16215	16461	16212	16385	16208
Overall length, ft [m]	4.67 [1.42]	N/A	6 [1.83]	7.83 [2.39]	6.92 [2.11]	8.17 [2.49]	6.75 [2.06]	8.25 [2.51]
Total stroke, in [mm]	9.75 [248]	7.25 [184]	12 [305]	16 [406]	14 [356]	16 [406]	16 [406]	16 [406]
Tensile yield, lbf [N]	56,000 [249,100]	69,000 [306,900]	95,800 [426,100]	192,000 [854,100]	185,000 [822,900]	257,000 [1,143,200]	233,000 [1,036,400]	348,000 [1,548,000]
Torsional yield,† ft.lbf [N.m]	800 [1,090]	750 [1,020]	2,900 [3,930]	4,100 [5,560]	4,200 [5,690]	6,600 [8,950]	7,400 [10,000]	11,000 [14,910]
Tool weight, lbm [kg]	48 [22]	54 [24]	75 [34]	125 [57]	100 [45]	142 [64]	120 [54]	232 [105]

Specifications (continued)							
Tool OD, in [mm]	4.25 [108]	4.75 [121]	4.75 [121]	6.25 [159]	6.50 [165]	7.75 [197]	8 [203]
Tool ID, in [mm]	2.44 [62]	2 [51]	2.25 [57]	2.25 [57]	2.25 [57]	3.50 [89]	3.50 [89]
Tool joint connection	2.88 EUE	3.50 API FH	3.50 API IF	3.50 API IF	4.50 API IF	6.63 API Reg	6.63 API Reg
Assembly number	16377	16202	16415	16415	16374	16375	16376
Overall length, ft [m]	9.33 [2.84]	8.67 [2.64]	9.50 [2.90]	9.67 [2.95]	9.67 [2.95]	10.33 [3.15]	10.33 [3.15]
Total stroke, in [mm]	16 [406]	16 [406]	16 [406]	18 [457]	18 [457]	18 [457]	18 [457]
Tensile yield, lbf [N]	320,000 [1,423,400]	422,000 [1,877,200]	510,000 [2,268,600]	900,000 [4,003,400]	928,000 [4,128,000]	1,304,000 [5,800,500]	1,304,000 [5,800,500]
Torsional yield,† ft.lbf [N.m]	10,000 [13,560]	14,000 [18,980]	14,000 [18,980]	50,000 [67,790]	50,000 [67,790]	118,000 [159,990]	118,000 [159,990]
Tool weight, lbm [kg]	260 [118]	337 [153]	314 [142]	794 [360]	890 [404]	955 [433]	1,110 [503]

† Torsional yield strength is based on the tool joint connection.

When ordering, please specify
- hole size
- connection size, type, and left- or right-hand threads
- tool diameter.

Hex Bumper Sub

Applications

- Openhole and cased-hole fishing operations in which the sub is placed above fishing tools or safety joints to deliver forceful blows
- Backoff operations in which the sub releases spears or overshots, shear pins, dislodges a stuck string, and acts as a feedoff tool
- Plug and abandonment operations in which low-level jarring may be required or strings of casing are being cut

Benefits

- Reliable performance
- Economical maintenance
- Effectiveness in the harshest downhole conditions

Features

- Hexagonal mandrel to ensure continuous torque transmission up to 36-in stroke for solid bumping action upward or downward
- Full-bore design to minimize pressure losses and provide wireline tool compatibility
- Simple design with only five major components to decrease maintenance requirements

The hex bumper sub provides durable and efficient upward or downward bumping action for fishing operations. Full torque transmission and circulation can be maintained through the tool at all times, in any stroke position.
The hex bumper sub's robust design, materials quality and comprehensive quality requirements ensure reliable performance in the harshest downhole environments.

Hex bumper sub.

Specifications												
Tool OD, in [mm]	1.81 [46]	3.50 [89]	3.75 [95]	3.75 [95]	4.25 [108]	4.75 [121]	6.25 [159]	6.25 [159]	6.50 [165]	6.75 [171]	7.75 [197]	8 [203]
Tool ID, in [mm]	0.38 [10]	1 [25]	1.50 [38]	1.25 [32]	1.94 [49]	2 [51]	2 [51]	2.25 [57]	2.25 [57]	2.75 [70]	3.50 [89]	3.50 [89]
Tool joint Connection	1.81 WFJ	2.38 API Reg	2.38 API IF	2.88 API Reg	2.88 API IF	3.50 API IF	4.50 API IF	4.50 API IF	4.50 API IF	5.50 API Reg	6.63 API Reg	6.63 API Reg
Assembly number	16734	16608	16541	16645	16240	16407	16431	16406	16955	16899	16606	16954
Stroke, in [mm]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]	20 [508]
Tensile yield, lbf [N]	99,000 [440,300]	193,000 [858,500]	214,000 [951,900]	233,500 [1,038,700]	352,000 [1,565,800]	341,400 [1,518,600]	813,900 [3,620,400]	705,400 [3,137,800]	760,000 [3,380,600]	790,000 [3,514,100]	900,000 [4,003,400]	1,200,000 [5,337,900]
Torsional yield, ft.lbf [N.m]	1,150 [1,560]	5,200 [7,050]	7,000 [9,490]	7,000 [9,490]	12,800 [17,350]	14,800 [20,070]	33,000 [44,740]	33,000 [44,740]	34,000 [46,100]	38,000 [51,520]	40,000 [54,230]	40,000 [54,230]
Total length (closed), ft [m]	3.48 [1.06]	5.21 [1.59]	5.13 [1.56]	5.13 [1.56]	4.93 [1.50]	5.21 [1.59]	5.38 [1.64]	5.38 [1.64]	5.39 [1.64]	5.60 [1.71]	5.93 [1.81]	5.94 [1.81]
Tool weight, lbm [kg]	25 [11]	95 [43]	140 [64]	150 [68]	140 [64]	198 [90]	390 [177]	375 [170]	415 [188]	455 [206]	655 [297]	717 [325]

When ordering, please specify
- hole size
- drillstring component OD where the tool will be used
- connection size and type
- required stroke length.

Wellhead Spear

The wellhead spear is designed for single-trip recovery of tubulars, such as conductor pipe, marine risers or the cutting and recovery of a section of casing as part of a redrill operation. Using these spears in deep cutting operations typically eliminates the need for two trips. The casing is engaged by the spear prior to cutting, then severed mechanically by a normal pipe cutter and recovered to surface all in one operation. These tools are simple yet reliable, and can save considerable rig time.

The rotating spear supports the weight of the casing at all times. The casing cuztting tool can operate in a neutral position or with a slight overpull. The spear itself is engaged in the casing, with the weight taken from the grapple through the outer mandrel onto the bearing assembly.

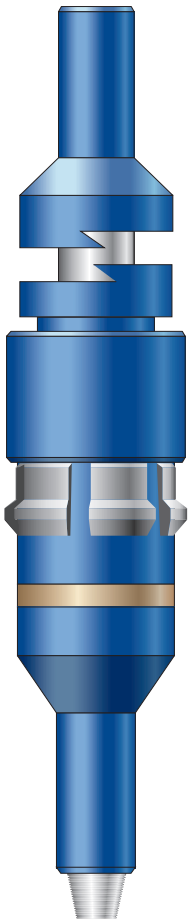
The drillstring is lowered to close the clutch assembly should it be necessary to release the spear. Additional lowering moves the upper mandrel through the grapple assembly, leaving the release dogs clear of the grapple. The drillstring is then rotated one-eighth turn to the right. The spear may then be pulled free of the casing. To set the spear, the procedure is reversed, and the drillstring turned to the left.

Applications

- Cutting and recovering tubulars in one trip
- Subsea wellhead cutting and recovery
- Conductor recovery in which coupling integrity is poor because of corrosion

Advantages

- Bearings capable of supporting 800,0000 lbf [3,558,998 N]
- Dependable operation under severe rotating loads
- Reliable and simple construction



Internal collet style.

Specifications

Tool Series	Connections	Body OD, in [cm]	Fishing Neck Diameter, in [mm]	Pin ID, in [cm]	Yield Torque, ft.lbf [N.m]	Tensile Yield, lbf [N]
9	4½ IF	7.25 [18.42]	6.25 [158.75]	2.25 [5.72]	29,200 [39,590]	650,000 [2,891,344]
13	6⅝ REG	11.75 [29.85]	8 [203.2]	3 [7.62]	96,000 [130,159]	860,000 [3,825,471]
18	6⅝ REG	16.5 [41.91]	8 [203.2]	3 [7.62]	96,000 [130,159]	1,100,000 [4,893,044.2]
18	7⅝ REG	16.5 [41.91]	9.5 [241.3]	3.25 [8.26]	159,400 [216,117]	1,100,000 [4,893,044.2]

Casing Mill

7 in and smaller

Casing mills in this size range have a round body dressed with wear-resistant tungsten carbide, stabilizing the mill inside the casing. The casing mill utilizes carbide inserts, which provide maximum footage and high rates of penetration. The continuous chip breaker design generates steel cuttings that can be easily circulated out of the hole with minimized specialized mud conditioning.

9.63 in and larger

The 9.63 in and larger casing mills use welded blade stabilizer pads to ensure the mill tracks straight down the casing stub. The blades are dressed with carbide inserts, yielding the highest possible performance. These larger-diameter mills are best suited to high rpm with moderate WOB and, in ideal conditions, are capable of milling long sections of casing.

7 in and Smaller

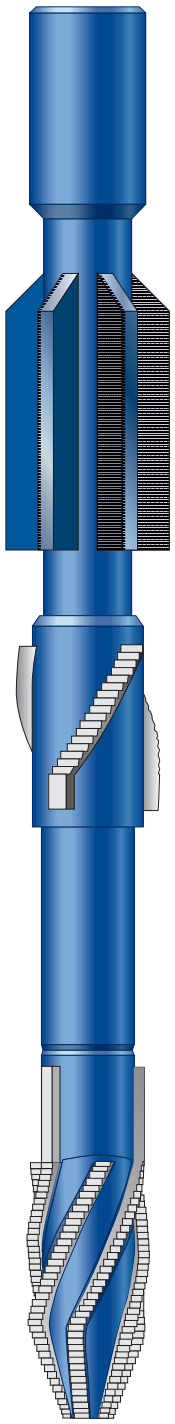
Dressed Diameter, in [mm]	Top Connection	Fishing Neck Diameter, in [mm]	Weight, lbm [kg]
3.50–4.50 [89–114]	2.38 Reg. or 2.88 PAC	3.13 [80]	190 [86]
4.50–5.50 [114–140]	2.88 Reg.	3.75 [95]	250 [113]
5.50–8.38 [140–213]	3.50 or 4.50 IF	4.75 or 6.50 [121 or 165]	375 [170]

9.63 in and Larger

Dressed Diameter, in [mm]	Top Connection	Fishing Neck Diameter, in [mm]	Weight, lbm [kg]
10.75 [273]	6.63 Reg.	6.50 [165]	440 [200]
14.50 [368]	7.63 Reg.	9.50 [241]	1,170 [531]

Notes: The casing mill is available in the eastern hemisphere only. Please contact Schlumberger for information on our system to hang weight under these mills.

When ordering, please specify
- mill dressed diameter
- top and bottom connection
- size and weight of casing to be milled
- size and weight of outer casing, if applicable.



Casing mill.

Section Mill

Applications

- Milling poorly cemented or corroded casing
- P&A operations requiring rock-to-rock isolation

Advantages

- Single-trip milling when combined with HRU
- High-performance ROP and hole cleaning during milling operations
- Integration with Schlumberger underreamer systems for virgin formation exposure
- Engineered milling technology based on laboratory analyses comparing cutter performance with casing metallurgy
- Downhole modeling using i-DRILL* integrated dynamic system analysis service
- Optional titanium-based blade treatment for section milling of chrome alloy tubulars

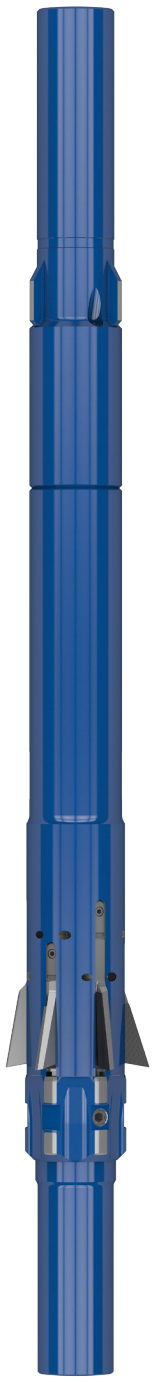
The section mill is a hydraulic downhole tool ideal for milling casing to set rock-to-rock well abandonment cement plugs. All cutter arms are dressed with TCIs that, along with the multiblade design, provide maximum footage and high ROP. When combined with the HRU, the section mill provides a single-trip milling system to ensure that rock-to-rock isolation is attainable.

Multiple cutter arms for optimal milling

As pump pressure is applied, three cutter arms expand and begin the cutout. When the cutout arms are fully open, three additional cutter arms automatically expand into the milling position using a cam and ramp interface. The shorter lead arm opens slightly ahead of the longer follow arms, providing maximum force for the cutout. When all the arms are fully expanded, the cam reaches a flat interface, locking the knives open as long as a minimum pressure drop across the tool is maintained. All six cutting surfaces are then squarely sealed on top of the casing for optimal milling performance.

Each cutter knife incorporates chip-breaker ridges, and the continuous chip-breaker design generates steel cuttings with a size and shape that will not accumulate and block flow. These cuttings can easily be circulated out of hole, requiring a minimum of specialized mud conditioning. Designed using the IDEAS integrated dynamic design and analysis platform, the milled casing shavings are engineered to minimize the size for optimal hydraulics without sacrificing milling speed.

As part of the IDEAS platform, a database of casing material catalogs the cutter performance and casing metallurgy to provide a clearer understanding of optimal milling performance and parameters. The IDEAS platform results are used to calibrate the i-DRILL service design.



Three cutter arms automatically expand into the milling position when the section mill cutout arms are fully open.

Cutter position indicator

The section mill is equipped with a Flo-Tel* downhole mechanical position indicator that provides a surface sizzgnal to notify the operator when the cutout is completed. This signal indicates that the cutting arms have extended to full sweep to ensure that the mill is not skimming the pipe. Section milling can then begin for the required interval.

Integrated components

Section mills require a guide mill that is run below the tool. An integral bladed stabilizer is also run below the mill to further enhance stabilization. The guide mill and stabilizer are usually sized at the nearest 0.13 in under the drift diameter of the casing.

A float valve is recommended to run above the section mill. The float valve prevents cuttings from entering the section mill and blocking the piston orifice while making a connection or when the pumps have to be shut down.

Shock tools are recommended for longer section milling intervals to help prolong the life of the section mill knife.

An optimized milling fluid from M-I SWACO, a Schlumberger company, provides maximum hole cleaning performance.

Section Mill Specifications

Mill Series	Body OD, in [cm]	Fishing Neck OD, in [cm]	Fishing Neck Length, in [cm]	Top Connection Size	Weight, lbm [kg]	Overall Length, in [cm]	Yield Torque, ft.lbf [N.m]	Yield Tensile, lbf [N]
3600	3.375 [8.57]	3.12	11.00 [27.94]	2⅜ REG Pin	133 [60.3]	53.2 [135.00]	5,800 [7,863.70]	244,500 [1,087,590]
4500	4.50 [11.43]	4.12	18.00 [45.72]	2⅞ REG Pin	275 [124.7]	70.5 [179.00]	11,100 [15,049.60]	413,550 [1,839,562]
5500	5.49 [13.94]	4.75	18.00 [45.72]	3½ REG Pin	420 [190.5]	90.8 [231.00]	19,000 [25,760.50]	777,000 [3,456,268]
8200	7.75 [19.69]	6.50	26.00 [66.04]	4½ IF Box or 6⅝ REG Pin	1,050 [476.3]	114 [290.00]	55,000 [74,570.00]	1,583,000 [7,041,535]
11700	10.00 [25.40]	8.00	20.00 [50.8]	8⅝ REG Pin	1,847 [837.76]	112.6 [286.00]	96,000 [130,159]	2,077,000 [9,238,957]

Standard and API regular pipe connections. Other connections are available upon request.

Hydraulic Pipe Cutter

Applications

- Internal cutting of single or multiple strings of casing
- Well abandonment
- Drillpipe cutting operations

Benefits

- More efficient operations by reliably severing single or multiple strings of casing in well abandonment operations

Features

- Crushed carbide milling structure provides cost-effective performance
- Customized knives can be matched to a range of pipe diameters
- Hydraulically actuated cutter arms ensure cutter opening
- Integral Flo-Tel downhole mechanical position indicator provides positive indication of cut-out success.
- Piston spring return mechanism ensures the knives stay closed when tripping in and out of the wellbore.

The hydraulic pipe cutter reliably severs single or multiple strings of casing for well abandonment. Three heavy-duty cutter arms, dressed with crushed carbide, are capable of completing an interval cutout in a variety of casing weights and grades, conductor pipes, and marine risers.

The hydraulic pipe cutter is available in a full range of sizes and is not dependent on the following pipe conditions:

- concentric
- eccentric
- cemented
- noncemented.

Hydraulic pipe cutter.

Specifications[†]

Pipe Cutter Size, in	System Part Number	Sub-Assembly Part Number (Without Knife Set)	Body Part Number	Fishing Neck OD, in [cm]	Top Sub Part Number	Fishing neck OD, in [cm]	Fishing Neck Length, in [cm]	Top Connection Size	Weight, lb [kg]
3⅝	80045158	0550-3000	0550-0044	3.625 [9.21]	0550-0042	3.125	24	2⅞ PAC DS Box	123
5⁹⁄₁₆	80044592	0540-1000	0540-0042	5.563 [14.13]	0540-0039	4.75	24	3½ IF Box	283
8¼	80045375	0520-1000	0520-0096	8.250 [20.96]	0520-0036	6.50	28	4½ IF Box	832
11¾	80046230	0502-5000	0502-0054	11.75 [29.84]	0502-0045	8.00	22	6⅝ IF Box	2680
16	80051911	80011707	80045784	16.00 [40.64]	80043630	8.00	18	6⅝ IF Box	4853

[†] Customized sizes available; contact your Schlumberger representative for information.

Casing Grapple Spear

Applications

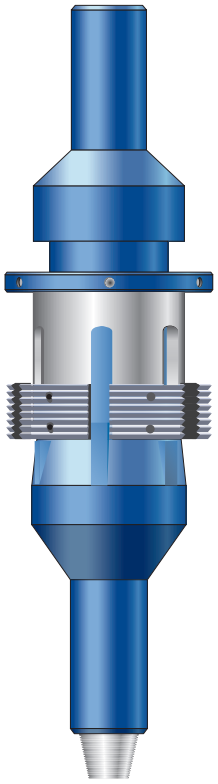
- Recovering casing where torque transmission is required
- Picking up very short pieces of casing

Advantages

- Two-piece body joined by an API connection for high strength
- Grapple design for casing wear resistance
- Mechanically set and released

The casing grappel spear superior torque transmitting characteristics make it ideal for demanding operations, such as releasing mudline suspension systems on jackup rigs. The standard casing grappel spear can also be used for picking up very short pieces of casing in situations where casing is being cut into pieces and recovered.

The casing grappel spear Series 18 system grapple-carrier combination is regarded as the easiest to use and most reliable large spear system on the market. The grapple design allows considerable variation of catch size which increases tolerance to casing wear. The strength of the two-piece tool is limited only by the strength of the API connection joining them, which is generally higher than that of the drillstring.



Casing grappel spear.

Specifications

Tool Series	Connections	Body OD, in [cm]	Fishing Neck Diameter, in [mm]	Pin ID, in [cm]	Yield Torque, ft.lbf, [N.m]	Tensile Yield, lbf [N]
7	3½ IF	5.69 [14.45]	4.75 [120.65]	2.25 [5.72]	19,000 [25,761]	777,000 [3,456,268]
9	4½ IF	7.25 [18.41]	6.5 [165.10]	2.8125 [7.15]	29,200 [39,590]	1,499,900 [6,671,888]
13, 18	6⅝ REG	11.75 [29.85]	8 [203.2]	3 [7.62]	96,000 [130,159]	2,077,200 [9,239,847]
18	7⅝ REG	16.5 [41.91]	9.5 [241.30]	3.25 [8.26]	159,400 [216,117]	3,008,200 [13,381,141]

Wellbore Departure Tools

TrackMaster Whipstock

The TrackMaster* whipstock is recommended for exiting standard steel casing ranging from 4.5 to 20-in OD in low-to hard-strength formation. It incorporates a multi-ramp design to enhance critical milling processes. The TrackMaster whipstock hookup attachments allows flexibility between the milling assembly and the whipstock. A one-way kickover hinge provides an additional flex point during orientation and when running in hole. It also ensures that whipstock ramp is positioned to direct the mill to the initial cutout point in the casing.
The TrackMaster whipstock designs has a hydraulic set mechanism.

Standard whipstock

- Rathole is 3 to 15 ft
- High-quality, full-gauge window
- Low dogleg severity across the exit
- Compatible with bi-mills and tri-mills

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Whipstock OD, in [cm]	Whipstock OAL, ft [m]	Whipstock Ramp Length, ft [m]	Break Bolt Load Rating, lbf [N]	Lower Connection
20 [51]	94.0–169.0 [140–251]	16 [40.64]	27.45 [0.8367]	23.5583 [7.18057]	75,000 [333,617]	8⅝ AZ IF Pin
18.625 [47.31]	87.5–117.5 [130.2–174.9]	16 [40.64]	27.45 [8.367]	23.5583 [7.18057]	75,000 [333,617]	8⅝ AZ IF Pin
16 [41]	84.0–109.0 [125–162]	14.2 [36.07]	29.77083 [9.074149]	24.283 [7.4015]	100,000 [444,823]	8⅝ AZ IF Pin
13.375 [33.97]	68.0–72.0 [101–107]	11.5 [29.21]	27.89583 [8.50265]	22.05 [6.721]	75,000 [333,617]	8⅝ AZ IF Pin
11.75 [29.84]	42.0–65.0 [63–97]	10.13 [25.73]	22.4375 [6.83895]	18.333 [5.5879]	75,000 [333,617]	5½ IF Pin
10.75 [27.3]	40.5–60.7 [60.3–90.3]	9.125 [23.18]	20.44 [6.23]	15.925 [4.8539]	75,000 [333,617]	5½ IF Pin
9.625 [24.45]	32.3–53.5 [48.1–79.6]	8 [20.32]	18.187 [5.5434]	14.025 [4.2748]	55,000 [244,652]	5½ IF Pin
8.625 [21.91]	24.0–44.0 [36–65]	6.98 [17.73]	16.729 [5.099]	12.525 [3.8176]	40,000 [177,929]	4½ IF Pin
7.625 [19.37]	24.2–39.0 [36–58]	6 [15.24]	15.25 [4.649]	11.375 [3.4671]	40,000 [177,929]	4 IF Pin
7 [18]	20.0–38.0 [30–57]	5.38 [13.67]	14.391 [4.3864]	10.575 [3.2233]	35,000 [155,688]	3½ IF Pin
5.5 [14]	14.0–23.0 [21–34]	4.19 [10.64]	10.063 [3.0672]	7.367 [2.24546]	20,000 [88,964]	2⅞ IF Pin
4.5 [11.4]	9.5–13.5 [14.1–20.1]	3.31 [8.41]	8.803 [2.6832]	5.475 [1.66878]	15,000 [66,723]	2⅜ IF Pin

Hard-formation whipstock

- Shortened full gauge section for quick departure
- Short slide, which is best for open hole sidetracking
- Compatible with bi-mills only

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Whipstock OD, in [cm]	Whipstock OAL, ft [m]	Whipstock Ramp Length, ft [m]	Break Bolt Load Rating, lbf [N]	Lower Connection
9.625 [24.448]	32.3–53.5 [48.1–79.6]	8 [20.32]	15.896 [4.8451]	11.65 [3.551]	55,000 [244,652]	5½-in IF Pin
7.625 [19.368]	24.2–39.0 [36–58]	6 [15.24]	12.333 [3.759]	8.75 [2.667]	40,000 [177,929]	4-in IF Pin
7 [17.8]	20.0–38.0 [30–57]	5.38 [13.67]	11.225 [3.4214]	7.883 [2.4027]	35,000 [155,688]	3½-in IF Pin

Standard whipstock.

Hard formation whipstock.

TrackMaster Mill

A variety of mill cutting structures deliver efficient and cost–effective performance in any sidetracking operation. The TrackMaster mill is designed to offer two-or three-mill configurations, providing advanced window milling capabilities. The bi-mill design includes both the lead mill and the follow mill. The tri-mill design includes the lead mill, the follow mill, and the dress mill.

FasTrack tri-mill

- Ideal for both conventional and extended ratholes
- Lead mill, follow mill, and dress mill design
- Delivers consistent, fast, and reliable milling performance
- Offers increased durability with PDC cutters resistance

Specifications

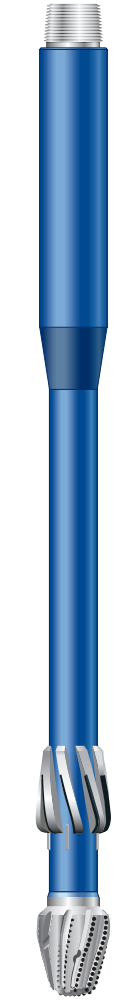
Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Mill Size Range, in [cm]	Mill Length, ft [m]	Upper Connection	Fish Neck OD, in [cm]
16 [41]	84.0–109.0 [125–162]	14.50–14.75 [36.8–37.47]	23.267 [7.0918]	8⅝ REG Pin	10.5 [26.67]
13.375 [33.973]	68.0–72.0 [101–107]	12.125–12.25 [30.798–31.12]	19.941 [6.078]	6⅝ FH Pin	9 [22.86]
11.75 [29.85]	42.0–65.0 [63–97]	10.5–10.75 [26.7–27.31]	19.592 [5.9716]	6⅝ REG Pin	7.5 [19.05]
10.75 [27.31]	40.5–60.7 [60.3–90.3]	9.50–9.875 [24.1–25.083]	15.8 [4.82]	4½ IF Pin	6.5 [16.51]
9.625 [24.448]	32.3–53.5 [48.1–79.6]	8.375–8.75 [21.273–22.23]	14.158 [4.3154]	4½ IF Pin	6.5 [16.51]
8.625 [21.908]	24.0–44.0 [36–65]	7.50–7.875 [19.1–20.003]	11.975 [3.65]	4 IF Pin	5.88 [14.94]
7.625 [19.37]	24.2–39.0 [36.01–58]	6.50–6.875 [16.5–17.46]	13.264 [4.0429]	3½ IF Pin	5 [12.70]
7 [18]	20.0–38.0 [30–57]	5.75–6.25 [14.61–15.88]	11.783 [3.5915]	3½ IF Pin	4.75 [12.07]
5.5 [14]	14.0–23.0 [21–34]	4.50–4.875 [11.4–58]	8.083 [2.4637]	2⅜ IF Pin	3.5 [8.89]
4.5 [11.4]	9.5–13.5 [14.1–20.1]	3.75–3.875 [9.53–9.843]	6.467 [1.9711]	NC23 Pin	3 [7.62]

FasTrack bi-mill

- Offers higher flexibility
- Lead mill and follow mill design
- Suggested for some double casing exits
- Delivers consistent, fast, and reliable milling performance
- Offers increased durability with PDC cutters resistance

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Mill Size Range, in [cm]	Mill Length, ft [m]	Upper Connection	Fish Neck OD, in [cm]
20 [51]	94.0–169.0 [140–251]	17.50–18.50 [44.5–47]	12.5 [3.81]	7⅝ REG Pin	9.5 [24.13]
18.625 [47.308]	87.5–117.5 [130–174.9]	17.25–17.50 [43.82–44.5]	12.5 [3.81]	7⅝ REG Pin	9.5 [24.13]
9.625 [24.448]	32.3–53.5 [48.1–79.6]	8.375–8.75 [23.813–22.23]	8.95 [2.728]	4½ IF Pin	6.5 [16.51]
7.625 [19.368]	24.2–39.0 [36–58]	6.50–6.875 [16.5–17.463]	6.883 [2.0979]	3½ IF Pin	5 [12.70]
7 [18]	20.0–38.0 [30–57]	5.75–6.25 [14.61–15.88]	6.383 [2.0979]	3½ IF Pin	4.75 [12.07]

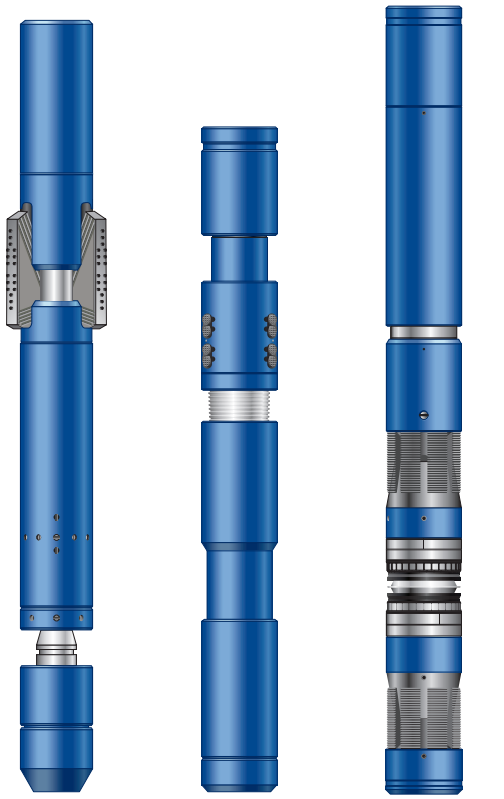


FastTrack bi-mill.

FastTrack tri-mill.

TrackMaster Anchor

The TrackMaster anchor maintains a firm grip on the hole wall to hold the whipstock in place. Once the whipstock setting depth has been reached, the anchor can be deployed. Four types of anchors are available to secure the TrackMaster whipstock during sidetracking operations:



Expandable anchor. *Retrievable packer anchor.* *Permanent packer anchor.*

Expandable anchor

- Multiple casing sizes and weights
- Accommodates a range of casing sizes when a packing element is not required in the borehole
- Hydraulic actuation
- Retrievability
- Antirotation, high-axial-load slip design

Specifications

Casing Weight Range	Tool OD, in [cm]	Tool Length, ft [m]	Connection
13.375-in (at 84.5 lb/ft) to 20-in (at 108.5 lb/ft)	11.94 [30.33]	9.203 [2.81]	8⅝ AZ IF Box × 6⅝ IF Pin
9.625-in (at 59.4 lb/ft) to 13.375-in (at 48.0 lb/ft)	8.19 [20.80]	7.136 [2.18]	5½ IF Box
7.0-in (at 29 lb/ft) to 9.625-in (at 32.0 lb/ft)	5.76 [14.63]	5.4375 [1.66]	3½ IF Box
4.5-in (at 13.5 lb/ft) to 7.0-in (at 29.0 lb/ft)	3.62 [9.19]	5.077 [1.55]	3.0-10-2G-SA Box

Retrievable packer anchor

- Retrievability
- Antirotation, high-axial-load slip design

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Tool OD, in [cm]	Tool Length, ft [m]	Connection
9.625 [24.448]	32.3–53.5 [48.1–79.6]	7.98 [20.27]	7.618 [2.322]	5½ IF Box
7 [18]	20.0–38.0 [30–57]	5.47 [13.89]	7.625 [2.3241]	3½ IF Box × 3½ IF Pin

Permanent packer anchor

- Hydraulic actuation
- 5,000-psi packer element
- Antirotation, high-axial-load slip design

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Tool OD, in [cm]	Tool Length, ft [m]	Connection
13.375 [33.973]	48.0–92.5 [122–235]	11.85 [30.1]	7.208 [2.197]	8⅝ AZ IF Box
9.625 [24.448]	32.0–53.5 [81.3–135.9]	8.1 [20.6]	6.953 [2.1193]	5½ IF Box
7.625 [19.368]	24.2–47.1 [61.5–119.6]	6.04 [15.34]	6.953 [2.1193]	4 IF Box
7 [18]	20.0–38.0 [50.8–96.52]	5.48 [13.92]	6.953 [2.1193]	3½ IF Box
5.5 [14]	15.5–23.0 [39.4–58]	4.29 [10.9]	6.318 [1.9257]	2⅞ IF Box

TrackMaster Accessories

In order to run a TrackMaster whipstock in hole, some additional tools are required to enable setting the equipment.

Running tool

The running tool is made up above the mill system for hydraulic setting anchor. This component contains a floating piston which serves as a barrier between the clean hydraulic fluid within the running tool and the drilling fluid that is in the drill string above. The running tool is used in the placement or setting of downhole equipment such as anchors or permanent packers.

Specifications		
Tool OD, in [cm]	**Tool Length, ft [m]**	**Connections, up/down**
9.5 [24.13]	10 [3.05]	7⅝ REG Box × 7⅝ Reg Box
10.5 [26.67]	9.167 [2.79]	6⅝ FH Box × 8⅝ REG Box
9 [22.86]	8.917 [2.72]	6⅝ REG Box × 6⅝ FH Box
8 [20.32]	7.458 [2.27]	6⅝ FH Box × 6⅝ REG Box
6.5 [16.51]	6.333 [1.93]	4½ IF Box × 4½ IF Box
5.88 [14.94]	6.292 [1.92]	4 IF Box × 4 IF Box
5 [12.70]	6.292 [1.92]	3½ IF Box × 3½ IF Box
3.5 [8.89]	6.25 [1.91]	2⅜ IF Box × 2⅜ IF Box
3.125 [7.94]	5.42 [1.65]	NC23 Box × NC23 Box

High-flow bypass valve

The high-flow bypass valve allows to fill the string through side ports, when tripping into hole as the anchor or packer seals off the bottom of the string. Applying a high flow rate activates the valve. Once the valve is activated, it will allow the internal string to be sealed off so that the rig pump can statically pressure up the anchor or packer to set the whipstock in the casing for milling of a window.

Specifications		
Tool OD, in [cm]	**Tool Length, ft [m]**	**Connections, up/down**
6.5 [16.5]	4 [1.2]	4½ IF Box × 4½ IF Pin
4.75 [12.07]	4 [1.2]	3½ IF Box × 3½ IF Pin

Non advance multicycle bypass valve

The non advance multicycle bypass valve (NAMCBV) allows fluid to be pumped downhole without setting the anchor. Once the valve has completed all of its six cycles, pressure is administered to set the anchor. If it was unable to orient the whipstock by the sixth cycle, the tool has to be pulled out of the hole and reset.

Specifications		
Tool OD, in [cm]	**Tool Length, ft [m]**	**Connections, up/down**
9 [23]	5.724 [1.7447]	7⅝ REG Box × 7⅝ REG Pin
8 [20]	5.703 [1.7383]	6⅝ FH Box × 6⅝ FH Pin
6.75 [17.15]	5.667 [1.7273]	4½ IF Box × 4½ IF Pin
5 [13]	4.848 [1.4777]	3½ IF Box × 3½ IF Pin
3.75 [9.53]	4.014 [1.2235]	2⅜ IF Box × 2⅜ IF Pin
3.125 [7.938]	2.083 [0.6349]	NC23 Box × NC23 Box

TrackMaster CH-M

The TrackMaster CH-M* enables casing exits and sidetracking in a single trip. The TrackMaster CH-M whipstock has a mechanical set mechanism and is recommended for exiting standard steel casing ranging from 5½- to 9⅝-in OD.

CH-M anchor.

CH-M whipstock

- Weight-set actuation
- Retrievability
- Antirotational slip design
- Compatible with carbide bi-mill only

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Whipstock OD, in [cm]	Whipstock OAL, ft [m]	Whipstock Ramp Length, ft [m]	Break bolt load rating, lbf [N]	Lower Connection
9.625 [24.448]	32.3–53.5 [48.1–79.6]	8 [20]	13.83 [4.215]	11.65 [3.551]	55,000 [244,652]	Hinge
7.625 [19.368]	24.2–39.0 [36–58]	6 [15]	10.416 [3.1748]	9.083 [2.7685]	40,000 [177,929]	Hinge
7 [18]	20.0–38.0 [30–57]	5.38 [13.67]	9.33 [2.844]	7.88 [2.401824]	35,000 [155,688]	Hinge
5.5 [14]	14.0–23.0 [21–34]	4.19 [10.64]	7.308 [2.2275]	6.1 [1.86]	20,000 [88,964]	Hinge

TrackMaster CH-M anchor

- Weight-set actuation
- Retrievability
- Antirotational slip design

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Tool OD, in [cm]	Tool Length, ft [m]	Connection
9.625 [24.448]	40.0–53.5 [60–79.6]	8 [20]	7.25 [2.21]	Hinge
9.625 [24.448]	32.3–36.0 [48.1–54]	8.384 [21.295]	7.25 [2.21]	Hinge
7.625 [19.368]	29.7–47.1 [44.2–70.1]	6 [15]	7.167 [2.1845]	Hinge
7.625 [19.368]	24.2–26.4 [36–39.3]	6.45 [16.38]	7.167 [2.1845]	Hinge
7 [18]	23.0–38.0 [34–57]	5.375 [13.653]	7.167 [2.1845]	Hinge
7 [18]	17.0–20.0 [25–30]	5.82 [14.78]	7.167 [2.1845]	Hinge
5.5 [14]	14.0–23.0 [21–34]	4.25 [10.8]	6.617 [2.0169]	Hinge

TrackMaster CH-M

The TrackMaster CH-M is designed to be run with two-mill configurations. The carbide bi-mill design includes both the lead mill and the follow mill. Its cylindrical tungsten carbide cutters and crushed tungsten carbide provide superior hardness and durability.

Carbide bi-mill

- Ideal for 3 to 15 ft [1 to 4.6 m] of rathole
- Provides cost-effective milling performance with standard TCI inserts.
- Dressed with cylindrical tungsten carbide cutters and crushed tungsten carbide inserts

Specifications

Casing Size, in [cm]	Casing Weight Range, lb/ft [kg/m]	Mill Size Range, in [cm]	Mill Length, ft [m]	Upper Connection	Fish Neck OD, in [cm]
9.625 [24.448]	32.3–53.5 [48.1–80]	8.375–8.75 [21.273–22.23]	8.95 [2.728]	4½ IF Pin	5.5 [14]
7.625 [19.368]	24.2–39.0 [36–58]	6.5–6.875 [16.5–17.46]	6.883 [2.0979]	3½ IF Pin	4.29 [10.9]
7 [18]	20.0–38.0 [30–57]	5.75–6.25 [14.61–15.88]	6.383 [1.9455]	3½ IF Pin	3.8 [9.7]
5.5 [14]	14.0–23.0 [21–34]	4.50–4.875 [11.4–12.383]	5 [1.5]	2⅜ IF Pin	3.02 [7.8]

TrackMaster and TrackMaster CH-M Retrieval Tools

There are two types of whipstock retrieval tools: the hook retrieval tool and the die collar assembly retrieval tool.

Hook retrieval tool

- Designed to retrieve whipstocks through a tab that fits into the hook retrieval slot of the whipstock.
- Most common method of whipstock retrieval used.

Die collar assembly retrieval tool

- Retrieve the whipstock by fitting over the end of the whipstock and threading onto it.
- Most commonly used with a whipstock assembly that uses a permanent packer for an anchor.

Hook retrieval tool.

Die collar.

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