



Motor Handbook

First Edition, April 2018, Version 1.2

This handbook is intended to be an aid to the operator and is solely provided for information and illustration purposes.

The technical data and text in this handbook is subject to change without notice.

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Rival Downhole Tools
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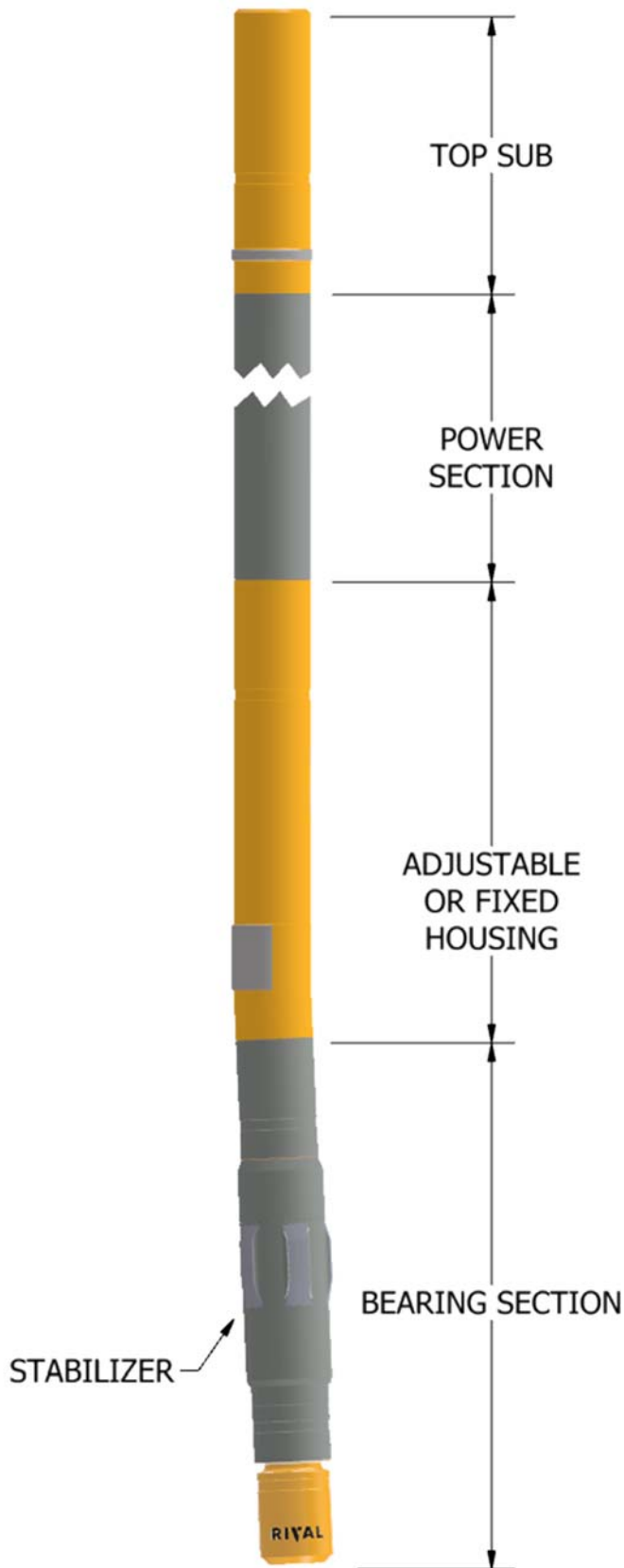


Certificate No. 7922

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Motor Components



Top Sub & Rotor Catch

At the top end of the motor is the top sub, which is a crossover housing between the power section and the rest of the BHA. Most top subs accommodate API float valves. The top sub also provides a seat for the rotor catch system.

The rotor catch is a retaining device which minimizes the possibility of losing motor components downhole in the unlikely event that an external connection breaks or backs-off. The rotor catch is attached to the top of the rotor by a threaded connection.

Power Section

The power section is a positive displacement motor comprised of a rotor and a stator. The rotor is a long, spiral shaft with a number of external, curved lobes. The stator has a similar spiral profile formed internally by the stator elastomer, but is designed to have one more lobe than the rotor.

The design results in a cavity for fluid to flow into. As pressure increases, the cavity progresses down the rotor by forcing the rotor to rotate and progress around the spiral profile. This action converts hydraulic horsepower into mechanical horsepower delivered to the drill bit.

The desired lobe configuration will vary depending on the application. In general, a power section with fewer lobes generates a lower torque and higher speed, and a power section with more lobes generates a higher torque and lower speed.

Since the power section is a positive displacement motor, speed and torque are determined independently from each other during operation.

The rotational speed is proportional to the fluid flow rate through the power section. The higher the flow rate, the higher the output speed.

The torque generated is proportional to the differential pressure across the power section. Differential pressure is created by applying a load to the bit, thus the more weight applied to the bit, the higher the differential pressure across the power section.

For each power section configuration, there is a limit to how much differential pressure the power section can handle. If the differential pressure increases beyond the elastomer limitations, the power section will no longer keep the fluid cavities travelling down the rotor separate from each other causing the rotor, and thus the bit, to stop rotating. This is commonly known as a stalled motor and

can cause damage to the stator elastomer, motor, and other BHA components.

Adjustable Bend Housing (EZ3)

The EZ3 adjustable bend housing is a proprietary design that connects the stator to the bearing section assembly. The angle setting is field adjustable, producing a wide range of build rates.

The EZ3 is simple to operate, service, and maintain due to having only three components. The design also allows for larger and stronger transmission assemblies to maximize torque throughput.

Fixed Bend Housing

Fixed, non-adjustable housings are available in a wide range of settings, including straight.

Transmission Assembly

The transmission assembly converts the eccentric rotational motion of the rotor to concentric rotational motion required by the bearing section. It also accommodates any angle set on a fixed bend or adjustable bend housing.

The current fleet of Rival motors utilizes two difference transmission assembly designs, a C-V Joint and a Claw. The c-v joint is utilized in the 8-1/2 PDMs, and the claw is utilized in the 5-1/8 and 7-1/8 PDMs. As a result of the claw design, there will be some rotational play in the 5-1/8 and 7-1/8 motors when rotating the drill bit on the surface.

Bearing Section

The bearing section is comprised of necessary components to transmit drilling forces to the bit. The main components include a bearing mandrel, radial bearings and thrust bearings. The thrust and radial bearings are mud-lubricated, eliminating the need for oil and seals, and providing a simple to operate and service design. Due to the mud-lubricated system, 2% to 5% of drilling fluid is expected to flow through the bearings and directly to the annulus, bypassing the drill bit.

The bearing mandrel transmits all of the power (torque and rpm) to the bit. The bearing mandrel is center bored to provide drilling fluid directly to the bit. Included on the driveshaft is a safety catch mechanism. In the unlikely event of a bearing mandrel break, the catch minimizes the possibility of leaving the drill bit in the hole.

The thrust bearings are designed to sustain the applied weight of the BHA to the bit during drilling operations. The thrust bearings are also capable of sustaining the forces required for off-bottom circulation and back-reaming.

The radial bearings keep the bearing mandrel centralized by providing a smooth and wear-resistant surface. The radial bearings resist the side-load forces seen in directional drilling operations.

Stabilizers

Stabilizers are available as removable or integral stabilizers. The removable stabilizers are threaded on to the bearing housing, whereas the integral stabilizers are directly integrated in the bearing housing.

A stabilizer can assist in maintaining a particular hole angle, and increase the yield of the motor with regards to angle change. Calculated build rates for stabilized motors are based on stabilizers that are 1/8” smaller than the hole size.

If no stabilizer is desired, slick bearing housings are available.

Policies & Procedures

EZ3 ABH Field Adjustment

Figure 1:

- Clean exterior of EZ3 ABH before clamping to ensure markings are clearly visible.
- Break middle connection with tongs in the indicated areas.
- Slowly back off Upper Housing four (4) full rotations, approximately one (1) inch.

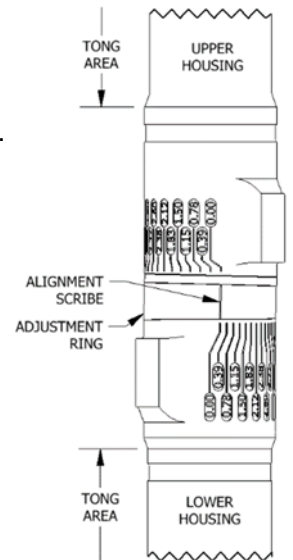


Figure 2:

- Lift Adjustment Ring above the spline. This allows free rotation of Adjustment Ring.
- Rotate until the scribe line is above the desired bend setting indicated on the Lower Housing.

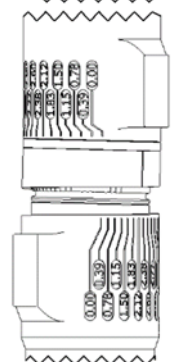


Figure 3:

- Lower Adjustment Ring over the spline while maintaining alignment with scribe line and the desired bend setting indicated on the Lower Housing.
- Rotate the Upper Housing to shoulder the connection.
- Note: The matching scribe on the Upper Housing will not be aligned with the scribe on the Adjusting Ring at this point.

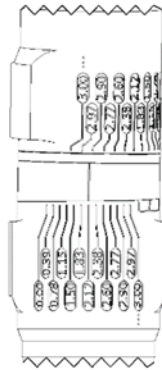
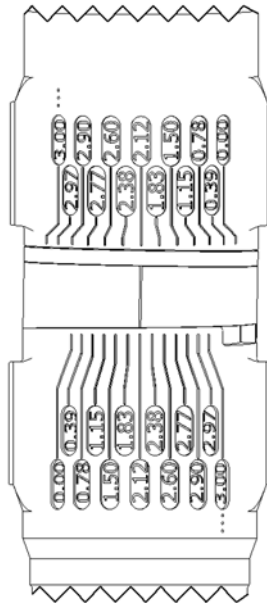


Figure 4:

- Torque the connection until the scribe line for the matching bend setting on the Upper Housing is aligned with the scribe line on the Adjusting ring.
- Note: The torque required to align scribe lines must fall within the make-up torque ranges given in the Make-up Torque table below.
- This example shows changing from a 0 degree setting to a 2.12 degree setting.



EZ3 ABH Make-up Torque

Motor Size	Make-up Torque Range (lbf-ft)
5-1/8"	8,000 – 13,000
7-1/8"	32,000 – 41,500
8-1/2"	42,000 – 71,000

Note: The torque required to align scribe lines must fall within the make-up torque range.

Stabilizer Field Replacement

Figure 5:

- To break Stabilizer connection, place the tongs in the areas indicated.

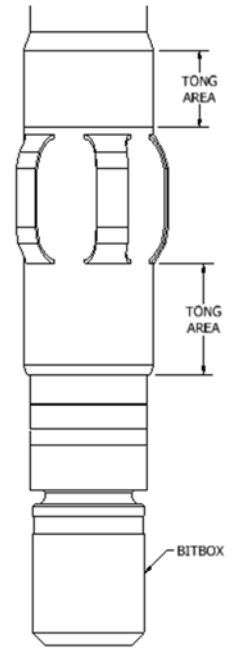


Figure 6:

- Slowly back out the stabilizer by rotating the stabilizer to the right
- Remove and set aside
- Apply thread dope to the exposed threads and shoulder
- Slowly slide the new Stabilizer over the Bitbox and screw onto the Bearing Section.

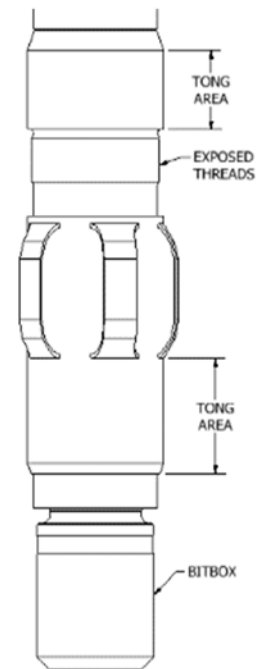
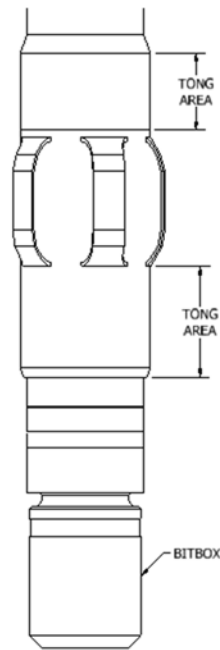


Figure 7:

- Shoulder the connection.
- Use Rig Tongs to Make-up the Stabilizer to the specified torque values in the table below
- Record the torque value



Example: Determine the maximum differential pressure allowed to produce maximum output for a BT675785.0. The maximum differential pressure per spec is 1130 psi. If this model is run at temperatures up to 200F, 100% of the 1130 psi is allowed. If this model is run at 250F, only 85% of the 1130 psi is allowed so the maximum differential pressure across the power section is 960.5 psi (0.85*1130) at 250F.

Similarly, the maximum differential pressure allowed to get the maximum life out of a BT675785.0 is 904 psi (80% of 1130 psi) at temperatures up to 200F and 768 psi at 250F (68% of 1130 psi).

Motor Performance Data

Performance Summary

Size	Lobes	Stages	Max Flow Rate (gpm)	Max Bit Speed (rpm)	Rev/Unit Volume (rev/gal)	Max Diff Pres. (psi)	Torque @ Max Pres. (lbf-ft)
5-1/8"	6/7	8.0	350	280	0.790	1,880	6,110
7-1/8"	4/5	7.0	600	300	0.494	1,650	8,820
7-1/8"	7/8	5.0	600	160	0.270	1,180	10,650
7-1/8"	7/8	5.7	600	140	0.230	1,340	14,200
8-1/2"	7/8	3.4	900	80	0.087	800	22,530
8-1/2"	7/8	4.0	900	140	0.155	940	14,830

Stabilizer Field Make-up Torque

Motor Size	Make-up Torque (lbf-ft)
5-1/8"	10,000
7-1/8"	20,000
8-1/2"	29,000

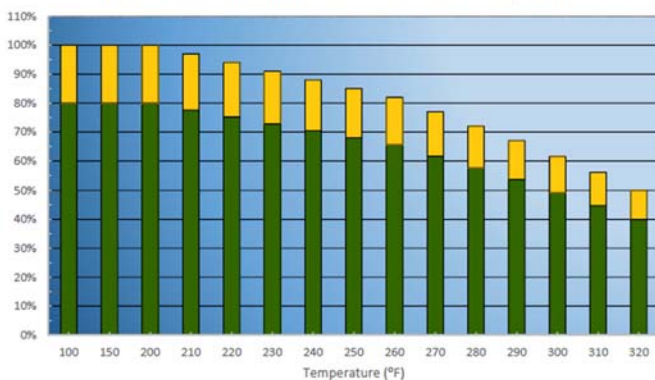
Downhole Temperature

Field testing has proven stator life is reduced at higher operational temperatures. In order to maintain a stable balance between stator life and performance it is required to reduce differential pressure at these elevated temperatures. The graph below illustrates the maximum allowable differential pressure at different temperature intervals. The green bars represent differential pressure needed for maximum life while the orange bars represent differential pressure needed for maximum output.

Weight on Bit and Overpull Limits

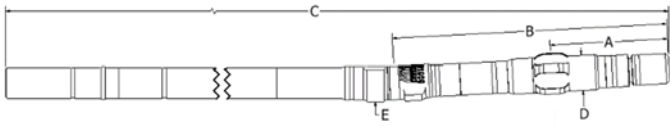
Size	Max WOB (lbf)	Max Overpull, Backream (lbf)	Max Overpull, Re-Run (lbf)	Max Overpull, POOH (lbf)
5-1/8"	54,000	78,000	154,000	441,000
7-1/8"	109,000	157,000	252,000	780,000
8-1/2"	164,000	236,000	440,000	1,172,000

% of Maximum Differential Pressure Allowed at Temperature



5-1/8" Motor 6/7 Lobe 8.0 Stage

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	22 in
Bit to Bend, ABH	B	55 in
Bit to Bend, Fixed	B	47 in
Bit to Top Sub	C	354 in
Body OD, Slick	D	5.13 in
Body OD, Stabilizer	D	5.80 in
Pad Radius, ABH	E	2.88 in
Pad Radius, Fixed	E	2.74 in
Bottom Connection	3-1/2 REG	
Top Connection	3-1/2 IF	
Top Sub Float Bore	3-1/2 IF	
Estimated Weight	1,350 lbf	

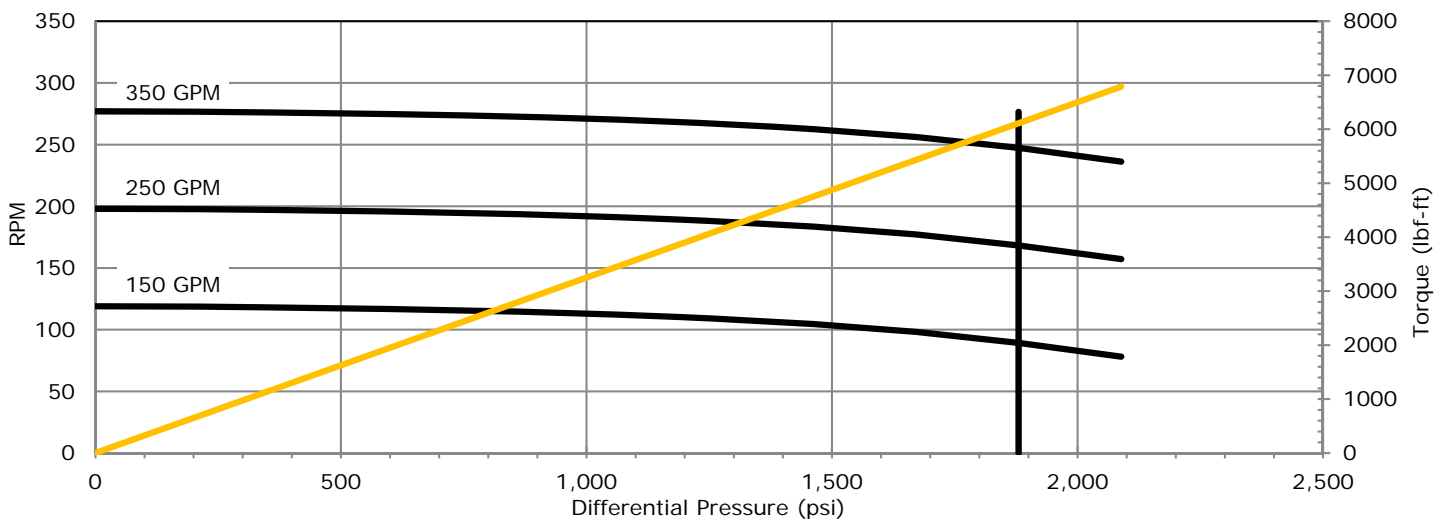
Recommended Operating Limits

Max WOB	54,000 lbf
Max Overpull, Backream	78,000 lbf
Max Overpull, Re-Run	154,000 lbf
Max Overpull, POOH	441,000 lbf

Performance Details

Max Diff Pressure	1,880 psi
Max Torque	6,110 lbf-ft
Stall Torque	9,630 lbf-ft
Speed	0.790 rev/gal
Flow Range	150-350 gpm
Speed Range	120-280 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	6	6 1/4	6 3/4	6	6 1/4
0.39	2.4	1.6	-	2.4	2.3	2.6
0.78	5.2	4.4	2.8	5.2	4.7	5.1
1.15	7.8	7.0	5.4	7.8	7.1	7.4
1.50	10.2	9.4	7.8	10.2	9.4	9.6
1.83	12.6	11.8	10.2	12.6	11.8	11.7
2.12	14.6	13.8	12.2	14.6	13.8	13.5
2.38*	16.4	15.6	14.0	16.4	15.6	15.1
2.60*	18.0	17.2	15.6	18.0	17.2	16.5
2.77*	19.2	18.4	16.8	19.2	18.4	17.6
2.90*	20.1	19.3	17.7	20.1	19.3	18.4
2.97*	20.6	19.8	18.2	20.6	19.8	18.8
3.00*	20.8	20.0	18.4	20.8	20.0	19.0

*Bend Setting not recommended for Rotary Drilling

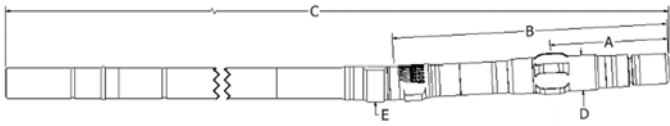
Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	6	6 1/4	6 3/4	6	6 1/4
0.78	3.8	2.9	1.1	4.7	4.9	5.2
1.15	6.4	5.5	3.7	7.1	7.3	7.6
1.50	8.9	8.0	6.2	9.4	9.5	9.9
1.75	10.6	9.7	7.9	11.0	11.1	11.5
1.83	11.2	10.3	8.5	11.5	11.7	12.0
2.00	12.4	11.5	9.7	12.6	12.8	13.1
2.12	13.2	12.3	10.5	13.4	13.5	13.9
2.25*	14.2	13.2	11.4	14.2	14.4	14.7
2.38*	15.1	14.2	12.3	15.1	15.2	15.5
2.50*	15.9	15.0	13.2	15.9	16.0	16.3

*Bend Setting not recommended for Rotary Drilling

7-1/8" Motor 4/5 Lobe 7.0 Stage

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	27 in
Bit to Bend, ABH	B	63 in
Bit to Bend, Fixed	B	52 in
Bit to Top Sub	C	326 in
Body OD, Slick	D	7.13 in
Body OD, Stabilizer	D	7.88 in
Pad Radius, ABH	E	4.26 in
Pad Radius, Fixed	E	3.74 in
Bottom Connection	4-1/2 REG	
Top Connection	4-1/2 IF	
Top Sub Float Bore	4R	
Estimated Weight	2,500 lbf	

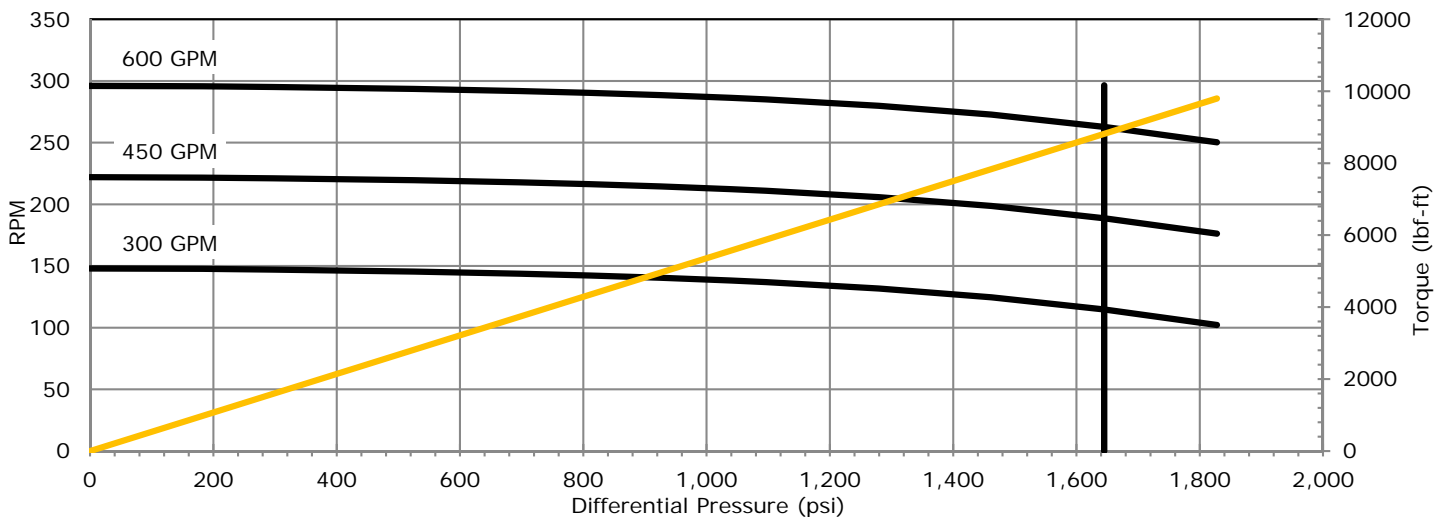
Recommended Operating Limits

Max WOB	109,000 lbf
Max Overpull, Backream	157,000 lbf
Max Overpull, Re-Run	252,000 lbf
Max Overpull, POOH	780,000 lbf

Performance Details

Max Diff Pressure	1,650 psi
Max Torque	8,820 lbf-ft
Stall Torque	13,980 lbf-ft
Speed	0.494 rev/gal
Flow Range	300-600 gpm
Speed Range	150-300 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	8 1/2	8 3/4	9 7/8	8 1/2	8 3/4
0.39	4.0	3.2	-	4.0	3.2	3.6
0.78	6.9	6.2	3.0	6.9	6.2	6.2
1.15	9.7	9.0	5.8	9.7	9.0	8.6
1.50	12.4	11.7	8.4	12.4	11.7	10.9
1.83	14.9	14.2	10.9	14.9	14.2	13.1
2.12	17.1	16.4	13.2	17.1	16.4	15.0
2.38*	19.1	18.4	15.1	19.1	18.4	16.7
2.60*	20.8	20.1	16.8	20.8	20.1	18.2
2.77*	22.1	21.4	18.1	22.1	21.4	19.3
2.90*	23.1	22.3	19.1	23.1	22.3	20.1
2.97*	23.6	22.9	19.6	23.6	22.9	20.6
3.00*	23.8	23.1	19.8	23.8	23.1	20.8

*Bend Setting not recommended for Rotary Drilling

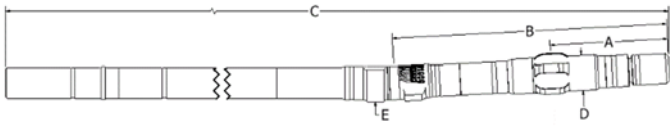
Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	8 1/2	8 3/4	9 7/8	8 1/2	8 3/4
0.78	2.4	1.6	-	5.3	5.5	6.4
1.15	5.2	4.4	0.6	7.9	8.1	9.0
1.50	7.9	7.1	3.2	10.3	10.5	11.4
1.75	9.8	9.0	5.1	12.0	12.2	13.1
1.83	10.4	9.6	5.8	12.6	12.8	13.7
2.00	11.7	10.9	7.0	13.8	13.9	14.8
2.12	12.6	11.8	8.0	14.6	14.8	15.7
2.25*	13.6	12.8	9.0	15.5	15.7	16.6
2.38*	14.6	13.8	9.9	16.4	16.6	17.4
2.50*	15.5	14.7	10.9	17.2	17.4	18.3

*Bend Setting not recommended for Rotary Drilling

7-1/8" Motor 4/5 Lobe 7.0 Stage ET

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	27 in
Bit to Bend, ABH	B	63 in
Bit to Bend, Fixed	B	52 in
Bit to Top Sub	C	326 in
Body OD, Slick	D	7.13 in
Body OD, Stabilizer	D	7.88 in
Pad Radius, ABH	E	4.26 in
Pad Radius, Fixed	E	3.75 in
Bottom Connection	4-1/2 REG	
Top Connection	4-1/2 IF	
Top Sub Float Bore	4R	
Estimated Weight	2,780 lbf	

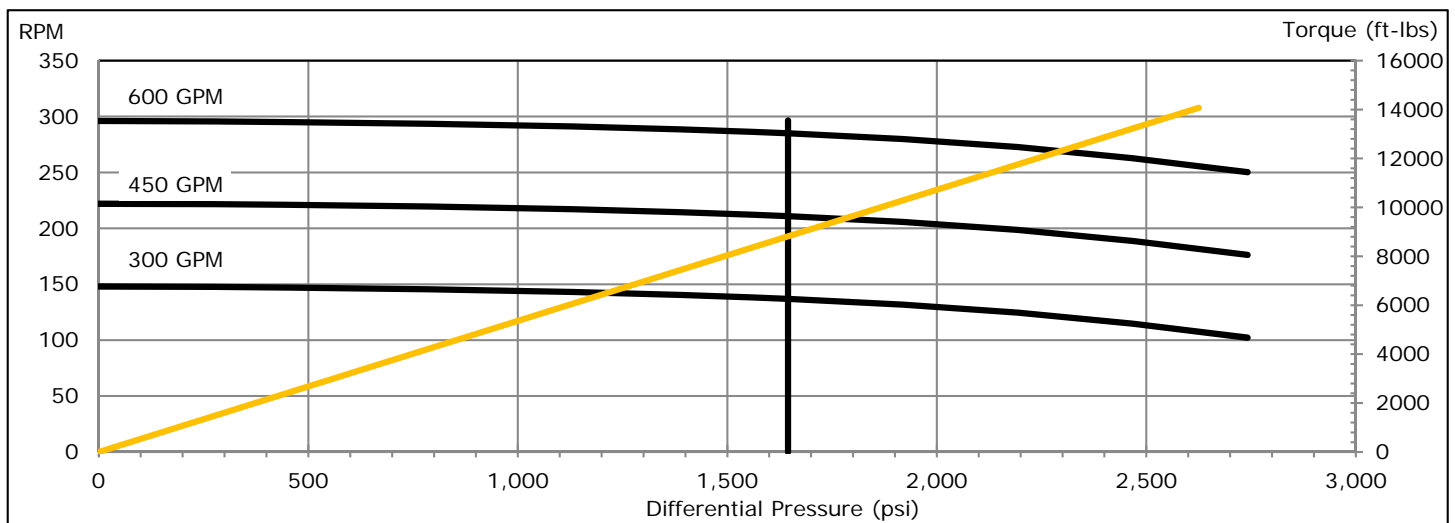
Recommended Operating Limits

Max WOB	109,000 lbf
Max Overpull, Backream	157,000 lbf
Max Overpull, Re-Run	252,000 lbf
Max Overpull, POOH	780,000 lbf

Performance Details

Max Diff Pressure	1,650 psi
Max Torque	8,820 lbf-ft
Stall Torque	19,840 lbf-ft
Speed	0.494 rev/gal
Flow Range	300-600 gpm
Speed Range	150-300 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operation conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

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	Deg	8 1/2	8 3/4	9 7/8	8 1/2	8 3/4
0.39	4.0	3.2	-	4.0	3.2	3.6
0.78	6.9	6.2	3.0	6.9	6.2	6.2
1.15	9.7	9.0	5.8	9.7	9.0	8.6
1.50	12.4	11.7	8.4	12.4	11.7	10.9
1.83	14.9	14.2	10.9	14.9	14.2	13.1
2.12	17.1	16.4	13.2	17.1	16.4	15.0
2.38*	19.1	18.4	15.1	19.1	18.4	16.7
2.60*	20.8	20.1	16.8	20.8	20.1	18.2
2.77*	22.1	21.4	18.1	22.1	21.4	19.3
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2.97*	23.6	22.9	19.6	23.6	22.9	20.6
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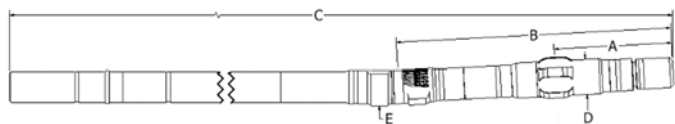
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1.15	5.2	4.4	0.6	7.9	8.1	9.0
1.50	7.9	7.1	3.2	10.3	10.5	11.4
1.75	9.8	9.0	5.1	12.0	12.2	13.1
1.83	10.4	9.6	5.8	12.6	12.8	13.7
2.00	11.7	10.9	7.0	13.8	13.9	14.8
2.12	12.6	11.8	8.0	14.6	14.8	15.7
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2.38*	14.6	13.8	9.9	16.4	16.6	17.4
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*Bend Setting not recommended for Rotary Drilling

7-1/8" Motor 7/8 Lobe 5.0 Stage

Hard Rubber



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Top Connection	4-1/2 IF	
Top Sub Float Bore	4R	
Estimated Weight	2,540 lbf	

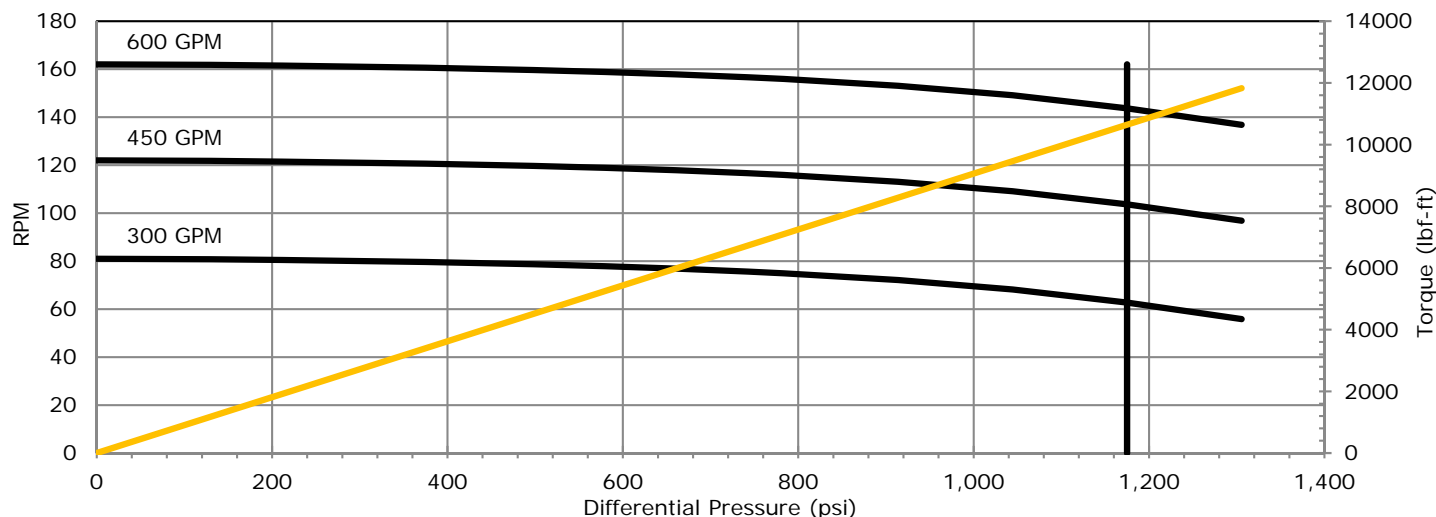
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Max WOB	109,000 lbf
Max Overpull, Backream	157,000 lbf
Max Overpull, Re-Run	252,000 lbf
Max Overpull, POOH	780,000 lbf

Performance Details

Max Diff Pressure	1,180 psi
Max Torque	10,650 lbf-ft
Stall Torque	16,770 lbf-ft
Speed	0.270 rev/gal
Flow Range	300-600 gpm
Speed Range	80-160 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
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0.78	7.4	6.6	3.2	7.4	6.6	6.6
1.15	10.3	9.6	6.1	10.3	9.6	9.1
1.50	13.1	12.4	8.9	13.1	12.4	11.5
1.83	15.8	15.0	11.6	15.8	15.0	13.8
2.12	18.1	17.3	13.9	18.1	17.3	15.8
2.38*	20.2	19.4	16.0	20.2	19.4	17.5
2.60*	21.9	21.2	17.7	21.9	21.2	19.1
2.77*	23.3	22.5	19.1	23.3	22.5	20.2
2.90*	24.3	23.6	20.1	24.3	23.6	21.1
2.97*	24.9	24.1	20.7	24.9	24.1	21.6
3.00*	25.1	24.4	20.9	25.1	24.4	21.8

*Bend Setting not recommended for Rotary Drilling

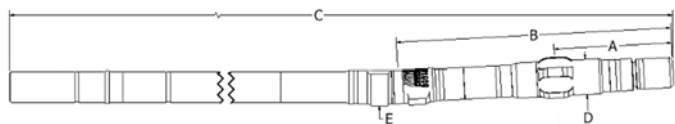
Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	8 1/2	8 3/4	9 7/8	8 1/2	8 3/4
0.78	2.5	1.7	-	5.6	5.9	6.8
1.15	5.5	4.6	0.6	8.3	8.5	9.5
1.50	8.3	7.4	3.4	10.8	11.0	12.0
1.75	10.3	9.4	5.4	12.6	12.8	13.8
1.83	11.0	10.1	6.1	13.2	13.4	14.4
2.00	12.3	11.4	7.4	14.4	14.6	15.6
2.12	13.3	12.4	8.4	15.3	15.5	16.5
2.25*	14.3	13.4	9.4	16.2	16.4	17.4
2.38*	15.4	14.5	10.5	17.2	17.4	18.4
2.50*	16.3	15.4	11.4	18.0	18.2	19.2

*Bend Setting not recommended for Rotary Drilling

7-1/8" Motor 7/8 Lobe 5.7 Stage

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	27 in
Bit to Bend, ABH	B	63 in
Bit to Bend, Fixed	B	52 in
Bit to Top Sub	C	376 in
Body OD, Slick	D	7.13 in
Body OD, Stabilizer	D	7.88 in
Pad Radius, ABH	E	4.26 in
Pad Radius, Fixed	E	3.74 in
Bottom Connection	4-1/2 REG	
Top Connection	4-1/2 IF	
Top Sub Float Bore	4R	
Estimated Weight	3,000 lbf	

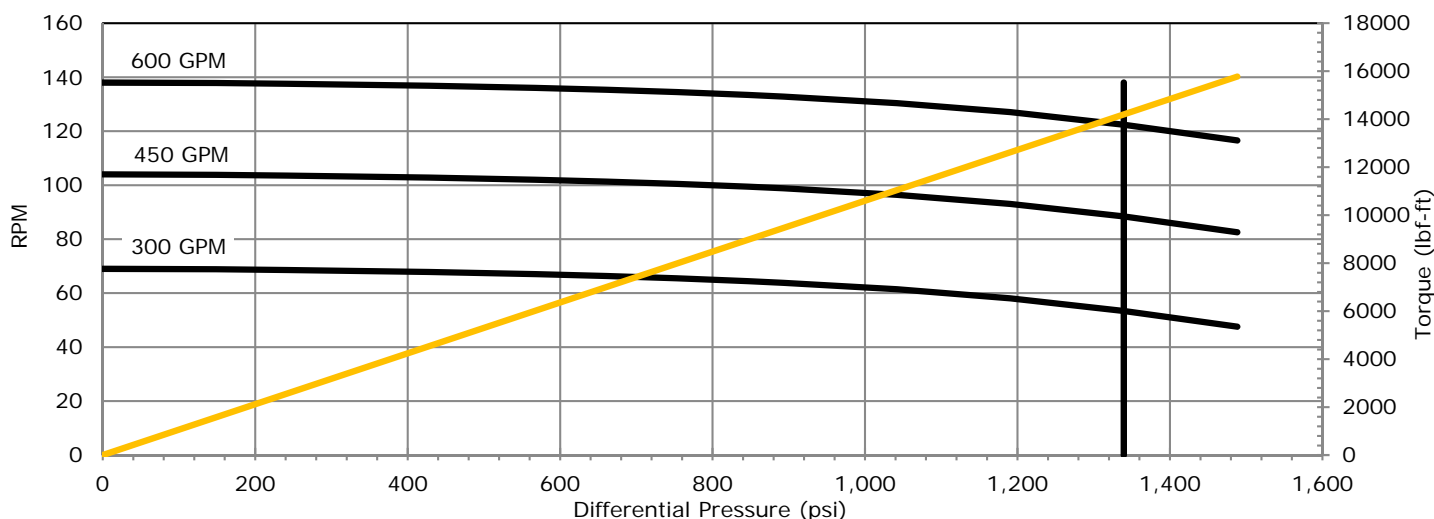
Recommended Operating Limits

Max WOB	109,000 lbf
Max Overpull, Backream	157,000 lbf
Max Overpull, Re-Run	252,000 lbf
Max Overpull, POOH	780,000 lbf

Performance Details

Max Diff Pressure	1,340 psi
Max Torque	14,200 lbf-ft
Stall Torque	22,370 lbf-ft
Speed	0.230 rev/gal
Flow Range	300-600 gpm
Speed Range	70-140 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	8 1/2	8 3/4	9 7/8	8 1/2	8 3/4
0.39	3.3	2.7	-	3.3	2.7	2.9
0.78	5.8	5.2	2.4	5.8	5.2	5.2
1.15	8.3	7.7	4.8	8.3	7.7	7.4
1.50	10.6	10.0	7.1	10.6	10.0	9.4
1.83	12.7	12.1	9.3	12.7	12.1	11.3
2.12	14.6	14.0	11.2	14.6	14.0	13.0
2.38*	16.4	15.7	12.9	16.4	15.7	14.5
2.60*	17.8	17.2	14.4	17.8	17.2	15.8
2.77*	18.9	18.3	15.5	18.9	18.3	16.8
2.90*	19.8	19.1	16.3	19.8	19.1	17.5
2.97*	20.2	19.6	16.8	20.2	19.6	17.9
3.00*	20.4	19.8	17.0	20.4	19.8	18.1

*Bend Setting not recommended for Rotary Drilling

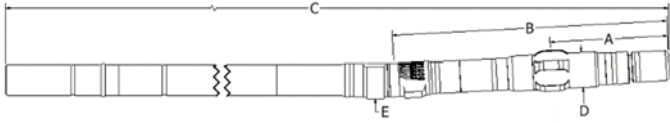
Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	8 1/2	8 3/4	9 7/8	8 1/2	8 3/4
0.78	2.1	1.4	-	4.6	4.7	5.4
1.15	4.5	3.8	0.5	6.8	7.0	7.6
1.50	6.8	6.1	2.8	8.9	9.1	9.7
1.75	8.5	7.7	4.4	10.5	10.6	11.2
1.83	9.0	8.3	5.0	10.9	11.1	11.7
2.00	10.1	9.4	6.1	12.0	12.1	12.8
2.12	10.9	10.2	6.9	12.7	12.8	13.5
2.25*	11.8	11.0	7.7	13.5	13.6	14.3
2.38*	12.6	11.9	8.6	14.3	14.4	15.1
2.50*	13.4	12.7	9.4	15.0	15.1	15.8

*Bend Setting not recommended for Rotary Drilling

8-1/2" Motor 7/8 Lobe 3.4 Stage

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	39 in
Bit to Bend, ABH	B	90 in
Bit to Bend, Fixed	B	76 in
Bit to Top Sub	C	452 in
Body OD, Slick	D	8.25 in
Body OD, Stabilizer	D	9.50 in
Pad Radius, ABH	E	4.65 in
Pad Radius, Fixed	E	4.30 in
Bottom Connection	6-5/8 REG	
Top Connection	6-5/8 REG	
Top Sub Float Bore	5F-6R	
Estimated Weight	4,650 lbf	

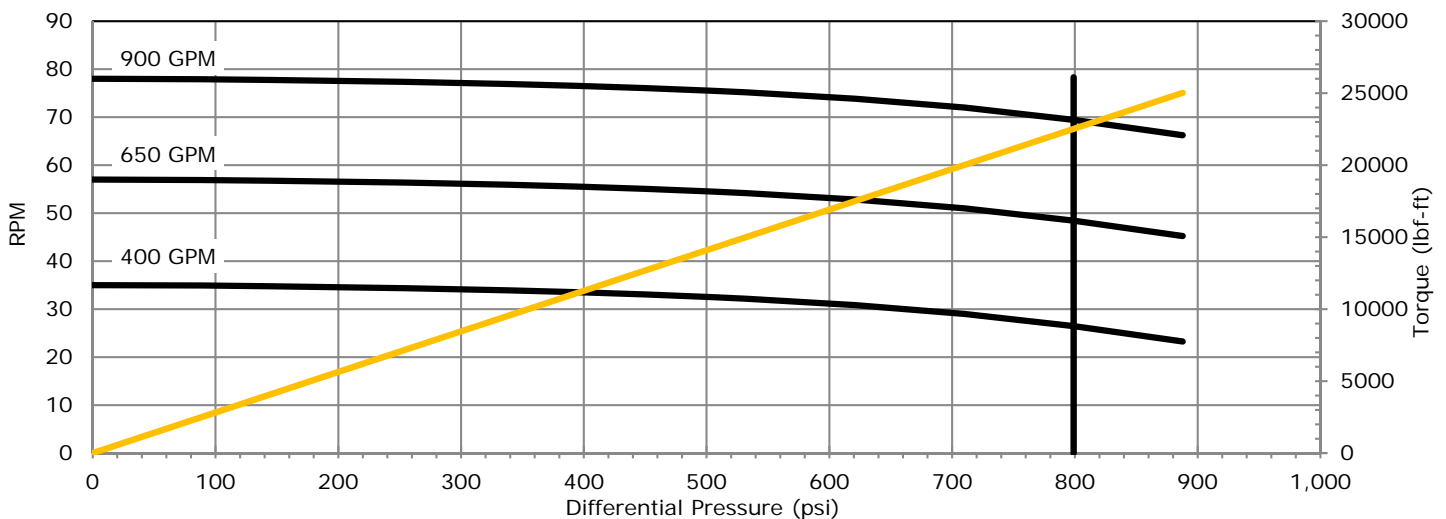
Recommended Operating Limits

Max WOB	164,000 lbf
Max Overpull, Backream	236,000 lbf
Max Overpull, Re-Run	440,000 lbf
Max Overpull, POOH	1,172,000 lbf

Performance Details

Max Diff Pressure	800 psi
Max Torque	22,530 lbf-ft
Stall Torque	35,480 lbf-ft
Speed	0.087 rev/gal
Flow Range	400-900 gpm
Speed Range	30-80 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	9 7/8	10 5/8	12 1/4	9 7/8	10 5/8
0.39	1.7	0.5	-	2.0	2.3	3.0
0.78	3.8	2.7	0.2	3.8	4.1	4.8
1.15	5.8	4.7	2.3	5.8	5.9	6.6
1.50	7.8	6.6	4.2	7.8	7.5	8.2
1.83	9.6	8.4	6.0	9.6	9.1	9.8
2.12	11.2	10.0	7.6	11.2	10.5	11.1
2.38*	12.6	11.5	9.0	12.6	11.7	12.4
2.60*	13.8	12.7	10.2	13.8	12.8	13.4
2.77*	14.7	13.6	11.1	14.7	13.6	14.2
2.90*	15.4	14.3	11.9	15.4	14.3	14.8
2.97*	15.8	14.7	12.2	15.8	14.7	15.2
3.00*	16.0	14.8	12.4	16.0	14.8	15.3

*Bend Setting not recommended for Rotary Drilling

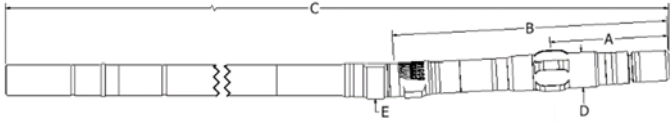
Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	9 7/8	10 5/8	12 1/4	9 7/8	10 5/8
0.78	2.1	0.8	-	4.0	4.3	4.9
1.15	4.1	2.8	-	5.8	6.1	6.8
1.50	6.1	4.8	2.0	7.5	7.8	8.5
1.75	7.4	6.1	3.3	8.8	9.1	9.7
1.83	7.9	6.6	3.8	9.2	9.5	10.1
2.00	8.8	7.5	4.7	10.0	10.3	11.0
2.12	9.5	8.2	5.4	10.6	10.9	11.6
2.25*	10.2	8.9	6.1	11.2	11.5	12.2
2.38*	10.9	9.6	6.8	11.9	12.2	12.8
2.50*	11.5	10.3	7.4	12.5	12.8	13.4

*Bend Setting not recommended for Rotary Drilling

8-1/2" Motor 7/8 Lobe 4.0 Stage

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	39 in
Bit to Bend, ABH	B	90 in
Bit to Bend, Fixed	B	76 in
Bit to Top Sub	C	355 in
Body OD, Slick	D	8.25 in
Body OD, Stabilizer	D	9.50 in
Pad Radius, ABH	E	4.65 in
Pad Radius, Fixed	E	4.30 in
Bottom Connection	6-5/8 REG	
Top Connection	6-5/8 REG	
Top Sub Float Bore	5F-6R	
Estimated Weight	3,780 lbf	

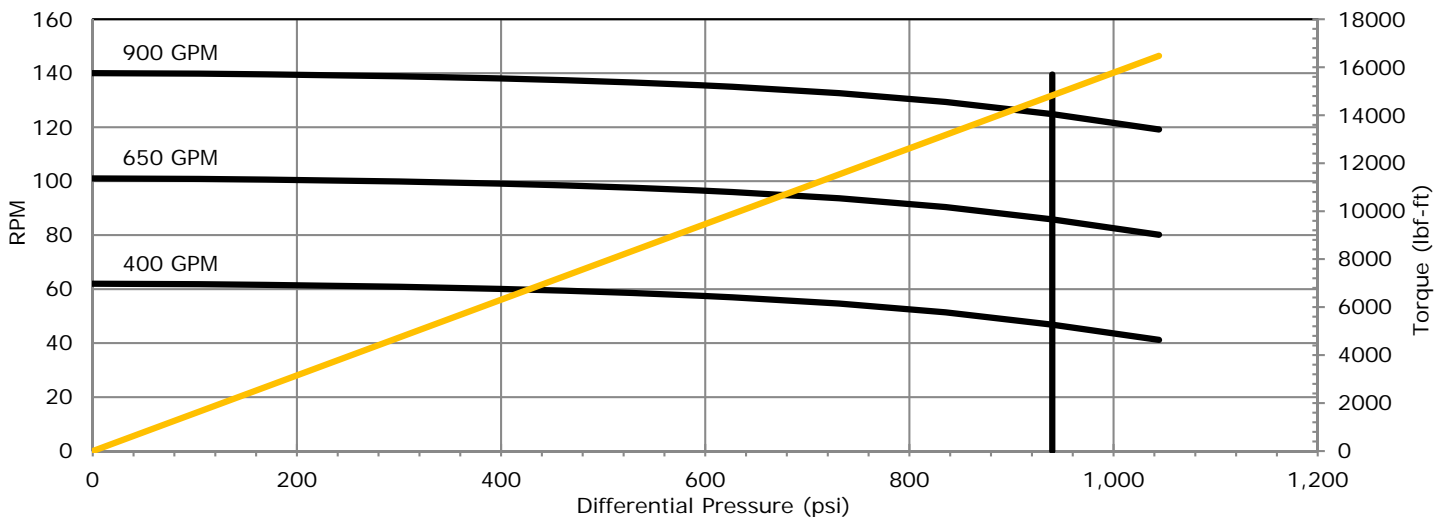
Recommended Operating Limits

Max WOB	164,000 lbf
Max Overpull, Backream	236,000 lbf
Max Overpull, Re-Run	440,000 lbf
Max Overpull, POOH	1,172,000 lbf

Performance Details

Max Diff Pressure	940 psi
Max Torque	14,830 lbf-ft
Stall Torque	23,350 lbf-ft
Speed	0.155 rev/gal
Flow Range	400-900 gpm
Speed Range	60-140 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	9 7/8	10 5/8	12 1/4	9 7/8	10 5/8
0.39	2.3	0.9	-	2.6	3.2	4.3
0.78	5.1	3.6	0.5	5.1	5.4	6.5
1.15	7.7	6.2	3.1	7.7	7.5	8.7
1.50	10.2	8.7	5.6	10.2	9.6	10.7
1.83	12.5	11.0	7.9	12.5	11.5	12.6
2.12	14.5	13.1	9.9	14.5	13.1	14.3
2.38*	16.4	14.9	11.8	16.4	14.9	15.8
2.60*	17.9	16.5	13.3	17.9	16.5	17.0
2.77*	19.1	17.7	14.5	19.1	17.7	18.0
2.90*	20.0	18.6	15.4	20.0	18.6	18.8
2.97*	20.5	19.1	15.9	20.5	19.1	19.2
3.00*	20.7	19.3	16.1	20.7	19.3	19.3

*Bend Setting not recommended for Rotary Drilling

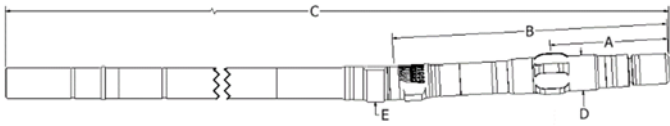
Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	9 7/8	10 5/8	12 1/4	9 7/8	10 5/8
0.78	2.7	1.1	-	5.1	5.7	6.8
1.15	5.3	3.7	-	7.4	7.9	9.1
1.50	7.8	6.1	2.5	9.5	10.1	11.2
1.75	9.6	7.9	4.3	11.1	11.6	12.7
1.83	10.1	8.5	4.9	11.5	12.1	13.2
2.00	11.3	9.7	6.1	12.6	13.1	14.2
2.12	12.2	10.5	6.9	13.3	13.8	15.0
2.25*	13.1	11.4	7.8	14.1	14.6	15.8
2.38*	14.0	12.3	8.7	14.9	15.4	16.5
2.50*	14.9	13.2	9.6	15.6	16.1	17.3

*Bend Setting not recommended for Rotary Drilling

8-1/2" Motor 7/8 Lobe 4.0 Stage ET

Hard Rubber



Dimensions

Bit to Stabilizer Center	A	39 in
Bit to Bend, ABH	B	90 in
Bit to Bend, Fixed	B	76 in
Bit to Top Sub	C	355 in
Body OD, Slick	D	8.25 in
Body OD, Stabilizer	D	9.50 in
Pad Radius, ABH	E	4.65 in
Pad Radius, Fixed	E	4.34 in
Bottom Connection	6-5/8 REG	
Top Connection	6-5/8 REG	
Top Sub Float Bore	5F-6R	
Estimated Weight	3888 lbf	

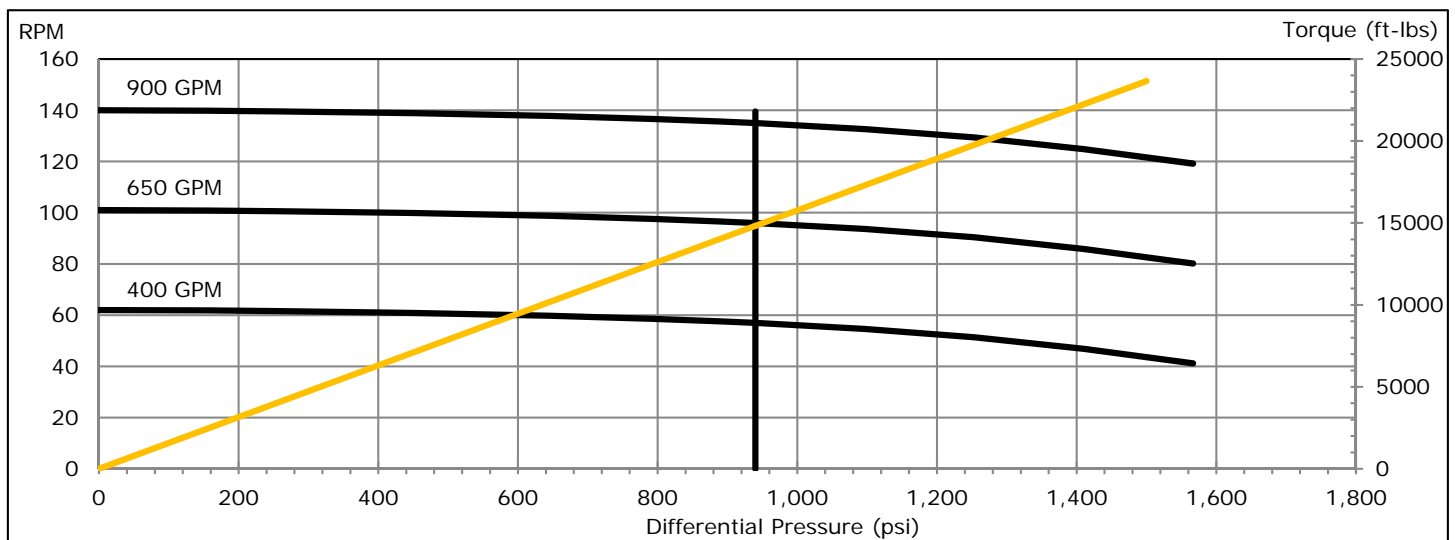
Recommended Operating Limits

Max WOB	164,000 lbf
Max Overpull, Backream	236,000 lbf
Max Overpull, Re-Run	440,000 lbf
Max Overpull, POOH	1,172,000 lbf

Performance Details

Max Diff Pressure	940 psi
Max Torque	14,830 lbf-ft
Stall Torque	33,360 lbf-ft
Speed	0.155 rev/gal
Flow Range	400-900 gpm
Speed Range	60-140 rpm

Theoretical Performance Curve



Performance curves based on testing at 70°F. Actual field performance may vary with field operating conditions.

Predicted Build Rates (Adj.) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	9 7/8	10 5/8	12 1/4	9 7/8	10 5/8
0.39	2.3	0.9	-	2.6	3.2	4.3
0.78	5.1	3.6	0.5	5.1	5.4	6.5
1.15	7.7	6.2	3.1	7.7	7.5	8.7
1.50	10.2	8.7	5.6	10.2	9.6	10.7
1.83	12.5	11.0	7.9	12.5	11.5	12.6
2.12	14.5	13.1	9.9	14.5	13.1	14.3
2.38*	16.4	14.9	11.8	16.4	14.9	15.8
2.60*	17.9	16.5	13.3	17.9	16.5	17.0
2.77*	19.1	17.7	14.5	19.1	17.7	18.0
2.90*	20.0	18.6	15.4	20.0	18.6	18.8
2.97*	20.5	19.1	15.9	20.5	19.1	19.2
3.00*	20.7	19.3	16.1	20.7	19.3	19.3

*Bend Setting not recommended for Rotary Drilling

Predicted Build Rates (Fixed) – Degrees/100ft

Bend Setting	Slick Hole Size			Stabilized Hole Size		
	Deg	9 7/8	10 5/8	12 1/4	9 7/8	10 5/8
0.78	2.7	1.1	-	5.1	5.7	6.8
1.15	5.3	3.7	-	7.4	7.9	9.1
1.50	7.8	6.1	2.5	9.5	10.1	11.2
1.75	9.6	7.9	4.3	11.1	11.6	12.7
1.83	10.1	8.5	4.9	11.5	12.1	13.2
2.00	11.3	9.7	6.1	12.6	13.1	14.2
2.12	12.2	10.5	6.9	13.3	13.8	15.0
2.25*	13.1	11.4	7.8	14.1	14.6	15.8
2.38*	14.0	12.3	8.7	14.9	15.4	16.5
2.50*	14.9	13.2	9.6	15.6	16.1	17.3

*Bend Setting not recommended for Rotary Drilling