TomaHawk
DOWNHOLE

The Cutting Edge in Mud Motors and Mud Motor Components

MOTOR HANDBOOK

Rev. 8, 2017

The purpose of this handbook is to provide technical information for TomaHawk Mud Motor users. It is provided solely as a reference guide; thus, the interpretation and application of the information contained herein is the responsibility of the user. Actual data values may vary from those presented in this handbook due to drilling conditions.

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ABH - Adjustable Bent Housing

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TOMAHAWK MUD MOTOR DESIGN PHILOSOPHY

Tomahawk Mud Motors are designed to meet directional drillers' most demanding criteria with the primary focus on reliability and simplicity in design. This results in an extremely tough and versatile mud motor, which offers the performance necessary for a variety of drilling applications. It also makes the TomaHawk motor one of the easiest to build, maintain and repair. All motor components are engineered with detail in mind and manufactured to exacting standards with only the highest quality materials. Our ISO 9001:2008 certifications testify to an unyeilding commitment to quality in everything we design and manufacture.

TomaHawk mud motors are "mud lubricated", which means that a portion of the drilling fluid flows through the bearing stack to cool and lubricate the internal components. This design makes the TomaHawk motor extremely reliable and relatively inexpensive to operate. There are no seals to fail and servicing of the motor is simple and cost effective.

The TomaHawk bearing pack consists of three main components: upper radial bearings, thrust bearings and lower radial bearings. "The Radial bearings are proprietary carbide tile style bearings which support the mandrel shaft and also control the amount of fluid flow through the bearing pack. Thrust bearings consist of multiple rows of super-hardened bearing races with Rock Bit ball bearings to provide the endurance necessary for long grueling motor runs. A lower mandrel catch is standard and prevents the bit from being lost in the hole in the event of a mandrel shaft failure. The backbone of the TomaHawk motor is the jaw-clutch transmission coupling. This coupling converts the eccentric motion of the rotor to concentric motion at the bit mandrel shaft. It has a long history of downhole use and has proven to be extremely reliable and economical. The TomaHawk Talon II ABH sets the standard for ease of angle adjustment for downhole motor adjustable housings. It features an extremely large internal bore while providing twice the breakout torque as make-up.

TomaHawk motors are available in sizes ranging from 1 $^{11}/_{16}$" up to 11 $^{1}/_{4}$" diameter and can be configured to accept any manufacturers power section. From high speed low torque, to low speed high torque, including "even-walled" and "hard-rubber" power sections. TomaHawk motors offer the versatility to meet any driller's needs.

TOMAHAWK MUD MOTOR FEATURES

- TomaHawk Mud Motors are extremely versatile in that they can be easily modified to accommodate customer needs by interchanging low torque/high speed or high torque/low speed power sections, varying bend angle on adjustable bent housings, fitting rotor with tungsten-carbide jets to control flow to bit and incorporating slick sleeve or blade-type stabilizers on bearing housings.

- Rugged transmission coupling incorporating a two-jaw design that converts the eccentric rotation of the rotor to concentric rotation of the drive components. These couplings are re-buildable and re-useable, eliminate side loading due to power section eccentricity, can be easily assembled or disassembled and are available in all sizes.

- Adjustable Bent Housings (ABHs) are designed so that the bend angle can be easily changed from 0° to 3° on the rig floor to provide the control necessary to be a leader in today's directional drilling market. TomaHawk ABHs can be outfitted with replaceable tungsten-carbide button wear pads or hard metal pads to protect the integrity of the housing. TomaHawk ABHs are as strong as any connection in the motor yet have exceptionally large I.D. bores to allow for larger and stronger TomaHawk transmissions. These ABHs can be designed to fit any pre-existing mud motor application.

- A mud lubricated bearing assembly provides the endurance to withstand long continuous run times in grueling drilling environments.

- TomaHawk housing threads feature a tapered design that increases resistance to backing-off while maximizing the inside diameter of the connection, thus allowing for larger and stronger internal parts.

TOP SUBS

TomaHawk Mud Motors use either crossover subs or dump (trip) subs.

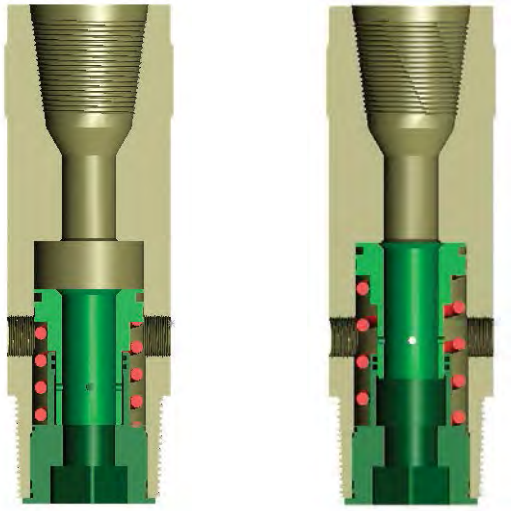
Crossover Subs

Crossover subs are simply top subs with customer requested API box threads and TomaHawk pin threads. These subs can be fitted with rotor catch devices to prevent the loss of the rotor and possibly the entire motor in the event of a connecction failure or back off. The top sub is also available with a float bore, which eliminates the need to run an additional float sub above the motor.

Dump Subs

Dump subs are pressure actuated valve type subs where all of the drilling fluid flows through the motor when the pump is on and allows the fluid to flow out of the motor when the pump is off. The advantage of a dump sub is that the drill string is allowed to fill when tripping into the hole and is allowed to drain when tripping out of the hole. *Refer to Fig. 2-1*.

Fig. 2-1 Dump Subs



POWER SECTION

The power section consists of a rotor and stator which, when fluid pressure is applied, act as a Moineau pump operated in reverse. The power section transforms the hydraulic energy from the drilling fluid pressure to mechanical energy which rotates the articulated driveshaft, in turn rotating the bit.
Refer to Fig. 2-2.

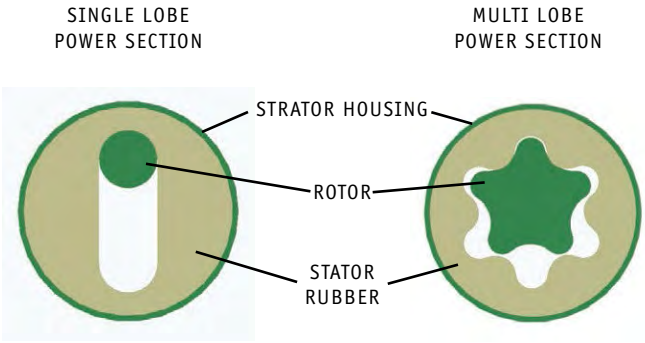
Rotor

The rotor is a helical-shaped, chrome-plated steel shaft which is the rotating part of the power section. The chrome plating helps to increase abrasion resistance as well as reduce friction within the stator. Rotors can also be coated with tungsten carbide to be used in highly corrosive environments.

Stator

The stator is a carbon steel tube with a bonded elastomer (rubber) lining which is the stationary part of the power section.

Fig. 2-2 Rotor/Stator Components



NOTE: VIEW IS OF CROSS SECTION OF POWER SECTION

Rotor/Stator Functionality

The rotor and stator rubber have similar cross sections described by the number of lobes with the exception that the rotor has one less lobe. Having one less lobe creates sufficient clearance allowing the rotor to rotate within the stator. The rotor forms a continuous seal lengthwise with the stator at their contact points creating wedge-shaped cavities. When drilling fluid pressure is applied to these cavities, the rotor is forced to rotate within the stator in a motion known as nutation. Nutation is defined as the oscillatory movement of the rotor's axis.

Rotor/Stator Ratio

The lobes of a rotor/stator are analogous to the teeth on a gear in that as the number of lobes change so does the torque versus speed ratio. These rotor/stator configurations are designated by the ratio of their lobes. Generally as the number of lobes increases so does the torque (reducing the speed). Another factor affecting torque is the number of spirals each lobe translates over the rotors length (one complete spiral is referred to as one stage).

Extended power sections offer increased torque without reducing speed by increasing the overall length of the power section (increasing the number of stages).

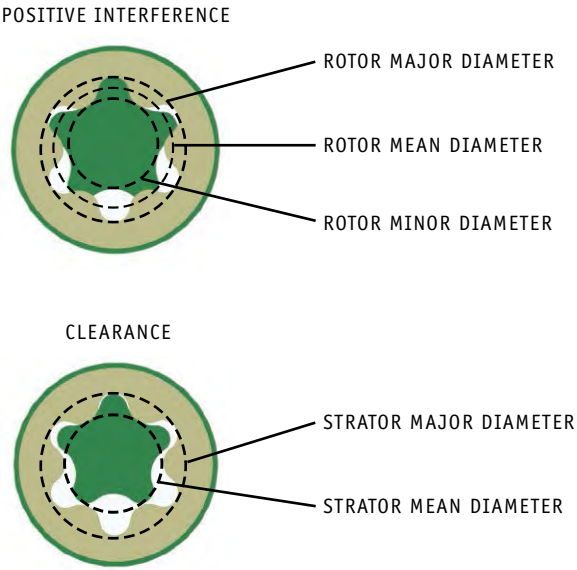
Rotor/Stator Interference

Rotor/stator interference is the difference between the stator minor diameter and the rotor mean diameter. *Refer to Fig. 2-3*. For rotors with even number of lobes, the mean diameter is determined by measuring lobe peak to lobe peak and lobe valley to lobe valley and averaging these two numbers (or measuring lobe peak to lobe peak and subtracting twice the eccentricity). For rotors with odd number of lobes, the mean diameter is determined by measuring lobe peak to lobe valley.

Generally, rotor mean diameters are sized slightly larger than the stator minor diameters creating an interference fit. Increasing rotor/stator interference increases the sealing surfaces thereby producing larger pressure drops, but decreases stator life because the elevated forces can cause premature wear or chunking. *Refer to Section 2-5 "Factors Affecting Power Section Life."*

Rotors with mean diameters that are slightly smaller than the mating stator's minor diameter, produce clearance (negative) fits. Clearance fits and/or flush fits (rotor mean diameter and stator minor diameter are the same size) are generally used when downhole temperatures are expected to be above 200°F or when used with oil-based drilling fluids. These clearances are measured at room temperature.

Fig. 2-3 Rotor/Stator Interference



NOTE: FIGURE IS EXAGGERATED FOR ILLUSTRATION PURPOSES

Increasing Power

Rotor/stator power is proportional to the number of stages of a power section. As a result, increasing the number of stages increases power. This can be accomplished by using an extended power section. Extended power sections can be used to produce more torque or to produce an equivalent amount of torque at a lower pressure drop, increasing power section life. Higher cost and extended motor lengths are the two major disadvantages of running extended power sections. There are new innovations in power section technology that aim to alleviate these disadvantages. One is the addition of new "hard rubber" elastomers. These new elastomers increase the pressure per stage that the stator can produce thereby increasing the torque output of the power section. Even-rubber thickness technology also known as "even-walled" stators are another new advancement that allows the rubber in the stator to be the same thickness due to the stator tube having the profile machined or formed into the tube. These power sections produce more power and torque as compared to traditional technology and also help combat the effects of oil based drilling fluids and high temperatures due to limited swelling of the rubber.

Factors Affecting Power Section Life

The primary mode of failure in power sections is damage to the stator rubber. The most common form of stator rubber damage is known as chunking. Chunking is where "chunks" (pieces) of stator lobes are torn or pulled away. This is caused when the forces between the rotor and stator rubber repeatedly exceed the yield strength of the rubber (hysteresis effect).

Power section life can be prolonged by abiding by the following:

- Never exceed the recommended maximum operating differential pressures.
- Never exceed the recommended maximum flowrate.
- Be certain that the correct interference/clearance is chosen for the application. This is primarily a function of downhole temperatures. (high temperatures can lead to premature chunking or excessive wear).
- When using oil-based drilling muds, consider the downhole operating temperatures as well as the aniline point. The aniline point is the minimum temperature where equal amounts of oil and distilled aniline form a homogenous solution (can cause the stator rubber to swell possibly leading to chunking).
- Avoid or minimize the occurrence of motor stalls (can cause chunking).
- Minimize the use of chlorides in drilling mud (can cause corrosion/pitting of the rotor which in turn can cut or damage stator lobes).
- Minimize the amount of contaminates (metal filings, etc.) in the drilling mud system (can cause lacerations in stator rubber).
- Monitoring the age and condition of stator rubber can help in making determinations on scheduled stator relines, possibly reducing failures.

Rotor Jets/Nozzles

The use of tungsten-carbide rotor jets/nozzles permit higher drilling fluid circulation rates by diverting a portion of the drilling fluid through the center of the rotor. They can also be used to reduce bit speed at high flow rates. At very low circulation rates, it is possible all circulation could pass through the jet, keeping the rotor from turning.

When the drilling requirements are within the operating criterion, the rotor is fitted with a plug.

The following hydraulic equation may be used to determine jet size.

$$A = \sqrt{(Q^2 \times W) / (P \times 10{,}858)}$$

Where: A = Total cross sectional flow area of jet (in^2)
Q = Desired motor bypass rate (gpm)
W = Drilling fluid weight (ppg)
P = Differential pressure (psi)

Refer to Table 2-1 for the flow area of a particular jet size or *Table 2-2* for the bypass flow for a particular jet size at a given differential pressure.

Refer to Section 5 "Formulas" for other hydraulic calculations.

Table 2-1 Jet Size

Table 2-1 Rotor Jet Size and Flow Area

Jet Size (in)	Flow Area (in^2)	Jet Size (in)	Flow Area (in^2)
6/32	0.028	15/32	0.172
7/32	0.038	16/32	0.196
8/32	0.049	18/32	0.249
9/32	0.062	20/32	0.306
10/32	0.077	22/32	0.371
11/32	0.093	24/32	0.442
12/32	0.110	26/32	0.518
13/32	0.130	28/32	0.601
14/32	0.150	30/32	0.690

Table 2-2 Rotor Jet Bypass Flow at Various Motor Differential Pressures										
Jet (in)	Mud Weight (ppg)	Bypass Flow Rates (gpm) at Various Differential Pressures (psi)								
		100 psi	200 psi	300 psi	400 psi	500 psi	600 psi	700 psi	800 psi	900 psi
7/32	water	14	19	23	27	30	33	36	38	41
	10	12	18	21	25	28	30	33	35	37
	12	11	16	20	23	25	28	30	32	34
	14	10	15	18	21	23	26	28	30	32
8/32	water	17	25	31	35	40	43	47	50	53
	10	15	23	28	32	36	40	43	46	48
	12	14	21	26	29	33	36	39	42	44
	14	13	19	24	27	30	33	36	39	41
10/32	water	28	39	48	55	62	68	72	78	83
	10	25	36	44	50	57	62	67	71	75
	12	23	33	40	46	52	56	61	65	69
	14	21	30	37	42	48	52	56	60	64
12/32	water	40	56	69	80	89	98	105	113	119
	10	36	51	63	73	81	89	96	103	109
	12	33	47	58	66	74	81	88	94	99
	14	31	43	53	62	69	75	81	87	91
14/32	water	54	77	94	108	121	133	144	153	162
	10	50	70	86	99	111	121	131	140	147
	12	45	64	78	90	101	111	120	128	135
	14	42	59	73	84	94	103	111	118	124
16/32	water	71	100	123	142	158	174	187	200	212
	10	65	91	112	129	145	158	171	183	193
	12	59	84	102	118	132	145	156	167	175
	14	55	77	95	109	122	134	145	155	162
18/32	water	90	127	155	179	200	220	237	254	268
	10	82	116	142	164	183	201	217	232	245
	12	75	106	129	150	167	183	198	211	221
	14	69	98	120	138	155	170	183	196	202

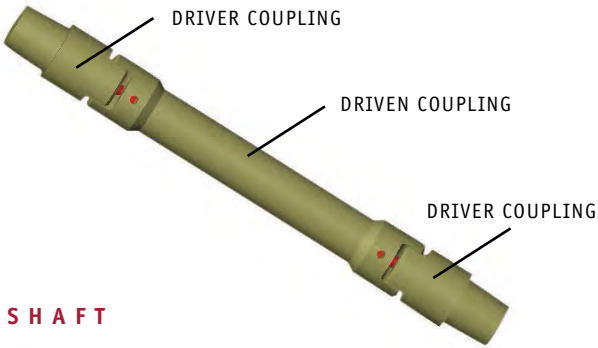
TRANSMISSION

The transmission* transmits torque and rotational speed from the rotor to the bearing mandrel (bit box). It also converts the eccentric rotation of the rotor to concentric rotation of the mandrel, while absorbing the downward thrust of the rotor. Hard weld metal is applied to the contacting wear surfaces of the couplings to extend transmission life.

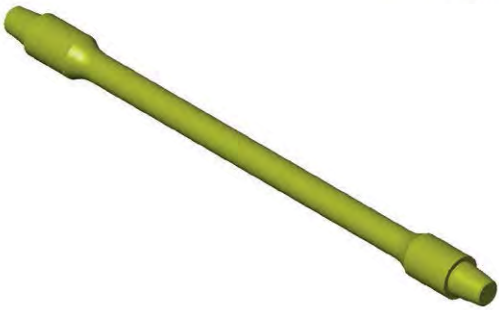
TomaHawk transmission couplings incorporate a rugged two-jaw design that are capable of withstanding the high torque of extended power sections yet still allow adjustable bent housing settings up to 3°. These couplings are re-buildable and re-useable, eliminate side loading due to power section eccentricity, can be easily assembled or disassembled and are available in all sizes.

TomaHawks's FlexShaft is a solid flexible shaft, which can be substituted in place of the jaw clutch drive couplings for straight motor applications. This option offers reliability and economy for straight motor applications.

JAW CLUTCH



FLEX SHAFT



TALON ADJUSTABLE BENT HOUSING

TomaHawk's Talon* adjustable bent housing sets the standard for ease of assembly and adjustability for down hole motor adjustable housings. The Talon* requires no calibration or set screws, features a large I.D. bore, improved resistance to thread galling and increased strength over the original TomaHawk adjustable housing. These housings can be custom manufactured to adapt to virtually any mud motor application.

The new Talon Model II adjustable housing offers even greater performance and economy due to the addition of a replaceable wear pad. This wear pad can be outfitted with welded hardmetal, tungston carbide buttons, or tungston carbide tiles. Any of TomaHawks transmission configurations can be run in the Talon* up to 3˚. **4 degree ABH's available upon request.

FIXED BEND HOUSING

TomaHawk offers fixed bend housings with hard metal or carbide button wear pads. These housings are available with bend angles from 0° for straight-hole work, up to 4° for short radius applications.

BEARING ASSEMBLY

The bearing assembly is the lower most portion of a mud motor whose main function is to support the bit loads. It is comprised of a mandrel (output shaft/bit box), upper and lower radial bearings and a thrust bearing stack.

The mandrel is a bored shaft supported in both radial and axial directions that allows drilling fluids to flow through its center. Its design is based on maximized fatigue resistance and minimized stress level for optimum life. The mandrel bit boxes are threaded per API standards but can be modified per customer request.

The ball bearing stack utilizes mud lubrication and multiple tiers of hardened races and rock bit balls to provide for an assembly that is capable of withstanding more WOB than conventional bearings.

Stabilizers or slick sleeve thread protectors must be used on T47 through T96 motor bearing assemblies.

Prolonging Bearing Assembly Life

Abiding by the maximum flow rate and WOB (*Refer to Section 4 "Motor Specifications"*) will significantly increase bearing assembly life.

Exceeding maximum flowrate can cause bearings to wash.

Exceeding maximum WOB can cause the races to wear prematurely.

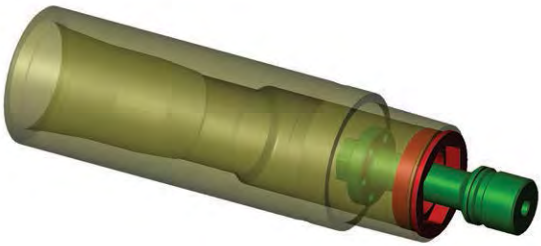
ROTOR CATCH

The rotor catch is an optional motor component which screws into the top of the rotor and runs inside the top sub. Its main function is to "catch" the rotor (and possibly the entire motor) in the event of a broken or backed off connection (below the top sub.)

When a connection failure occurs, the catch contacts a ring inside of the top sub. Since the catch operates in the top sub, it still works if the top sub connection backs off. At the time of failure, the catch is designed to allow only a portion of the fluid flow to reach the power section, thereby producing a noticeable increase in pressure. Thus the driller will be forced to remove the failed motor from the hole. Also, allowing a portion of the fluid to continue flowing through the motor prevents large pressure spikes from damaging upstream equipment.

Rotor catches can be equipped with bit jets (rotor jets) or plugs to regulate the amount of fluid flow across the power section. *Refer to Section 3-1 Rotor Jet Sizing* for additional information.

Refer to Table 4-2 (Section 4-23) for rotor catch torque values.



JOB PREPARATION

Motor Selection

Motor diameter is determined by hole diameter and flowrate required. Other specifications can be chosen after the motor diameter is selected.

Power Section Selection

The rotor/stator combination should be selected to provide the correct performance characteristics for the drilling application (i.e., necessary speed and torque). *Refer to Section 4 "Motor Specifications"* for available combinations.

Adjustable Bent Housing (ABH) Angle

ABH angle is determined by the desired build rate. These build rates can be ascertained from build rate tables *found in Section 4 "Motor Specifications"* for a particular motor. These tables are based on theoretical calculations and should be used with driller experience for accurate build rate predictions.

(For Talon ABH alignment instructions *refer to Section 3-4*)

Rotor Jet Sizing

Should the flow rate for a particular size motor exceed the recommended maximum, a rotor jet should be used allowing a portion of the fluid to flow through the rotor. *Refer to Table 2-1* and *Table 2-2* for jet sizing.

Top Sub and Bit Box Connections

Be certain that the top sub and the bit box connections requested match those of the rig. *Refer to Section 4 "Motor Specifications"* for standard top sub and bit connections.

Stabilizers

It is recommended to select an 1/8" – 1/4" under-gauge stabilizer. If a stabilizer is not necessary, a slick sleeve thread protector must be used on T47 – T96 motors (with threaded housing). Always ring gauge stabilizers before tripping into the hole to ensure it is a minimum of 1/8" under gauge.

PRE-RUN MOTOR EVALUATIONS AND SET-UP

Visual Inspection

Perform a visual inspection of the motor, checking for any signs of external damage to the motor.

Adjusting Angle on A djustable Bent Housings

Refer to Section 3-4 for Talon ABH Angle Adjustments

Stabilizers

If the bearing housing is threaded for a stabilizer, be certain that either a stabilizer or slick sleeve is used. *Refer to Table 4-2 (Section 4-23)* for recommended sleeve torque values.

Bearing Assembly Wear Measurements (Push / Pull)

- ***Before*** the motor is used, measure the gap between the end nut and bit box when the motor is hanging above the rig floor, and when the motor is standing on the rig floor. *(See Fig. 3-1*)
- ***After*** the motor is used, measure the gap between the end nut and bit box when the motor is hanging above the rig floor and when the motor is standing on the rig floor. *(See Fig. 3-1)*
- Subtract the "new" and "used" hanging gaps.
- Subtract the "new" and "used" standing gaps.
- Lay the motor down if the difference between either the hanging or standing gap exceeds those in *Table 3-1 (Section 3-3)*.

Fig. 3-1 Push / Pull

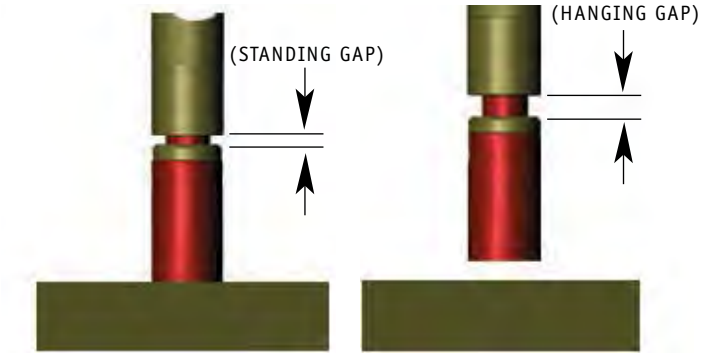


Table 3.1 Push / Pull Measurements	
Motor Size (in)	Max. Bearing Wear in Either Hanging or Standing Positions (in)
1 11/16"	0.080
2 1/8"	0.100
2 3/8"	0.100
2 7/8"	0.110
3 1/8"	0.110
3 3/8"	0.120
3 1/2"	0.130
3 3/4"	0.130
4 3/4"	0.150
5"	0.150
6 1/4"	0.200
6 1/2"	0.200
6 3/4"	0.200
7"	0.210
7 3/4"	0.210
8"	0.220
9 5/8"	0.250

TALON ABH ANGLE ADJUSTMENTS

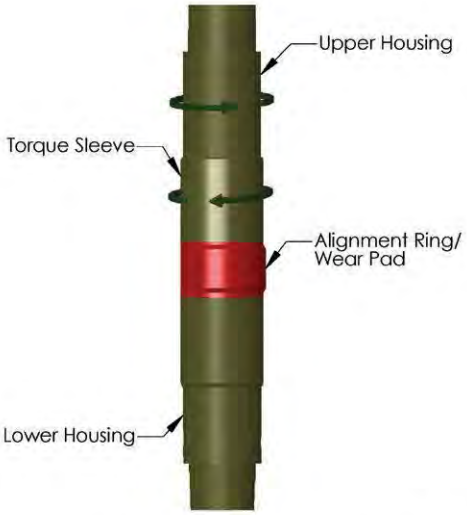


Fig. 1.
Break Connection

Fig. 2.
Make-Up Connection

BREAK CONNECTION

Place tongs on the Upper Housing and on the Torque Sleeve. Break connection by applying torque in the direction indicated above. (Fig 1.)

Back off Torque Sleeve at least one turn (360˚)

SET ABH ANGLE

Holding the Upper Housing Stationary, rotate the Lower Housing until desired angle marks located on Alignment Ring and Lower Housing are aligned.

*Note: Always use the shortest direction to the required angle.

MAKE-UP CONNECTION

Holding the Upper and Lower Housings stationary, use a chain tong to make-up the Torque Sleeve until it shoulders on the Alignment Ring.

Place tongs on the Upper Housing and on the Torque Sleeve. Torque connection to recommended value by applying torque in the direction indicated above. (Fig 2.)

RUNNING TOMAHAWK MUD MOTORS

Running In

Be very careful when tripping the drill string through the blowout preventers, casings, liner hangers, etc., especially when using an ABH set to a large angle.

If the downhole temperatures are high or there is a possibility the mud system is contaminated with steel cuttings or cement, periodically circulate the motor during the trip.

Starting the Motor

With the motor held off of the bottom, begin circulating the motor until the desired flowrate is achieved. Avoid flowrates outside of the recommended values to prevent motor damage. Record the off-bottom standpipe pressure.

Drilling

Slowly lower the motor to the bottom and note the increase in standpipe pressure. This increase is the differential pressure represented in the *"Motor Specification" Performance Curves found in Section 4*. Gradually increase the weight on bit (WOB) until the rate of penetration is optimized. Optimum ROP can be maintained by continuously monitoring differential pressure and incrementally adjusting WOB accordingly. DO NOT EXCEED RECOMMENDED DIFFERENTIAL PRESSURES GIVEN IN "MOTOR SPECIFICATION" PERFORMANCE DATA WHILE INCREASING WOB OR MOTOR STALLING MAY OCCUR.

*NOTE: Use extreme caution while rotating the entire drill string when the ABH angle is 1˚ or above due to possible fatigue failure. (See table 3-2 for maximum bend angle for rotary drilling.) In addition, Tomahawk does not recommend running any tools below the bit box other than standard bits. Tools which have extended lengths such as extension subs, stabilizers, reamers, hole openers, etc., create increased stress and can cause motor failure. Please contact Tomahawk Engineering department with any questions or concerns about running a particular tool.

Table 3.2 SuperHawk Motor Rotary Angles (ABH)

Maximum Recommended ABH Bend Angle For Rotary Speeds Up To 100 RPM

Motor OD		Slick				Partially Stabilized				Fully Stabilized			
4 3/4''	Hole Size	5 3/4''	6 1/8"	6 3/4"	7 7/8"	5 3/4''	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4''	7 7/8"
	Max. Bend	1.25°	1.50°	1.75°	2.00°	1.00°	1.25°	1.75°	1.75°	1.25°	1.25°	1.25°	1.25°
5"	Hole Size	5 3/4''	6 1/8"	6 3/4"	7 7/8"	5 3/4''	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4''	7 7/8"
	Max. Bend	1.00°	1.25°	1.50°	2.00°	1.00°	1.25°	1.75°	1.75°	1.25°	1.25°	1.25°	1.25°
6 1/4"	Hole Size	7 7/8''	8 1/2''	8 3/4"	*****	7 7/8''	8 1/2"	8 3/4"	*****	7 7/8"	8 1/2"	8 3/4''	*****
	Max. Bend	1.25°	1.50°	1.75°	*****	1.25°	1.50°	1.75°	*****	1.25°	1.25°	1.25°	*****
6 1/2"	Hole Size	7 7/8''	8 1/2''	8 3/4"	9 7/8"	7 7/8''	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4''	9 7/8"
	Max. Bend	1.25°	1.50°	1.75°	2.00°	1.25°	1.50°	1.75°	2.00°	1.25°	1.25°	1.25°	1.25°
6 3/4"	Hole Size	7 7/8''	8 1/2''	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.25°	1.50°	1.50°	1.75°	1.25°	1.50°	1.75°	1.75°	1.25°	1.25°	1.25°	1.25°
7"	Hole Size	7 7/8''	8 1/2''	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.25°	1.50°	1.50°	1.75°	1.25°	1.50°	1.75°	1.75°	1.25°	1.25°	1.25°	1.25°
7 3/4"	Hole Size	9 1/2''	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"
	Max. Bend	1.25°	1.50°	1.50°	1.75°	1.25°	1.25°	1.50°	1.50°	1.25°	1.25°	1.25°	1.25°
8"	Hole Size	9 1/2''	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"
	Max. Bend	1.25°	1.50°	1.50°	1.75°	1.25°	1.25°	1.50°	1.50°	1.25°	1.25°	1.25°	1.25°
9 5/8"	Hole Size	12 1/4"	14 3/4"	17 1/2"	20"	12 1/4"	14 3/4"	17 1/2"	20"	12 1/4"	14 3/4"	17 1/2"	20"
	Max. Bend	1.50°	1.75°	2.00°	2.00°	1.25°	1.50°	1.75°	1.75°	1.25°	1.25°	1.25°	1.25°

- Partially Stabilized motor has a 1/8" undergauge near-bit stabilizer.
- Fully Stabilized motor has a 1/8" undergauge near-bit stabilizer and a 1/8" undergauge top stabilizer located immediately above the motor.
- The above values are not valid if a bit cross-over is used.
- Aggressive rotation of the motor should be avoided if the dogleg severity exceeds 8 degrees/100 feet.
- For every 0.125 deg. above values listed in chart, reduce rotation by 20 rpm

Table 3.3 SuperHawk Motor Rotary Angles (Fixed Bend)

Maximum Recommended Fixed Bend Angle For Rotary Speeds Up To 100 RPM

Motor OD		Slick				Partially Stabilized				Fully Stabilized			
4 3/4"	Hole Size	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"
	Max. Bend	1.50°	1.75°	2.00°	2.25°	1.25°	1.50°	2.00°	2.00°	1.50°	1.50°	1.50°	1.50°
5"	Hole Size	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.25°	1.50°	1.75°	1.75°	1.50°	1.50°	1.50°	1.50°
6 1/4"	Hole Size	7 7/8"	8 1/2"	8 3/4"	*****	7 7/8"	8 1/2"	8 3/4"	*****	7 7/8"	8 1/2"	8 3/4"	*****
	Max. Bend	1.50°	1.75°	2.00°	*****	1.50°	1.75°	2.00°	*****	1.50°	1.50°	1.50°	*****
6 1/2"	Hole Size	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.50°	1.75°	1.75°	2.00°	1.50°	1.50°	1.50°	1.50°
6 3/4"	Hole Size	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.50°	1.75°	1.75°	2.00°	1.50°	1.50°	1.50°	1.50°
7"	Hole Size	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.50°	1.75°	1.75°	2.00°	1.50°	1.50°	1.50°	1.50°
7 3/4"	Hole Size	9 1/2"	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.50°	1.50°	1.75°	1.75°	1.50°	1.50°	1.50°	1.50°
8"	Hole Size	9 1/2"	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"	9 1/2"	10 5/8"	12 1/4"	13 1/2"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.50°	1.50°	1.75°	1.75°	1.50°	1.50°	1.50°	1.50°
9 5/8"	Hole Size	12 1/4"	14 3/4"	17 1/2"	20"	12 1/4"	14 3/4"	17 1/2"	20"	12 1/4"	14 3/4"	17 1/2"	20"
	Max. Bend	1.75°	2.00°	2.25°	2.25°	1.50°	1.75°	2.00°	2.00°	1.50°	1.50°	1.50°	1.50°

- Partially Stabilized motor has a 1/8" undergauge near-bit stabilizer.
- Fully Stabilized motor has a 1/8" undergauge near-bit stabilizer and a 1/8" undergauge top stabilizer located immediately above the motor.
- The above values are not valid if a bit cross-over is used.
- Aggressive rotation of the motor should be avoided if the dogleg severity exceeds 10 degrees/100 feet.
- For every .125 deg. above values listed in chart reduce rotation by 20 rpm

Table 3.4 Short SuperHawk Rotary Angles (Fixed Bend)													
Maximum Recommended Bend Angle For Rotary Speeds Up To 100 RPM													
Motor OD		Slick				Partially Stabilized				Fully Stabilized			
4 3/4"	Hole Size	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"
	Max. Bend	1.50°	1.75°	2.00°	2.25°	1.50°	1.75°	2.00°	2.25°	1.50°	1.75°	1.75°	1.75°
5"	Hole Size	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"	5 3/4"	6 1/8"	6 3/4"	7 7/8"
	Max. Bend	1.50°	1.50°	1.75°	2.00°	1.50°	1.75°	2.00°	2.25°	1.50°	1.50°	1.75°	1.75°
6 1/4"	Hole Size	7 7/8"	8 1/2"	8 3/4"	*****	7 7/8"	8 1/2"	8 3/4"	*****	7 7/8"	8 1/2"	8 3/4"	*****
	Max. Bend	1.25°	1.50°	1.75°	*****	1.25°	1.50°	1.75°	*****	1.25°	1.25°	1.25°	*****
6 1/2"	Hole Size	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.50°	1.75°	1.75°	2.00°	1.50°	1.75°	2.00°	2.00°	1.50°	1.75°	1.75°	1.75°
6 3/4"	Hole Size	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"	7 7/8"	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	1.25°	1.75°	1.75°	2.00°	1.25°	1.75°	2.00°	2.00°	1.25°	1.75°	1.75°	1.75°
7"	Hole Size	*****	8 1/2"	8 3/4"	9 7/8"	*****	8 1/2"	8 3/4"	9 7/8"	*****	8 1/2"	8 3/4"	9 7/8"
	Max. Bend	*****	1.75°	1.75°	2.00°	*****	1.75°	2.00°	2.00°	*****	1.75°	1.75°	1.75°

- Partially Stabilized motor has a 1/8" undergauge near-bit stabilizer.

- Fully Stabilized motor has a 1/8" undergauge near-bit stabilizer and a 1/8" undergauge top stabilizer located immediately above the motor.

- The above values are not valid if a bit cross-over is used.

Stalling

Motor stalls are indicated by an abrupt increase in differential pressure without a significant increase in ROP. Stalls are very damaging to stator rubber as well as other internal motor components and should be avoided.

If a motor stall should occur, the following steps should be immediately taken:

- Cut-back or shut down pumps
- Shut down the rotary table
- Slowly release trapped torque using the rotary table brake
- Lift the bit off of the bottom

Following this procedure shortly after the motor stall greatly reduces the chance of motor damage as well as possible connection back-off.

Bit Pressure Drop

The bit pressure drop should never exceed 1500 psi. Exceeding this value can cause premature bearing failure.

Drilling Fluids

The selection of drilling fluids is critical to motor longevity and performance as well as aiding in drilling. Some drilling fluid additives can be detrimental to the rotor and/or stator rubber.

Drilling fluids containing chlorides can cause severe corrosion damage to rotors, and other exposed motor components. This can also cause damage to the stator rubber or even lead to a catastrophic failure of the mud motor assembly due to stress corrosion cracking. The chloride concentration should never exceed 30,000 PPM. Always flush out motors with fresh water as soon as possible after exposure to chlorides.

Sand content in drilling fluids should never exceed 2%. Higher solid content will cause premature washing in the motor.

The pumping of acid through a motor can cause severe corrosion. Always flush out motors with fresh water as soon as possible after exposure to acids.

Tripping Out of the Hole and Surface Checking

No special procedures are necessary when tripping out of the hole.

The motor should be flushed with water until the water flowing out of the bit box is clear before it is laid down or the bit is removed.

SUPER HAWK SERIES MOTORS

TomaHawk's **SuperHawk Series** motors are on the cutting edge of mud motor technology, strength and performance. All major torque carrying components including the bit mandrel and transmission couplings have been redesigned and enlarged to handle the increased torque of "Even-Walled" and "Hard Rubber" power sections. Thrust and radial bearing capacity has been increased, utilizing "BTS" designed radial bearings, providing improved wear life and reliability for extended run times so often required in the field. A uniquely designed mandrel catch device provides reduced stress concentration over previous designs and supports the mandrel shaft reducing bending stress. A redesigned stator connection reduces cracked threads and provides protection from corrosive drilling fluids.

These improvements allow the **SuperHawk** motor to easily handle the most extreme drilling conditions while utilizing the increased torque from "even-walled" and "hard rubber" power sections. This enables drillers to maximize rate of penetration and be highly competitive in Today's drilling market.

SuperHawk motors are available in sizes ranging from 1 $^{11}/_{16}$" to 11 $^{1}/_{4}$" diameters and are available in several configurations including adjustable bent housing, fixed bend housing, or straight housing with TomaHawk's jaw clutch or flexshaft driveshaft. **** In addition, a "Short **SuperHawk**" version of our motor is offered in select sizes which have a reduced bit to bend distance. These "Short **SuperHawk**" motors contain the same torque handling capability of the standard length **SuperHawk**, utilizing the same transmission components and housing, but with a shorter bearing housing length.

Key Features of the TomaHawk SuperHawk Motor:

- Durable mud lubricated bearing assembly
- Exceptionally strong forged alloy steel bearing mandrel
- Improved mandrel catch device
- Higher thrust and radial capacity
- Improved radial bearing capacity and service life through use of "BTS" radial bearings
- Enlarged TomaHawk transmission couplings
- Larger and stronger flow diverter and rotor connections
- Improved stator connection
- Compatible with "Even Walled" and "Hard Rubber" power sections

*Patent #'s 7,445,061; 6,799,646; 5,205,789; 8,025,110; 8,770,845; other Patents Pending

SuperHawk High Pull SH16
1 11/16 in O.D.

General Data

Bit Sizes	1 13/16 - 3 in
Std Bit Connection (1)	1 in MT
Std Top Connection (1)	1 in MT
Make-Up Torques	See 4-22
Max WOB (operating)	5,600 lbs
Max WOB (continuous) (2)	2,800 lbs
Max Bit Pull (3)	30,000 lbs
Max Body Pull (3)	45,500 lbs

(1) Other connections available upon request.

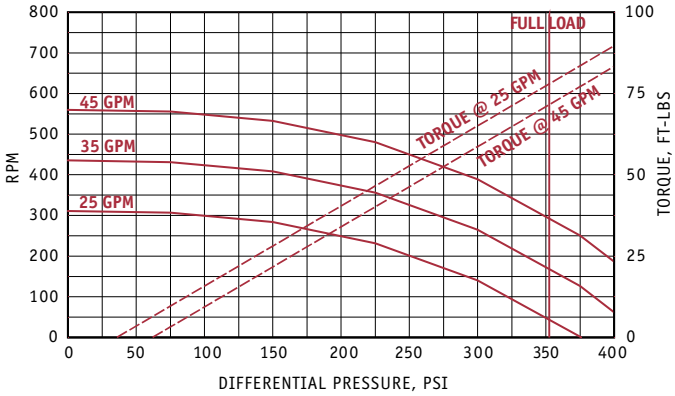
(2) Optimum motor life.

(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk High Pull 1 11/16 in O.D.
5:6 Lobes, 1.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	N/A
Nominal Length	91 in
Weight	37 lbs
Performance Data	
Bit Speed (No Load)	313-563 rpm
Flow Range	25-45 gpm
Max Operating Pressure	350 psi
Max Power	3.8 hp
Max Torque	78 ft-lbs

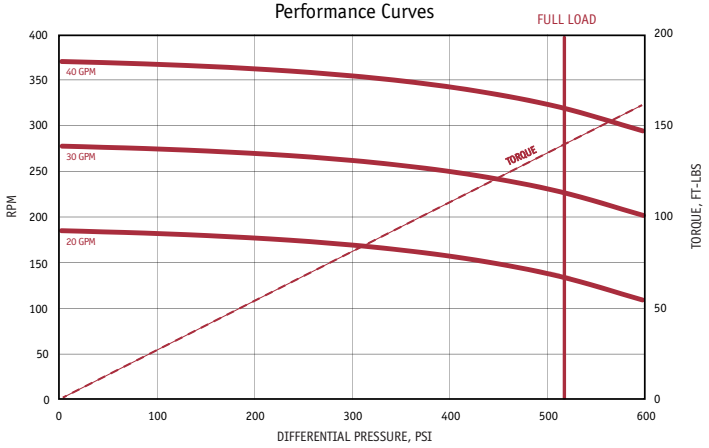
Performance Curves



SuperHawk High Pull 1 11/16 in O.D.
5:6 Lobes, 2.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	N/A
Nominal Length	98.7 in.
Weight	50 lbs
Performance Data	
Bit Speed (No Load)	216-433 rpm
Flow Range	20-40 gpm
Max Operating Pressure	600 psi
Max Power	11 hp
Max Torque	131 ft-lbs

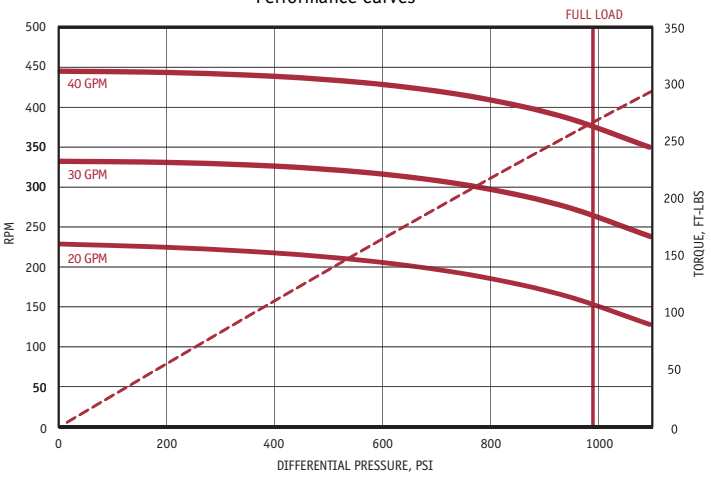
Performance Curves



SuperHawk High Pull 1 11/16 in O.D.
5:6 Lobes, 4.4 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	N/A
Nominal Length	123.7 in.
Weight	62 lbs
Performance Data	
Bit Speed (No Load)	277-500 rpm
Flow Range	20-40 gpm
Max Operating Pressure	675 psi
Max Power	8.0 hp
Max Torque	145 ft-lbs

Performance Curves



SuperHawk High Pull SH21
2 1/8 in O.D.

General Data

Bit Sizes	2 5/8 - 3 1/4 in
Std Bit Connection (1)	1 1/2 in MT
Std Top Connection (1)	1 1/2 in MT
Make-Up Torques	See 4-22
Max WOB (operating)	9,700 lbs
Max WOB (continuous) (2)	4,850 lbs
Max Bit Pull (3)	39,000 lbs
Max Body Pull (3)	90,000 lbs

(1) Other connections available upon request.

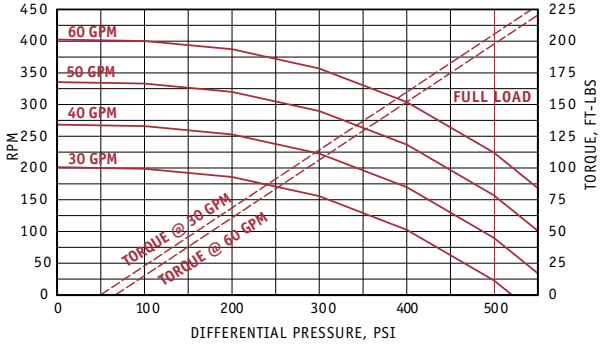
(2) Optimum motor life.

(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk High Pull 2 1/8 in O.D.
5:6 Lobes, 2.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	N/A
Nominal Length	105 in.
Weight	74 lbs
Performance Data	
Bit Speed (No Load)	201-403 rpm
Flow Range	30-60 gpm
Max Operating Pressure	500 psi
Max Power	8.4 hp
Max Torque	206 ft-lbs

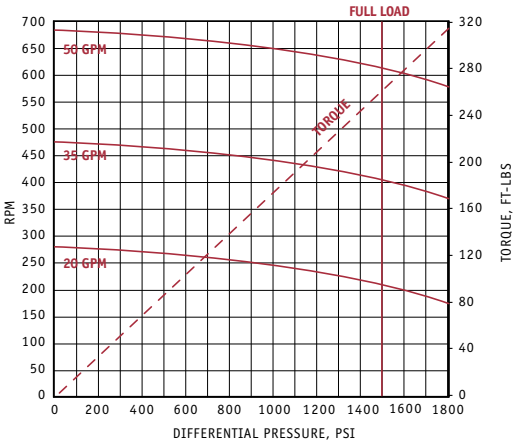
Performance Curves



SuperHawk High Pull 2 1/8 in O.D.
5:6 Lobes, 6.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	N/A
Nominal Length	137 in.
Weight	93 lbs
Performance Data	
Bit Speed (No Load)	270-680 rpm
Flow Range	20-50 gpm
Max Operating Pressure	1500 psi
Max Power	33 hp
Max Torque	256 ft-lbs

Performance Curves



SuperHawk High Pull SH23
2 3/8 in O.D.

General Data

Bit Sizes	2 7/8 - 3 1/2 in
Std Bit Connection (1)	1 1/2 in MT
Std Top Connection (1)	1 1/2 in MT
Make-Up Torques	See 4-22
Max WOB (operating)	9,900 lbs
Max WOB (continuous) (2)	4,950 lbs
Max Bit Pull (3)	45,000 lbs
Max Body Pull (3)	105,000 lbs

(1) Other connections available upon request.

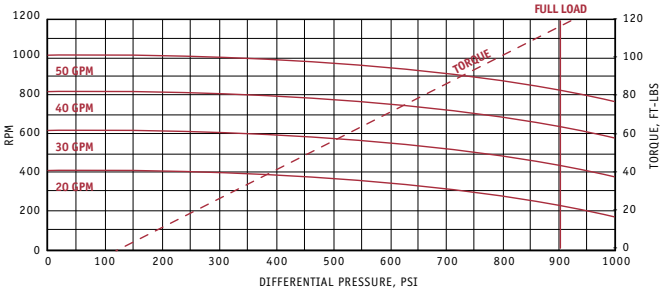
(2) Optimum motor life.

(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk High Pull 2 1/8 in O.D.
4:5 Lobes, 4.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.38 in
Bit to Bend Length (Fixed)	22.38 in
Nominal Length	118 in
Weight	107 lbs
Performance Data	
Bit Speed (No Load)	400-1000 rpm
Flow Range	20-50 gpm
Max Operating Pressure	900 psi
Max Power	20 hp
Max Torque	118 ft-lbs

Performance Curves

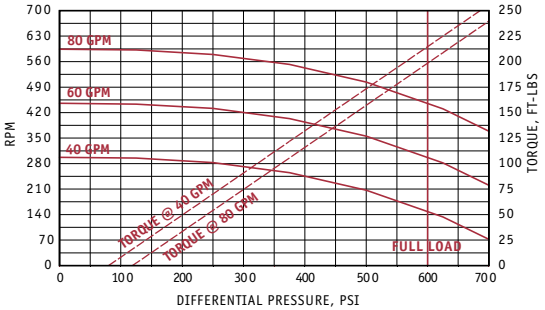


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle (Deg.)	Hole Size (in.) - Slick			
	2.875	3.130	3.250	3.500
0.25	7.3	5.8	5.1	3.7
0.50	11.0	9.6	8.9	7.3
0.75	14.8	13.3	12.6	11.2
1.00	18.5	17.1	16.4	14.9
1.25	22.3	20.8	20.1	18.7
1.50	26.0	24.5	23.9	22.4
1.75	29.7	28.3	27.6	26.2
2.00	33.5	32.0	31.4	29.9
2.25	37.2	35.8	35.1	33.7
2.50	41.0	39.5	38.8	37.4
2.75	44.7	43.3	42.6	41.2
3.00	48.5	47.0	46.3	44.9

SuperHawk High Pull 2 3/8 in O.D.
5:6 Lobes, 4.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.38 in
Bit to Bend Length (Fixed)	22.38 in
Nominal Length	135 in
Weight	127 lbs
Performance Data	
Bit Speed (No Load)	300-595 rpm
Flow Range	40-80 gpm
Max Operating Pressure	600 psi
Max Power	16.5 hp
Max Torque	180 ft-lbs

Performance Curves

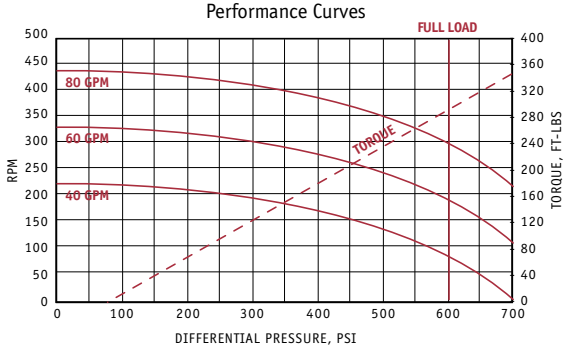


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	2.875	3.130	3.250	3.500
0.25	6.2	4.6	3.9	2.3
0.50	9.5	7.9	7.2	5.2
0.75	12.8	11.2	10.5	8.9
1.00	16.1	14.5	13.8	12.2
1.25	19.4	17.8	17.1	15.6
1.50	22.7	21.2	20.4	18.9
1.75	26.0	24.5	23.7	22.2
2.00	29.4	27.8	27.0	25.5
2.25	32.7	31.1	30.3	28.8
2.50	36.0	34.4	33.6	32.1
2.75	39.3	37.7	37.0	35.4
3.00	42.6	41.0	40.3	38.7

SuperHawk High Pull 2 3/8 in O.D.
7:8 Lobes, 4.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.38 in
Bit to Bend Length (Fixed)	22.38 in
Nominal Length	131 in
Weight	134 lbs
Performance Data	
Bit Speed (No Load)	216-432 rpm
Flow Range	40-80 gpm
Max Operating Pressure	600 psi
Max Power	20.2 hp
Max Torque	294 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	2.875	3.130	3.250	3.500
0.25	6.4	4.9	4.1	2.6
0.50	9.8	8.3	7.5	6.1
0.75	13.2	11.7	10.9	9.4
1.00	16.6	15.1	14.3	12.8
1.25	20.0	18.5	17.7	16.2
1.50	23.4	21.9	21.1	19.6
1.75	26.8	25.3	24.5	23.0
2.00	30.2	28.7	27.9	26.4
2.25	33.6	32.1	31.3	29.8
2.50	37.0	35.5	34.7	33.2
2.75	40.4	38.9	38.1	36.6
3.00	43.8	42.3	41.5	40.0

SuperHawk High Pull SH28
2 7/8 in O.D.

General Data

Bit Sizes	3 1/2 - 4 3/4 in
Std Bit Connection (1)	2 3/8 Reg
Std Top Connection (1)	2 3/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	10,400 lbs
Max WOB (continuous) (2)	5,200 lbs
Max Bit Pull (3)	70,000 lbs
Max Body Pull (3)	165,000 lbs

(1) Other connections available upon request.

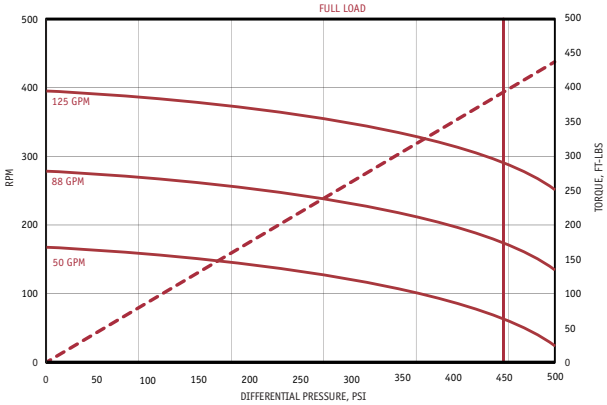
(2) Optimum motor life.

(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk High Pull 2 7/8 in O.D.
5:6 Lobes, 2.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.75 in
Nominal Length	164 in
Weight	152 lbs
Performance Data	
Bit Speed (No Load)	180-440 rpm
Flow Range	50-125 gpm
Max Operating Pressure	300 psi
Max Power	33.0 hp
Max Torque	260 ft-lbs

Performance Curves

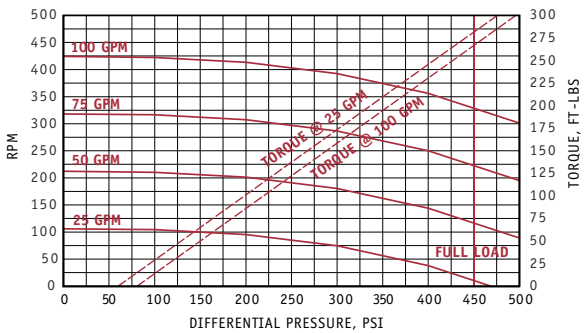


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	3.500	3.875	4.250	4.750
0.25	4.2	2.5	0.9	
0.50	7.0	5.3	3.6	
0.75	9.7	8.0	6.4	4.2
1.00	12.5	10.8	9.1	6.9
1.25	15.2	13.5	11.9	9.7
1.50	18.0	16.3	14.6	12.4
1.75	20.7	19.0	17.4	15.2
2.00	23.5	21.8	20.1	17.9
2.25	26.2	24.5	22.9	20.7
2.50	29.0	27.3	25.6	23.4
2.75	31.7	30.0	28.4	26.2

SuperHawk High Pull 2 7/8 in O.D.
5:6 Lobes, 3.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.25 in
Nominal Length	135.38 in
Weight	107 lbs
Performance Data	
Bit Speed (No Load)	105-424 rpm
Flow Range	25-100 gpm
Max Operating Pressure	450 psi
Max Power	17.0 hp
Max Torque	281 ft-lbs

Performance Curves

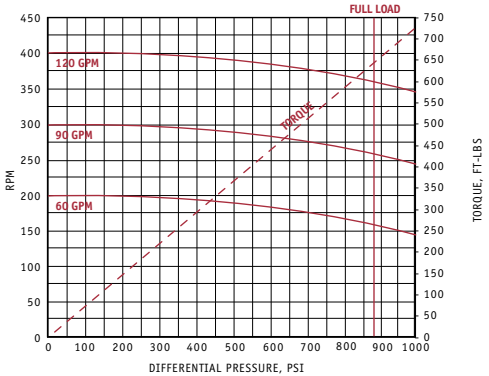


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	3.500	3.875	4.250	4.750
0.25	5.5	4.0	2.6	0.7
0.50	8.8	7.3	5.9	3.3
0.75	12.1	10.6	9.2	7.2
1.00	15.3	13.9	12.4	10.5
1.25	18.6	17.2	15.7	13.8
1.50	21.9	20.5	19.0	17.1
1.75	25.2	23.8	22.3	20.4
2.00	28.5	27.0	25.6	23.7
2.25	31.8	30.3	28.9	26.9
2.50	35.1	33.6	32.2	30.2
2.75	38.4	36.9	35.5	33.5
3.00	41.6	40.2	38.7	36.8

SuperHawk High Pull 2 7/8 in O.D.
5:6 Lobes, 3.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.25 in
Nominal Length	157.25 in
Weight	205 lbs
Performance Data	
Bit Speed (No Load)	200-400 rpm
Flow Range	60-120 gpm
Max Operating Pressure	875 psi
Max Power	49 hp
Max Torque	637 ft-lbs

Performance Curves

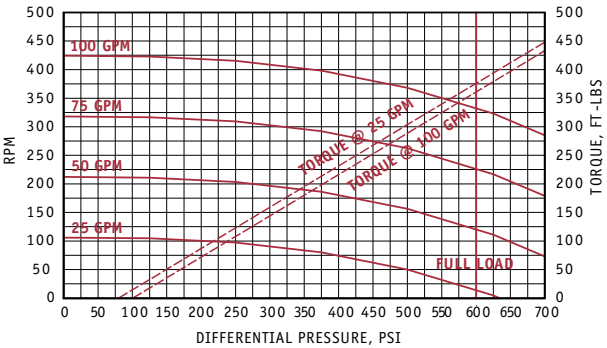


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle (Deg.)	Hole Size (in.) - Slick			
	3.500	3.875	4.250	4.750
0.25	4.5	2.8	1.2	
0.50	7.3	5.7	4.0	
0.75	10.2	8.5	6.9	4.7
1.00	13.0	11.4	9.8	7.6
1.25	15.9	14.3	12.6	10.4
1.50	18.8	17.1	15.5	13.3
1.75	21.6	20.0	18.3	16.2
2.00	24.5	22.8	21.2	19.0
2.25	27.3	25.7	24.1	21.9
2.50	30.2	28.6	26.9	24.7
2.75	33.1	31.4	29.8	27.6
3.00	35.9	34.3	32.6	30.4

SuperHawk High Pull 2 7/8 in O.D.
5:6 Lobes, 4.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.25 in
Nominal Length	154.38 in
Weight	195 lbs
Performance Data	
Bit Speed (No Load)	105-424 rpm
Flow Range	25-100 gpm
Max Operating Pressure	600 psi
Max Power	23.0 hp
Max Torque	375 ft-lbs

Performance Curves

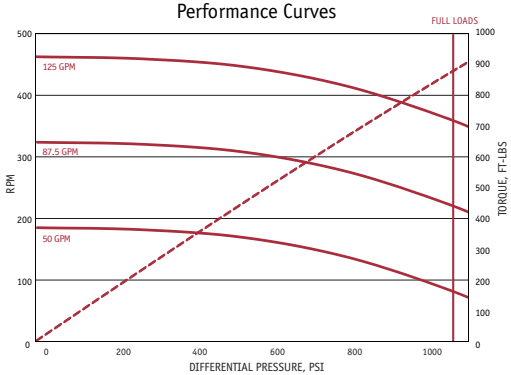


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	3.500	3.875	4.250	4.750
0.25	4.6	2.9	1.3	
0.50	7.5	5.9	4.2	
0.75	10.4	8.8	7.1	5.0
1.00	13.3	11.7	10.0	7.9
1.25	16.2	14.6	13.0	10.8
1.50	19.1	17.5	15.9	13.7
1.75	22.0	20.4	18.8	16.6
2.00	24.9	23.3	21.7	19.5
2.25	27.9	26.2	24.6	22.4
2.50	30.8	29.1	27.5	25.3
2.75	33.7	32.0	30.4	28.2
3.00	36.6	35.0	33.3	31.2

SuperHawk High Pull 2 7/8 in O.D.
5:6 Lobes, 4.7 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.75 in
Nominal Length	164 in
Weight	220 lbs
Performance Data	
Bit Speed (No Load)	190-460 rpm
Flow Range	50-125 gpm
Max Operating Pressure	1,060 psi
Max Power	103 hp
Max Torque	880 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	3.500	3.875	4.250	4.750
0.25	4.2	2.5	0.9	
0.50	7.0	5.3	3.6	
0.75	9.7	8.0	6.4	4.2
1.00	12.5	10.8	9.1	6.9
1.25	15.2	13.5	11.9	9.7
1.50	18.0	16.3	14.6	12.4
1.75	20.7	19.0	17.4	15.2
2.00	23.5	21.8	20.1	17.9
2.25	26.2	24.5	22.9	20.7
2.50	29.0	27.3	25.6	23.4
2.75	31.7	30.0	28.4	26.2
3.00	34.5	32.8	31.1	28.9

SuperHawk High Pull SH11
3 1/8 in O.D.

General Data

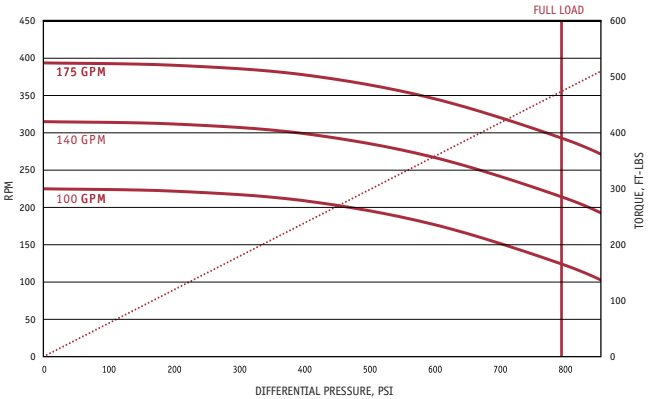
Bit Sizes	3 3/4 - 5 in
Std Bit Connection (1)	2 3/8 Reg
Std Top Connection (1)	2 3/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	11,300 lbs
Max WOB (continuous) (2)	5,650 lbs
Max Bit Pull (3)	75,000 lbs
Max Body Pull (3)	180,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk High Pull 3 1/8 in O.D.
5:6 Lobes, 3.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.75 in
Nominal Length	154 in
Weight	265 lbs
Performance Data	
Bit Speed (No Load)	230-390 rpm
Flow Range	100-175 gpm
Max Operating Pressure	790 psi
Max Power	107 hp
Max Torque	1,070 ft-lbs

Performance Curves

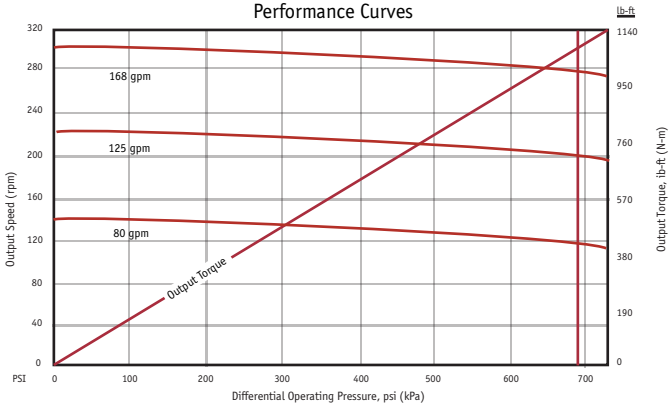


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	3.750	4.250	4.500	5.000
0.25	4.6	2.4	1.3	
0.50	7.5	5.3	4.2	
0.75	10.5	8.3	7.2	5.0
1.00	13.4	11.2	10.1	7.9
1.25	16.3	14.1	13.0	10.8
1.50	19.2	17.0	16.0	13.8
1.75	22.2	20.0	18.9	16.7
2.00	25.1	22.9	21.8	19.6
2.25	28.0	25.8	24.7	22.5
2.50	31.0	28.8	27.7	25.5
2.75	33.9	31.7	30.6	28.4
3.00	36.8	34.6	33.5	31.3

SuperHawk High Pull 3 1/8 in O.D.
7:8 Lobes, 3.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	31.25 in
Bit to Bend Length (Fixed)	27.75 in
Nominal Length	172 in
Weight	275 lbs
Performance Data	
Bit Speed (No Load)	144-303 rpm
Flow Range	80 -168 gpm
Max Operating Pressure	690 psi
Max Power	53.0 hp
Max Torque	990 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)				
Angle	Hole Size (in.) - Slick			
(Deg.)	3.750	4.250	4.500	5.000
0.25	4.0	1.7	0.6	
0.50	6.6	4.3	3.2	
0.75	9.2	7.0	5.8	3.6
1.00	11.9	9.6	8.5	6.2
1.25	14.5	12.2	11.1	8.8
1.50	17.2	14.9	13.8	11.5
1.75	19.8	17.5	16.4	14.1
2.00	22.4	20.2	19.0	16.8
2.25	25.1	22.8	21.7	19.4
2.50	27.7	25.4	24.3	22.0
2.75	30.4	28.1	26.9	24.7
3.00	33.0	30.7	29.6	27.3

SuperHawk SH35
3 1/2 in O.D.

General Data

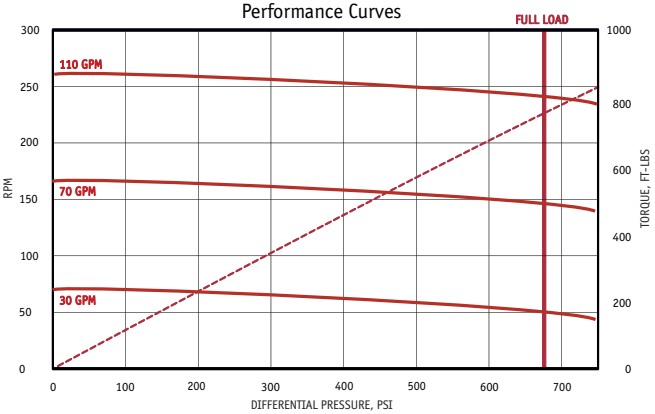
Bit Sizes	4 3/4 - 5 7/8 in
Std Bit Connection (1)	2 7/8 Reg
Std Top Connection (1)	2 7/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	16,000 lbs
Max WOB (continuous) (2)	8,000 lbs
Max Bit Pull (3)	150,000 lbs
Max Body Pull (3)	238,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 3 1/2 in O.D.
5:6 Lobes, 3.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	145.1 in
Weight	385 lbs
Performance Data	
Bit Speed (No Load)	71-270 rpm
Flow Range	30-110 gpm
Max Operating Pressure	680 psi
Max Power	36 hp
Max Torque	750 ft-lbs

Performance Curves

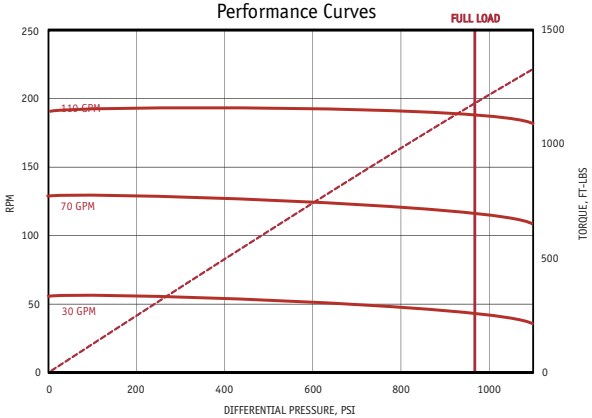


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	4.9	4.8	4.6	4.4	4.6	5.5	7.2	8.5
0.50	7.9	7.8	7.6	7.1	7.8	8.6	10.4	11.7
0.75	10.9	10.8	10.6	10.5	10.9	11.8	13.5	14.8
1.00	14.0	13.9	13.7	13.5	14.1	14.9	16.7	18.0
1.25	17.0	16.9	16.7	16.5	17.2	18.1	19.8	21.1
1.50	20.1	20.0	19.7	19.6	20.4	21.3	23.0	24.3
1.75	23.1	23.0	22.8	22.6	23.5	24.4	26.1	27.4
2.00	26.1	26.0	25.8	25.7	26.7	27.6	29.3	30.6
2.25	29.2	29.1	28.9	28.7	29.9	30.7	32.5	33.8
2.50	32.2	32.1	31.9	31.7	33.0	33.9	35.6	36.9
2.75	35.3	35.1	34.9	34.8	36.2	37.0	38.8	40.1
3.00	38.3	38.2	38.0	37.8	39.3	40.2	41.9	43.2

SuperHawk 3 1/2 in O.D.
7:8 Lobes, 4.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	199.1 in
Weight	474 lbs
Performance Data	
Bit Speed (No Load)	55-210 rpm
Flow Range	30-110 gpm
Max Operating Pressure	970 psi
Max Power	52 hp
Max Torque	1380 ft-lbs

Performance Curves

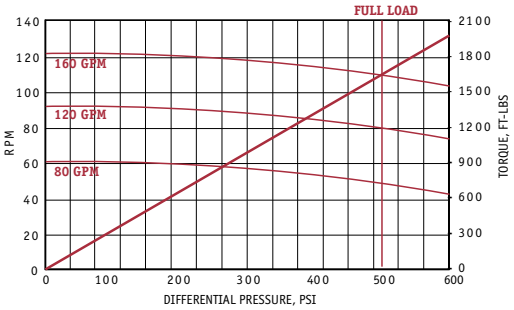


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	2.1	1.6	0.6		2.7	3.2	4.1	4.8
0.50	4.3	3.8	2.8		5.2	5.7	6.6	7.3
0.75	6.6	6.1	5.1	4.4	7.7	8.2	9.1	9.8
1.00	8.9	8.4	7.4	6.6	10.2	10.7	11.6	12.3
1.25	11.1	10.6	9.6	8.9	12.7	13.2	14.1	14.8
1.50	13.4	12.9	11.9	11.2	15.2	15.7	16.6	17.2
1.75	15.7	15.2	14.2	13.4	17.7	18.2	19.1	19.7
2.00	17.9	17.4	16.4	15.7	20.2	20.7	21.6	22.2
2.25	20.2	19.7	18.7	18.0	22.7	23.2	24.1	24.7
2.50	22.5	22.0	21.0	20.2	25.2	25.7	26.6	27.2
2.75	24.7	24.2	23.2	22.5	27.7	28.2	29.1	29.7
3.00	27.0	26.5	25.5	24.8	30.2	30.7	31.6	32.2

SuperHawk 3 1/2 in O.D.
7:8 Lobes, 2.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	217.5
Weight	444 lbs
Performance Data	
Bit Speed (No Load)	31-130 rpm
Flow Range	80-160 gpm
Max Operating Pressure	520 psi
Max Power	37 hp
Max Torque	1670 ft-lbs

Performance Curves

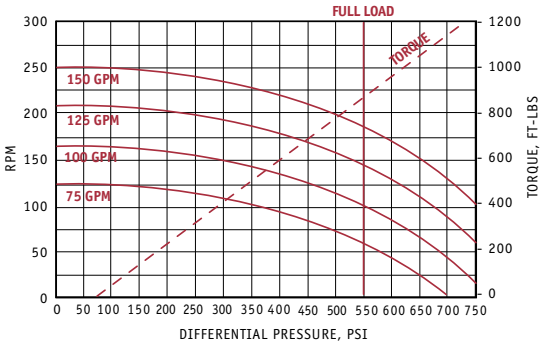


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	1.6	1.1	0.0		2.4	2.8	3.5	4.1
0.50	3.7	3.2	2.1	1.1	4.7	5.1	5.8	6.4
0.75	5.8	5.3	4.2	3.4	7.0	7.4	8.2	8.7
1.00	7.9	7.4	6.3	5.5	9.4	9.7	10.5	11.1
1.25	10.0	9.5	8.4	7.6	11.7	12.1	12.8	13.4
1.50	12.1	11.6	10.5	9.7	14.0	14.4	15.1	15.7
1.75	14.2	13.7	12.6	11.8	16.3	16.7	17.5	18.0
2.00	16.3	15.8	14.7	13.9	18.7	19.0	19.8	20.4
2.25	18.4	17.9	16.8	16.0	21.0	21.4	22.1	22.7
2.50	20.5	20.0	18.9	18.1	23.3	23.7	24.5	25.0
2.75	22.6	22.0	21.0	20.2	25.7	26.0	26.8	27.4
3.00	24.7	24.1	23.1	22.3	28.0	28.4	29.1	29.7

SuperHawk 3 1/2 in O.D.
7:8 Lobes, 3.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	210.25 in
Weight	432 lbs
Performance Data	
Bit Speed (No Load)	124-248 rpm
Flow Range	75-150 gpm
Max Operating Pressure	570 psi
Max Power	28.3 hp
Max Torque	915 ft-lbs

Performance Curves

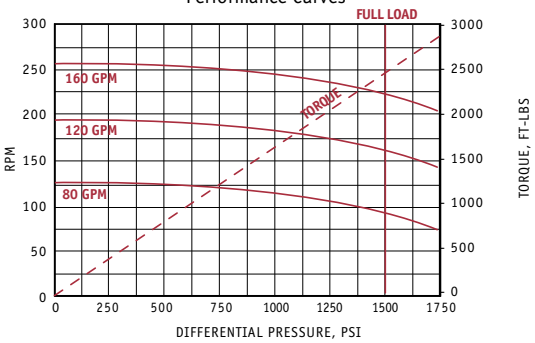


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	1.8	1.3	0.3		2.5	2.9	3.7	4.3
0.50	3.9	3.4	2.4	1.2	4.9	5.3	6.1	6.7
0.75	6.0	5.5	4.5	3.8	7.3	7.7	8.5	9.1
1.00	8.2	7.7	6.7	5.9	9.7	10.1	10.9	11.5
1.25	10.3	9.8	8.8	8.0	12.1	12.5	13.3	13.9
1.50	12.4	11.9	10.9	10.2	14.5	14.9	15.7	16.3
1.75	14.5	14.0	13.0	12.3	16.9	17.3	18.1	18.7
2.00	16.6	16.1	15.2	14.4	19.2	19.6	20.5	21.1
2.25	18.8	18.3	17.3	16.5	21.6	22.0	22.8	23.5
2.50	20.9	20.4	19.4	18.7	24.0	24.4	25.2	25.8
2.75	23.0	22.5	21.5	20.8	26.4	26.8	27.6	28.2
3.00	25.1	24.6	23.6	22.9	28.8	29.2	30.0	30.6

SuperHawk 3 1/2 in O.D.
7:8 Lobes, 6.7 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	256.50 in
Weight	520 lbs
Performance Data	
Bit Speed (No Load)	159-260 rpm
Flow Range	80-160 gpm
Max Operating Pressure	1510 psi
Max Power	114 hp
Max Torque	2460 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	1.0	0.5			1.8	2.1	2.6	3.0
0.50	2.8	2.2	1.2	0.2	3.9	4.1	4.7	5.1
0.75	4.5	4.0	2.9	2.1	5.9	6.2	6.7	7.1
1.00	6.3	5.8	4.7	3.9	7.9	8.2	8.7	9.1
1.25	8.1	7.5	6.5	5.6	10.0	10.2	10.8	11.2
1.50	9.8	9.3	8.2	7.4	12.0	12.2	12.8	13.2
1.75	11.6	11.0	10.0	9.2	14.0	14.3	14.8	15.2
2.00	13.3	12.8	11.7	10.9	16.0	16.3	16.8	17.3
2.25	15.1	14.6	13.5	12.7	18.1	18.3	18.9	19.3
2.50	16.9	16.3	15.3	14.5	20.1	20.4	20.9	21.3
2.75	18.6	18.1	17.0	16.2	22.1	22.4	22.9	23.3
3.00	20.4	19.9	18.8	18.0	24.2	24.4	25.0	25.4

SuperHawk SH37
3 3/4 in O.D.

General Data

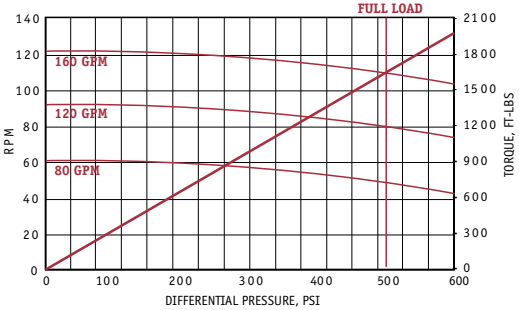
Bit Sizes	4 3/4 - 5 7/8 in
Std Bit Connection (1)	2 7/8 Reg
Std Top Connection (1)	2 7/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	16,000 lbs
Max WOB (continuous) (2)	8,000 lbs
Max Bit Pull (3)	150,000 lbs
Max Body Pull (3)	318,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 3 3/4 in O.D.
7:8 Lobes, 2.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	217.5 in
Weight	490 lbs
Performance Data	
Bit Speed (No Load)	31-130 rpm
Flow Range	80-160 gpm
Max Operating Pressure	520 psi
Max Power	37 hp
Max Torque	1670 ft-lbs

Performance Curves

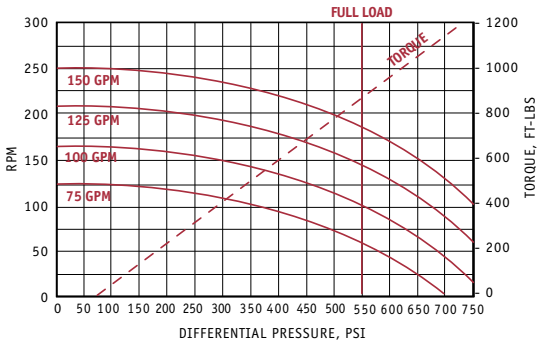


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	2.1	1.6	0.6		2.0	2.4	3.1	3.7
0.50	4.2	3.7	2.7	2.1	4.3	4.7	5.5	6.0
0.75	6.2	5.7	4.7	4.0	6.7	7.0	7.8	8.3
1.00	8.3	7.8	6.8	6.0	9.0	9.4	10.1	10.7
1.25	10.4	9.9	8.8	8.1	11.3	11.7	12.4	13.0
1.50	12.4	11.9	10.9	10.1	13.6	14.0	14.8	15.3
1.75	14.5	14.0	12.9	12.2	16.0	16.3	17.1	17.7
2.00	16.5	16.0	15.0	14.2	18.3	18.7	19.4	20.0
2.25	18.6	18.1	17.1	16.3	20.6	21.0	21.8	22.3
2.50	20.6	20.1	19.1	18.4	23.0	23.3	24.1	24.6
2.75	22.7	22.2	21.2	20.4	25.3	25.7	26.4	27.0
3.00	24.8	24.2	23.2	22.5	27.6	28.0	28.7	29.3

SuperHawk 3 3/4 in O.D.
7:8 Lobes, 3.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	210.25 in
Weight	460 lbs
Performance Data	
Bit Speed (No Load)	124-248 rpm
Flow Range	75-150 gpm
Max Operating Pressure	570 psi
Max Power	28.3 hp
Max Torque	915 ft-lbs

Performance Curves

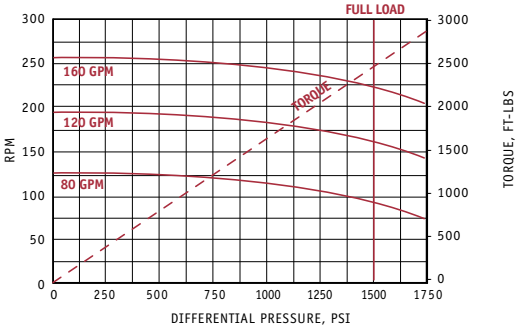


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	2.3	1.8	0.8	0.0	2.1	2.5	3.3	3.9
0.50	4.4	3.9	2.9	2.4	4.5	4.9	5.7	6.3
0.75	6.5	6.0	5.0	4.3	6.9	7.3	8.1	8.7
1.00	8.6	8.2	7.2	6.4	9.3	9.7	10.5	11.1
1.25	10.8	10.3	9.3	8.5	11.7	12.1	12.9	13.5
1.50	12.9	12.4	11.4	10.7	14.1	14.5	15.3	15.9
1.75	15.0	14.5	13.5	12.8	16.5	16.9	17.7	18.3
2.00	17.1	16.6	15.6	14.9	18.8	19.2	20.1	20.7
2.25	19.3	18.8	17.8	17.0	21.2	21.6	22.4	23.1
2.50	21.4	20.9	19.9	19.1	23.6	24.0	24.8	25.4
2.75	23.5	23.0	22.0	21.3	26.0	26.4	27.2	27.8
3.00	25.6	25.1	24.1	23.4	28.4	28.8	29.6	30.2

SuperHawk 3 3/4 in O.D.
7:8 Lobes, 6.7 Stages HR

Physical Data	
Bit to Bend Length (ABH)	50.50 in
Bit to Bend Length (Fixed)	40.50 in
Nominal Length	256.50 in
Weight	580 lbs
Performance Data	
Bit Speed (No Load)	159-260 rpm
Flow Range	80-160 gpm
Max Operating Pressure	1510 psi
Max Power	114 hp
Max Torque	2460 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	4.750	5.000	5.500	5.875	4.750	5.000	5.500	5.875
0.25	1.5	1.0			1.6	1.8	2.4	2.8
0.50	3.3	2.8	1.7		3.6	3.9	4.4	4.8
0.75	5.1	4.5	3.5	2.7	5.6	5.9	6.4	6.8
1.00	6.8	6.3	5.2	4.4	7.7	7.9	8.5	8.9
1.25	8.6	8.1	7.0	6.2	9.7	10.0	10.5	10.9
1.50	10.4	9.8	8.7	7.9	11.7	12.0	12.5	12.9
1.75	12.1	11.6	10.5	9.7	13.7	14.0	14.5	15.0
2.00	13.9	13.3	12.3	11.5	15.8	16.0	16.6	17.0
2.25	15.6	15.1	14.0	13.2	17.8	18.1	18.6	19.0
2.50	17.4	16.9	15.8	15.0	19.8	20.1	20.6	21.0
2.75	19.2	18.6	17.6	16.8	21.9	22.1	22.7	23.1
3.00	20.9	20.4	19.3	18.5	23.9	24.2	24.7	25.1

SuperHawk SH47
4 3/4 in O.D.

General Data

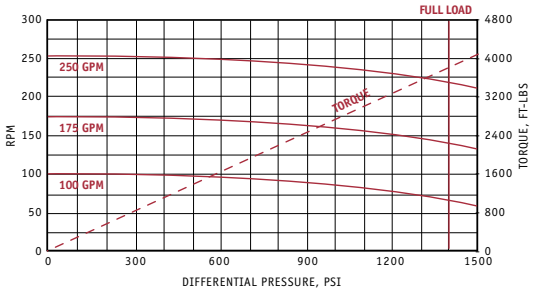
Bit Sizes	6 - 7 7/8 in
Std Bit Connection (1)	3 1/2 Reg
Std Top Connection (1)	3 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	38,500 lbs
Max WOB (continuous) (2)	19,250 lbs
Max Bit Pull (3)	190,000 lbs
Max Body Pull (3)	403,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 4 3/4 in O.D.
4:5 Lobes, 6.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	63.00 in
Bit to Bend Length (Fixed)	52.69 in
Nominal Length	319 in
Weight	1175 lbs
Performance Data	
Bit Speed (No Load)	102-260 rpm
Flow Range	100-250 gpm
Max Operating Pressure	1420 psi
Max Power	177 hp
Max Torque	3870 ft-lbs

Performance Curves

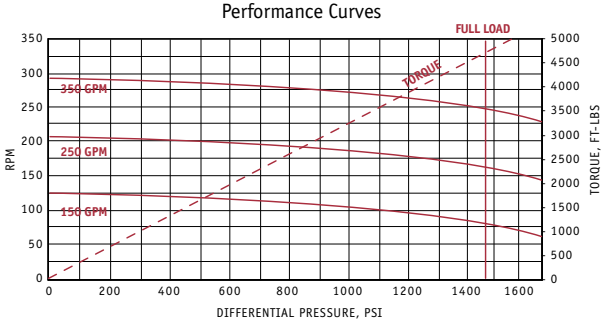


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.0	0.8	0.0		1.5	1.6	2.0	2.8
0.50	2.4	2.3	1.4		3.1	3.2	3.6	4.4
0.75	3.8	3.7	2.9	1.4	4.7	4.8	5.2	6.0
1.00	5.3	5.1	4.3	2.8	6.3	6.4	6.8	7.6
1.25	6.7	6.5	5.7	4.3	7.9	8.0	8.4	9.2
1.50	8.1	7.9	7.1	5.7	9.5	9.6	10.1	10.8
1.75	9.5	9.4	8.6	7.1	11.1	11.2	11.7	12.4
2.00	11.0	10.8	10.0	8.5	12.8	12.8	13.3	14.1
2.25	12.4	12.2	11.4	9.9	14.4	14.5	14.9	15.7
2.50	13.8	13.6	12.8	11.4	16.0	16.1	16.5	17.3
2.75	15.2	15.1	14.2	12.8	17.6	17.7	18.1	18.9
3.00	16.6	16.5	15.7	14.2	19.2	19.3	19.7	20.5

SuperHawk 4 3/4 in O.D.
5:6 Lobes, 6.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	63.00 in
Bit to Bend Length (Fixed)	52.69 in
Nominal Length	289 in
Weight	1150 lbs
Performance Data	
Bit Speed (No Load)	127-296 rpm
Flow Range	150-350 gpm
Max Operating Pressure	1500 psi
Max Power	220 hp
Max Torque	4596 ft-lbs

Performance Curves

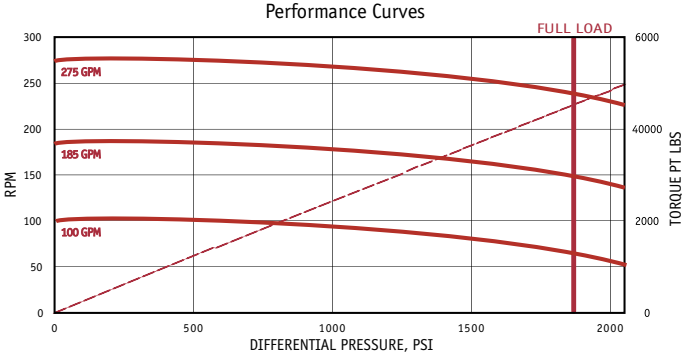


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.3	1.1	0.3		1.7	1.8	2.3	3.3
0.50	2.8	2.7	1.9		3.4	3.5	4.1	5.0
0.75	4.4	4.2	3.4	2.0	5.2	5.3	5.8	6.8
1.00	5.9	5.8	5.0	3.6	6.9	7.0	7.6	8.5
1.25	7.5	7.3	6.6	5.1	8.7	8.8	9.3	10.3
1.50	9.1	8.9	8.1	6.7	10.4	10.5	11.1	12.0
1.75	10.6	10.5	9.7	8.3	12.2	12.3	12.8	13.8
2.00	12.2	12.0	11.2	9.8	13.9	14.0	14.6	15.5
2.25	13.7	13.6	12.8	11.4	15.7	15.8	16.3	17.3
2.50	15.3	15.1	14.4	12.9	17.4	17.5	18.1	19.0
2.75	16.9	16.7	15.9	14.5	19.2	19.3	19.8	20.8
3.00	18.4	18.3	17.5	16.1	20.9	21.0	21.6	22.5

SuperHawk 4 3/4 in O.D.
5:6 Lobes, 8.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	63.00 in
Bit to Bend Length (Fixed)	52.69 in
Nominal Length	335 in
Weight	1,210 lbs
Performance Data	
Bit Speed (No Load)	100-280 rpm
Flow Range	100-275 gpm
Max Operating Pressure	1,870 psi
Max Power	239 hp
Max Torque	4,810 ft-lbs

Performance Curves

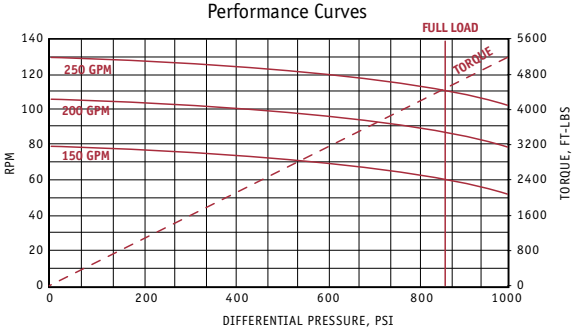


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	0.9	0.7			1.4	1.4	1.8	2.5
0.50	2.2	2.1	1.3		2.9	3.0	3.4	4.1
0.75	3.6	3.4	2.6	1.2	4.5	4.5	4.9	5.6
1.00	5.0	4.8	4.0	2.5	6.0	6.1	6.5	7.2
1.25	6.3	6.2	5.3	3.9	7.6	7.6	8.0	8.7
1.50	7.7	7.5	6.7	5.2	9.1	9.2	9.6	10.3
1.75	9.0	8.9	8.1	6.6	10.7	10.7	11.1	11.8
2.00	10.4	10.2	9.4	8.0	12.2	12.3	12.7	13.4
2.25	11.8	11.6	10.8	9.3	13.8	13.8	14.2	14.9
2.50	13.1	12.9	12.1	10.7	15.3	15.4	15.8	16.5
2.75	14.5	14.3	13.5	12.0	16.9	16.9	17.3	18.0
3.00	15.8	15.7	14.8	13.4	18.4	18.5	18.9	19.6

SuperHawk 4 3/4 in O.D.
7:8 Lobes, 3.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	63.00 in
Bit to Bend Length (Fixed)	52.69 in
Nominal Length	289 in
Weight	1150 lbs
Performance Data	
Bit Speed (No Load)	80-140 rpm
Flow Range	150-250 gpm
Max Operating Pressure	860 psi
Max Power	104 hp
Max Torque	4450 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.3	1.1	0.3		1.7	1.8	2.3	3.3
0.50	2.8	2.7	1.9		3.4	3.5	4.1	5.0
0.75	4.4	4.2	3.4	2.0	5.2	5.3	5.8	6.8
1.00	5.9	5.8	5.0	3.6	6.9	7.0	7.6	8.5
1.25	7.5	7.3	6.6	5.1	8.7	8.8	9.3	10.3
1.50	9.1	8.9	8.1	6.7	10.4	10.5	11.1	12.0
1.75	10.6	10.5	9.7	8.3	12.2	12.3	12.8	13.8
2.00	12.2	12.0	11.2	9.8	13.9	14.0	14.6	15.5
2.25	13.7	13.6	12.8	11.4	15.7	15.8	16.3	17.3
2.50	15.3	15.1	14.4	12.9	17.4	17.5	18.1	19.0
2.75	16.9	16.7	15.9	14.5	19.2	19.3	19.8	20.8
3.00	18.4	18.3	17.5	16.1	20.9	21.0	21.6	22.5

SuperHawk SH50
5 in O.D.

General Data

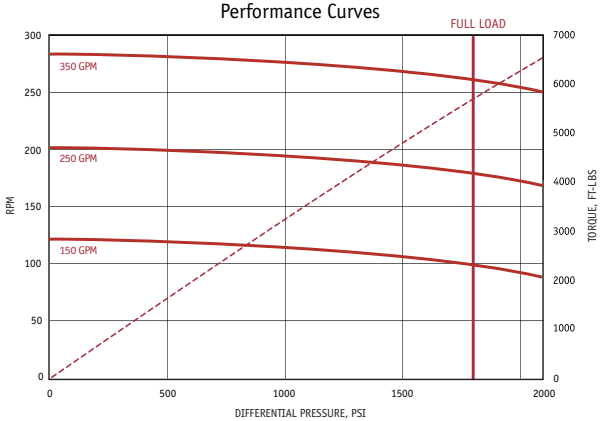
Bit Sizes	6 - 7 7/8 in
Std Bit Connection (1)	3 1/2 Reg
Std Top Connection (1)	3 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	40,500 lbs
Max WOB (continuous) (2)	20,250 lbs
Max Bit Pull (3)	200,000 lbs
Max Body Pull (3)	425,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 5 in O.D.
6:7 Lobes, 8.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	63.38 in
Bit to Bend Length (Fixed)	51.13 in
Nominal Length	339 in
Weight	1,310 lbs
Performance Data	
Bit Speed (No Load)	121-290 rpm
Flow Range	150-350 gpm
Max Operating Pressure	1,200 psi
Max Power	206 hp
Max Torque	3,810 ft-lbs

Performance Curves

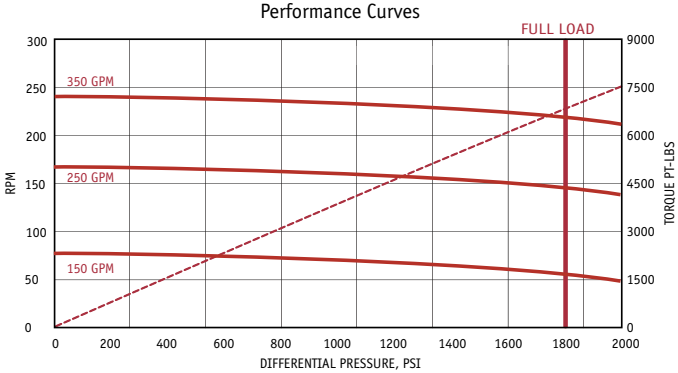


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.2	1.0	0.1		1.1	1.2	1.6	2.3
0.50	2.5	2.3	1.5		2.7	2.8	3.1	3.8
0.75	3.8	3.7	2.8	1.3	4.2	4.3	4.7	5.4
1.00	5.2	5.0	4.2	2.6	5.8	5.8	6.2	6.9
1.25	6.5	6.4	5.5	4.0	7.3	7.4	7.8	8.4
1.50	7.9	7.7	6.9	5.3	8.8	8.9	9.3	10.0
1.75	9.2	9.0	8.2	6.7	10.4	10.4	10.8	11.5
2.00	10.6	10.4	9.5	8.0	11.9	12.0	12.4	13.0
2.25	11.9	11.7	10.9	9.3	13.4	13.5	13.9	14.6
2.50	13.2	13.1	12.2	10.7	15.0	15.0	15.4	16.1
2.75	14.6	14.4	13.6	12.0	16.5	16.6	17.0	17.7
3.00	15.9	15.7	14.9	13.4	18.0	18.1	18.5	19.2

SuperHawk 5 in O.D.
7:8 Lobes, 8.2 Stages HR

Physical Data	
Bit to Bend Length (ABH)	63.38 in
Bit to Bend Length (Fixed)	51.13 in
Nominal Length	343 in
Weight	1,328 lbs
Performance Data	
Bit Speed (No Load)	105-250 rpm
Flow Range	150-350 gpm
Max Operating Pressure	1,850 psi
Max Power	299 hp
Max Torque	6,700 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.1	1.0	0.1		1.1	1.2	1.6	2.3
0.50	2.5	2.3	1.4		2.7	2.7	3.1	3.8
0.75	3.8	3.6	2.8	1.2	4.2	4.2	4.6	5.3
1.00	5.1	5.0	4.1	2.6	5.7	5.8	6.1	6.8
1.25	6.4	6.3	5.4	3.9	7.2	7.3	7.7	8.3
1.50	7.8	7.6	6.8	5.2	8.7	8.8	9.2	9.9
1.75	9.1	8.9	8.1	6.6	10.3	10.3	10.7	11.4
2.00	10.4	10.3	9.4	7.9	11.8	11.9	12.2	12.9
2.25	11.8	11.6	10.7	9.2	13.3	13.4	13.7	14.4
2.50	13.1	12.9	12.1	10.5	14.8	14.9	15.3	15.9
2.75	14.4	14.2	13.4	11.9	16.3	16.4	16.8	17.5
3.00	15.7	15.6	14.7	13.2	17.9	17.9	18.3	19.0

SuperHawk SH62
6 1/4 in O.D.

General Data

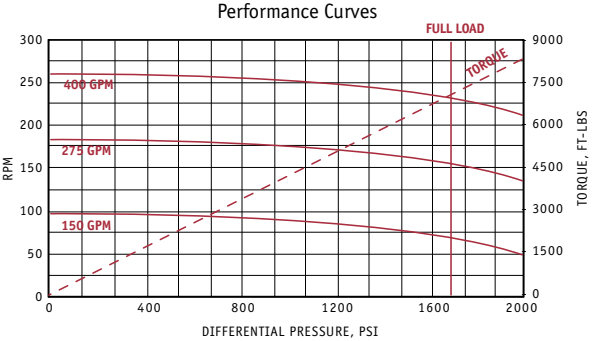
Bit Sizes	7 7/8 - 8 3/4 in
Std Bit Connection (1)	4 1/2 Reg
Std Top Connection (1)	4 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	68,500 lbs
Max WOB (continuous) (2)	34,250 lbs
Max Bit Pull (3)	300,000 lbs
Max Body Pull (3)	625,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 6 1/4 in O.D.
4:5 Lobes, 7.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	78.25 in
Bit to Bend Length (Fixed)	62.25 in
Nominal Length	315 in
Weight	1950 lbs
Performance Data	
Bit Speed (No Load)	98-270 rpm
Flow Range	150-400 gpm
Max Operating Pressure	1,690 psi
Max Power	342 hp
Max Torque	7,150 ft-lbs

Performance Curves

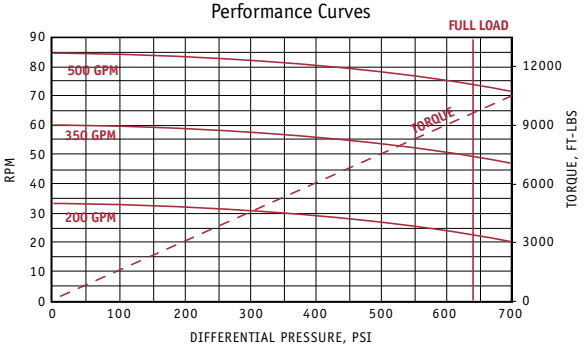


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	0.9	0.4	0.1		1.7	2.1	2.3	3.1
0.50	2.4	1.8	1.6		3.2	3.7	3.9	4.7
0.75	3.8	3.2	3.0	2.0	4.8	5.3	5.4	6.2
1.00	5.2	4.7	4.4	3.4	6.4	6.8	7.0	7.8
1.25	6.7	6.1	5.9	4.8	8.0	8.4	8.6	9.4
1.50	8.1	7.5	7.3	6.3	9.5	10.0	10.1	10.9
1.75	9.5	9.0	8.7	7.7	11.1	11.5	11.7	12.5
2.00	11.0	10.4	10.2	9.1	12.7	13.1	13.3	14.1
2.25	12.4	11.8	11.6	10.6	14.2	14.7	14.9	15.7
2.50	13.8	13.3	13.0	12.0	15.8	16.2	16.4	17.2
2.75	15.3	14.7	14.5	13.4	17.4	17.8	18.0	18.8
3.00	16.7	16.1	15.9	14.9	18.9	19.4	19.6	20.4

SuperHawk 6 1/4 in O.D.
4:5 Lobes, 2.9 Stages ESX HR

Physical Data	
Bit to Bend Length (ABH)	78.25 in
Bit to Bend Length (Fixed)	62.25 in
Nominal Length	341 in
Weight	2000 lbs
Performance Data	
Bit Speed (No Load)	35-85 rpm
Flow Range	200-500 gpm
Max Operating Pressure	650 psi
Max Power	148 hp
Max Torque	9600 ft-lbs

Performance Curves

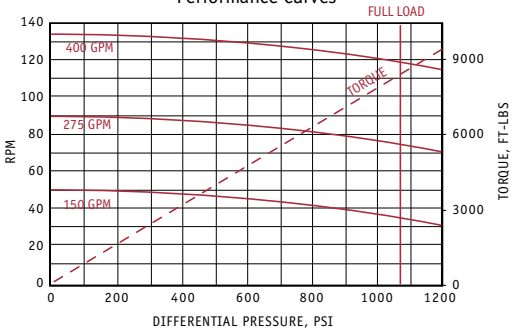


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	0.7	0.1			1.5	1.9	2.0	2.7
0.50	2.0	1.5	1.2		3.0	3.3	3.5	4.2
0.75	3.4	2.8	2.5	1.5	4.4	4.8	5.0	5.7
1.00	4.7	4.1	3.9	2.8	5.9	6.3	6.4	7.1
1.25	6.0	5.4	5.2	4.1	7.4	7.8	7.9	8.6
1.50	7.4	6.8	6.5	5.5	8.9	9.2	9.4	10.1
1.75	8.7	8.1	7.9	6.8	10.3	10.7	10.9	11.5
2.00	10.0	9.4	9.2	8.1	11.8	12.2	12.3	13.0
2.25	11.4	10.8	10.5	9.5	13.3	13.7	13.8	14.5
2.50	12.7	12.1	11.9	10.8	14.8	15.1	15.3	16.0
2.75	14.0	13.4	13.2	12.1	16.2	16.6	16.8	17.4
3.00	15.4	14.8	14.5	13.4	17.7	18.1	18.2	18.9

SuperHawk 6 1/4 in O.D.
7:8 Lobes, 4.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	78.25 in
Bit to Bend Length (Fixed)	62.25 in
Nominal Length	315 in
Weight	2050 lbs
Performance Data	
Bit Speed (No Load)	49-140 rpm
Flow Range	150-400 gpm
Max Operating Pressure	1080 psi
Max Power	207 hp
Max Torque	8620 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	0.9	0.4	0.1		1.7	2.1	2.3	3.1
0.50	2.4	1.8	1.6		3.2	3.7	3.9	4.7
0.75	3.8	3.2	3.0	2.0	4.8	5.3	5.4	6.2
1.00	5.2	4.7	4.4	3.4	6.4	6.8	7.0	7.8
1.25	6.7	6.1	5.9	4.8	8.0	8.4	8.6	9.4
1.50	8.1	7.5	7.3	6.3	9.5	10.0	10.1	10.9
1.75	9.5	9.0	8.7	7.7	11.1	11.5	11.7	12.5
2.00	11.0	10.4	10.2	9.1	12.7	13.1	13.3	14.1
2.25	12.4	11.8	11.6	10.6	14.2	14.7	14.9	15.7
2.50	13.8	13.3	13.0	12.0	15.8	16.2	16.4	17.2
2.75	15.3	14.7	14.5	13.4	17.4	17.8	18.0	18.8
3.00	16.7	16.1	15.9	14.9	18.9	19.4	19.6	20.4

SuperHawk SH65
6 1/2 in O.D.

General Data

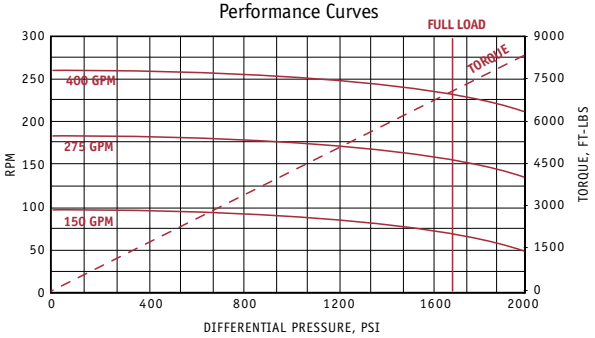
Bit Sizes	7 7/8 - 8 3/4 in
Std Bit Connection (1)	4 1/2 Reg
Std Top Connection (1)	4 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	110,000 lbs
Max WOB (continuous) (2)	55,000 lbs
Max Bit Pull (3)	380,000 lbs
Max Body Pull (3)	675,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 6 1/2 in O.D.
4:5 Lobes, 7.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	324 in
Weight	2,102 lbs
Performance Data	
Bit Speed (No Load)	98-270 rpm
Flow Range	150-400 gpm
Max Operating Pressure	1,690 psi
Max Power	342 hp
Max Torque	7,150 ft-lbs

Performance Curves

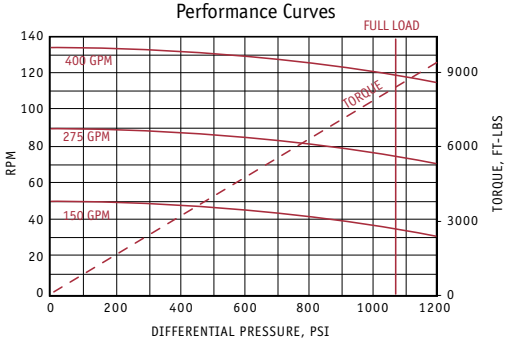


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.4	1.9	1.7	0.8	1.5	1.9	2.1	2.9
0.50	3.8	3.3	3.1	2.8	3.0	3.5	3.6	4.4
0.75	5.2	4.7	4.5	3.6	4.6	5.0	5.1	5.9
1.00	6.6	6.1	5.9	5.0	6.1	6.5	6.7	7.4
1.25	7.9	7.4	7.2	6.3	7.6	8.0	8.2	8.9
1.50	9.3	8.8	8.6	7.7	9.1	9.5	9.7	10.5
1.75	10.7	10.2	10.0	9.1	10.6	11.1	11.2	12.0
2.00	12.1	11.6	11.4	10.5	12.2	12.6	12.7	13.5
2.25	13.5	13.0	12.8	11.9	13.7	14.1	14.3	15.0
2.50	14.9	14.4	14.2	13.3	15.2	15.6	15.8	16.5
2.75	16.3	15.8	15.6	14.7	16.7	17.1	17.3	18.1
3.00	17.6	17.1	16.9	16.0	18.2	18.7	18.8	19.6

SuperHawk 6 1/2 in O.D.
7:8 Lobes, 4.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	324 in
Weight	2,210 lbs
Performance Data	
Bit Speed (No Load)	49-140 rpm
Flow Range	150-400 gpm
Max Operating Pressure	1,080 psi
Max Power	207 hp
Max Torque	8,620 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.4	1.9	1.7	0.8	1.5	1.9	2.1	2.9
0.50	3.8	3.3	3.1	2.8	3.0	3.5	3.6	4.4
0.75	5.2	4.7	4.5	3.6	4.6	5.0	5.1	5.9
1.00	6.6	6.1	5.9	5.0	6.1	6.5	6.7	7.4
1.25	7.9	7.4	7.2	6.3	7.6	8.0	8.2	8.9
1.50	9.3	8.8	8.6	7.7	9.1	9.5	9.7	10.5
1.75	10.7	10.2	10.0	9.1	10.6	11.1	11.2	12.0
2.00	12.1	11.6	11.4	10.5	12.2	12.6	12.7	13.5
2.25	13.5	13.0	12.8	11.9	13.7	14.1	14.3	15.0
2.50	14.9	14.4	14.2	13.3	15.2	15.6	15.8	16.5
2.75	16.3	15.8	15.6	14.7	16.7	17.1	17.3	18.1
3.00	17.6	17.1	16.9	16.0	18.2	18.7	18.8	19.6

SuperHawk SH67
6 3/4 in O.D.

General Data

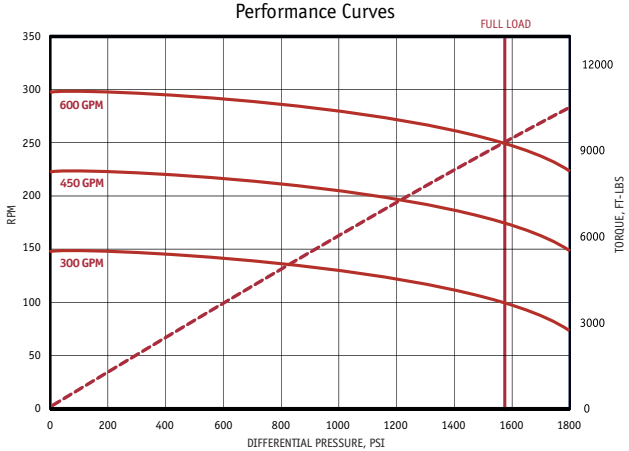
Bit Sizes	7 7/8 - 8 3/4 in
Std Bit Connection (1)	4 1/2 Reg
Std Top Connection (1)	4 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	110,000 lbs
Max WOB (continuous) (2)	55,000 lbs
Max Bit Pull (3)	380,000 lbs
Max Body Pull (3)	832,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 6 3/4 in O.D.
4:5 Lobes, 7.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	330 in
Weight	2,490 lbs
Performance Data	
Bit Speed (No Load)	149-300 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,580 psi
Max Power	482 hp
Max Torque	9,090 ft-lbs

Performance Curves

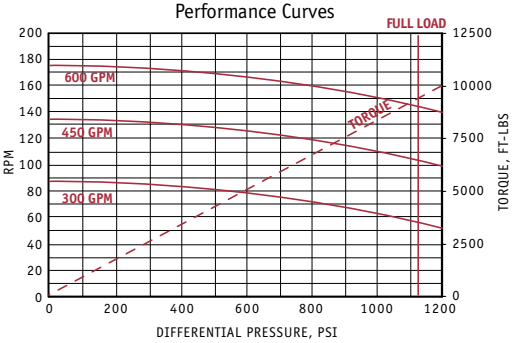


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.5	2.0	1.8	0.9	1.3	1.7	1.9	2.6
0.50	3.9	3.4	3.2	1.6	2.8	3.2	3.4	4.1
0.75	5.3	4.8	4.6	3.6	4.3	4.7	4.9	5.6
1.00	6.6	6.1	5.9	5.0	5.8	6.2	6.4	7.1
1.25	8.0	7.5	7.3	6.4	7.3	7.7	7.9	8.6
1.50	9.4	8.9	8.6	7.7	8.8	9.2	9.4	10.1
1.75	10.7	10.2	10.0	9.1	10.3	10.7	10.9	11.6
2.00	12.1	11.6	11.4	10.5	11.8	12.2	12.4	13.1
2.25	13.4	12.9	12.7	11.8	13.3	13.7	13.9	14.6
2.50	14.8	14.3	14.1	13.2	14.8	15.2	15.4	16.1
2.75	16.2	15.7	15.5	14.5	16.3	16.7	16.9	17.6
3.00	17.5	17.0	16.8	15.9	17.8	18.2	18.4	19.1

SuperHawk 6 3/4 in O.D.
6:7 Lobes, 5.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	315 in
Weight	2350 lbs
Performance Data	
Bit Speed (No Load)	87-180 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1130 psi
Max Power	290 hp
Max Torque	9350 ft-lbs

Performance Curves

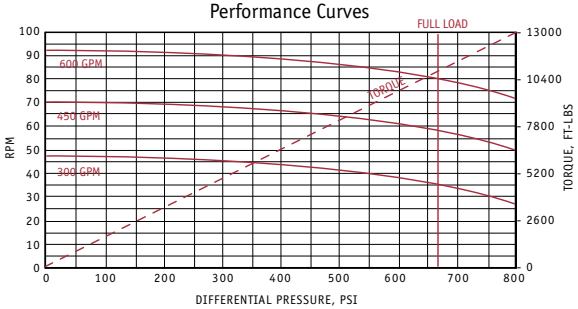


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.7	2.2	2.0	1.1	1.4	1.8	2.0	2.8
0.50	4.1	3.6	3.4	2.3	3.0	3.4	3.6	4.4
0.75	5.5	5.0	4.9	4.0	4.5	5.0	5.1	5.9
1.00	7.0	6.5	6.3	5.4	6.1	6.5	6.7	7.5
1.25	8.4	7.9	7.7	6.8	7.6	8.1	8.2	9.0
1.50	9.8	9.3	9.1	8.2	9.2	9.6	9.8	10.6
1.75	11.2	10.7	10.5	9.7	10.7	11.2	11.3	12.1
2.00	12.6	12.2	12.0	11.1	12.3	12.7	12.9	13.7
2.25	14.1	13.6	13.4	12.5	13.8	14.3	14.4	15.2
2.50	15.5	15.0	14.8	13.9	15.4	15.8	16.0	16.8
2.75	16.9	16.4	16.2	15.4	16.9	17.4	17.6	18.4
3.00	18.3	17.9	17.7	16.8	18.5	18.9	19.1	19.9

SuperHawk 6 3/4 in O.D.
7:8 Lobes, 3.0 Stages SS HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	319 in
Weight	2450 lbs
Performance Data	
Bit Speed (No Load)	46-90 rpm
Flow Range	300-600 gpm
Max Operating Pressure	680 psi
Max Power	180 hp
Max Torque	10,800 ft-lbs

Performance Curves

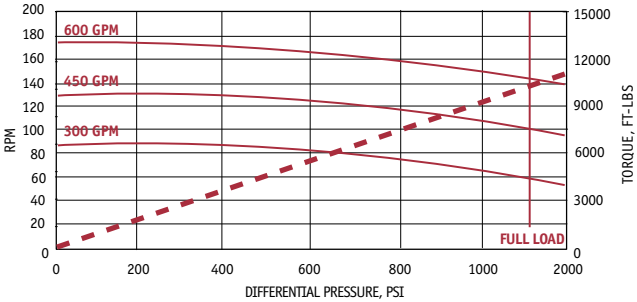


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.7	2.2	2.0	1.1	1.4	1.8	2.0	2.8
0.50	4.1	3.6	3.4	1.6	2.9	3.4	3.5	4.3
0.75	5.5	5.0	4.8	3.9	4.5	4.9	5.1	5.8
1.00	6.9	6.4	6.2	5.3	6.0	6.4	6.6	7.4
1.25	8.3	7.8	7.6	6.7	7.5	8.0	8.1	8.9
1.50	9.7	9.2	9.0	8.1	9.1	9.5	9.7	10.5
1.75	11.1	10.6	10.4	9.5	10.6	11.0	11.2	12.0
2.00	12.5	12.0	11.8	10.9	12.1	12.6	12.8	13.5
2.25	13.9	13.4	13.2	12.3	13.7	14.1	14.3	15.1
2.50	15.3	14.8	14.6	13.7	15.2	15.7	15.8	16.6
2.75	16.7	16.2	16.0	15.1	16.8	17.2	17.4	18.1
3.00	18.1	17.6	17.4	16.5	18.3	18.7	18.9	19.7

SuperHawk 6 3/4 in O.D.
7:8 Lobes, 5.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	315 in
Weight	2415 lbs
Performance Data	
Bit Speed (No Load)	86-180 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1130 psi
Max Power	323 hp
Max Torque	10,460 ft-lbs

Performance Curves

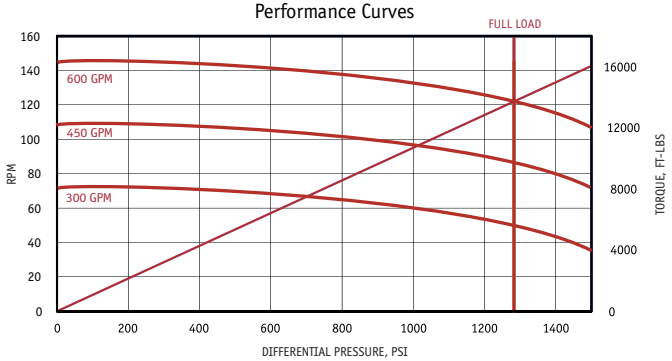


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.7	2.2	2.0	1.1	1.4	1.8	2.0	2.8
0.50	4.1	3.6	3.4	2.3	3.0	3.4	3.6	4.4
0.75	5.5	5.0	4.9	4.0	4.5	5.0	5.1	5.9
1.00	7.0	6.5	6.3	5.4	6.1	6.5	6.7	7.5
1.25	8.4	7.9	7.7	6.8	7.6	8.1	8.2	9.0
1.50	9.8	9.3	9.1	8.2	9.2	9.6	9.8	10.6
1.75	11.2	10.7	10.5	9.7	10.7	11.2	11.3	12.1
2.00	12.6	12.2	12.0	11.1	12.3	12.7	12.9	13.7
2.25	14.1	13.6	13.4	12.5	13.8	14.3	14.4	15.2
2.50	15.5	15.0	14.8	13.9	15.4	15.8	16.0	16.8
2.75	16.9	16.4	16.2	15.4	16.9	17.4	17.6	18.4
3.00	18.3	17.9	17.7	16.8	18.5	18.9	19.1	19.9

SuperHawk 6 3/4 in O.D.
7:8 Lobes, 5.7 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	380 in
Weight	2,860 lbs
Performance Data	
Bit Speed (No Load)	72-150 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,280 psi
Max Power	355 hp
Max Torque	13,720 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.2	1.6	1.4	0.4	1.1	1.4	1.5	2.1
0.50	3.4	2.8	2.6	1.5	2.4	2.7	2.9	3.4
0.75	4.6	4.0	3.8	2.8	3.8	4.1	4.2	4.8
1.00	5.8	5.2	5.0	4.0	5.1	5.4	5.5	6.1
1.25	6.9	6.4	6.2	5.2	6.5	6.8	6.9	7.4
1.50	8.1	7.6	7.4	6.4	7.8	8.1	8.2	8.8
1.75	9.3	8.8	8.6	7.6	9.1	9.4	9.6	10.1
2.00	10.5	10.0	9.8	8.8	10.5	10.8	10.9	11.4
2.25	11.7	11.2	11.0	10.0	11.8	12.1	12.2	12.8
2.50	12.9	12.4	12.1	11.2	13.1	13.5	13.6	14.1
2.75	14.1	13.6	13.3	12.4	14.5	14.8	14.9	15.5
3.00	15.3	14.8	14.5	13.5	15.8	16.1	16.2	16.8

SuperHawk SH70
7 in O.D.

General Data

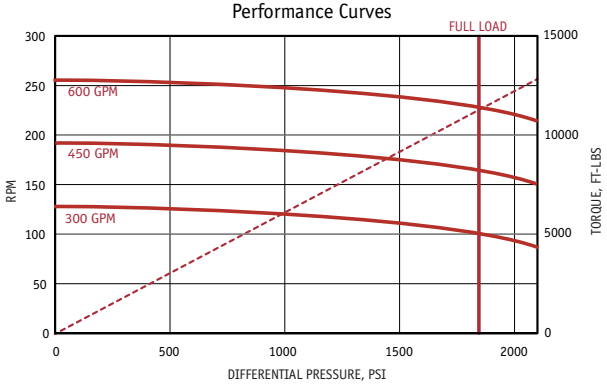
Bit Sizes	8 1/2 - 10 5/8 in
Std Bit Connection (1)	4 1/2, 6 5/8 Reg
Std Top Connection (1)	4 1/2 IF, 6 5/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	114,000 lbs
Max WOB (continuous) (2)	57,000 lbs
Max Bit Pull (3)	400,000 lbs
Max Body Pull (3)	975,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 7 in O.D.
5:6 Lobes, 8.2 Stages HR

Physical Data	
Bit to Bend Length (ABH)	82.50 in
Bit to Bend Length (Fixed)	64.25 in
Nominal Length	363 in
Weight	3,095 lbs
Performance Data	
Bit Speed (No Load)	127-260 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,850 psi
Max Power	523 hp
Max Torque	11,270 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	8.500	8.750	9.875	10.625	8.500	8.750	9.875	10.625
0.25	2.0	1.7	0.8	0.1	1.4	1.5	2.1	2.5
0.50	3.2	3.0	2.0	1.0	2.8	2.9	3.5	3.9
0.75	4.5	4.2	3.3	2.6	4.1	4.3	4.9	5.3
1.00	5.7	5.5	4.5	3.9	5.5	5.7	6.3	6.7
1.25	6.9	6.7	5.8	5.1	6.9	7.1	7.7	8.1
1.50	8.2	8.0	7.0	6.4	8.3	8.4	9.0	9.4
1.75	9.4	9.2	8.3	7.6	9.7	9.8	10.4	10.8
2.00	10.7	10.5	9.5	8.9	11.1	11.2	11.8	12.2
2.25	11.9	11.7	10.7	10.1	12.5	12.6	13.2	13.6
2.50	13.2	13.0	12.0	11.3	13.9	14.0	14.6	15.0
2.75	14.4	14.2	13.2	12.6	15.3	15.4	16.0	16.4
3.00	15.7	15.5	14.5	13.8	16.6	16.8	17.4	17.8

SuperHawk SH77
7 3/4 in O.D.

General Data

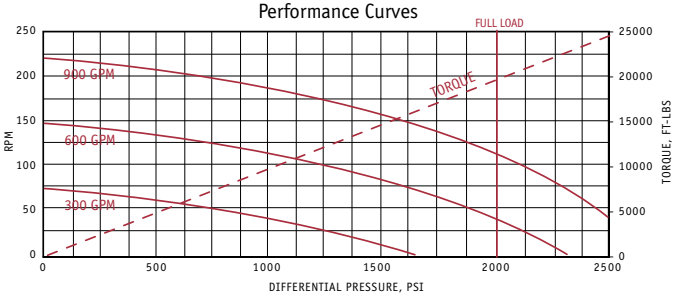
Bit Sizes	9 7/8 - 12 1/4 in
Std Bit Connection (1)	6 5/8 Reg
Std Top Connection (1)	6 5/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	116,000 lbs
Max WOB (continuous) (2)	58,000 lbs
Max Bit Pull (3)	450,000 lbs
Max Body Pull (3)	1,000,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 7 3/4 in O.D.
5:6 Lobes, 5.2 Stages HR

Physical Data	
Bit to Bend Length (ABH)	88.50 in
Bit to Bend Length (Fixed)	68.50 in
Nominal Length	350 in
Weight	3675 lbs
Performance Data	
Bit Speed (No Load)	71-215 rpm
Flow Range	300-900 gpm
Max Operating Pressure	1600 psi
Max Power	475 hp
Max Torque	17,120 ft-lbs

Performance Curves

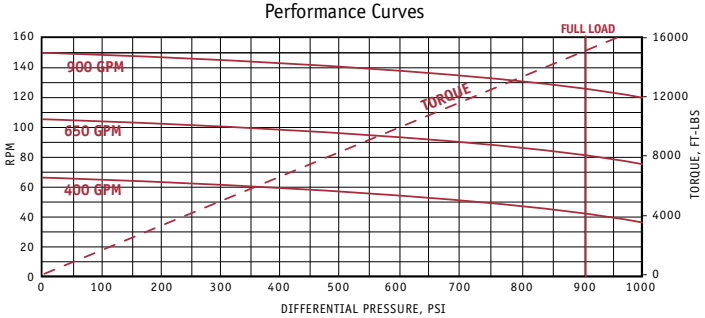


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	9.875	10.625	11.250	12.250	9.875	10.625	11.250	12.250
0.25	1.6	1.1	0.7	0.0	1.9	2.3	2.7	3.3
0.50	2.9	2.4	2.0	0.8	3.3	3.7	4.1	4.7
0.75	4.2	3.7	3.2	2.6	4.7	5.2	5.5	6.1
1.00	5.5	5.0	4.5	3.8	6.1	6.6	6.9	7.5
1.25	6.8	6.2	5.8	5.1	7.5	8.0	8.3	8.9
1.50	8.1	7.5	7.1	6.4	9.0	9.4	9.8	10.3
1.75	9.3	8.8	8.4	7.7	10.4	10.8	11.2	11.7
2.00	10.6	10.1	9.7	9.0	11.8	12.2	12.6	13.2
2.25	11.9	11.4	10.9	10.3	13.2	13.6	14.0	14.6
2.50	13.2	12.7	12.2	11.5	14.6	15.0	15.4	16.0
2.75	14.5	13.9	13.5	12.8	16.0	16.5	16.8	17.4
3.00	15.8	15.2	14.8	14.1	17.4	17.9	18.2	18.8

SuperHawk 7 3/4 in O.D.
7:8 Lobes, 4.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	88.50 in
Bit to Bend Length (Fixed)	68.50 in
Nominal Length	333 in
Weight	3300 lbs
Performance Data	
Bit Speed (No Load)	66-150 rpm
Flow Range	400-900 gpm
Max Operating Pressure	900 psi
Max Power	400 hp
Max Torque	14,930 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	9.875	10.625	11.250	12.250	9.875	10.625	11.250	12.250
0.25	1.8	1.3	0.9	0.2	2.0	2.5	2.9	3.6
0.50	3.2	2.7	2.2	1.3	3.5	4.0	4.4	5.0
0.75	4.5	4.0	3.6	2.9	5.0	5.5	5.9	6.5
1.00	5.8	5.3	4.9	4.3	6.4	6.9	7.3	8.0
1.25	7.2	6.7	6.3	5.6	7.9	8.4	8.8	9.4
1.50	8.5	8.0	7.6	7.0	9.4	9.9	10.3	10.9
1.75	9.9	9.4	9.0	8.3	10.9	11.3	11.7	12.4
2.00	11.2	10.7	10.3	9.7	12.3	12.8	13.2	13.8
2.25	12.6	12.1	11.7	11.0	13.8	14.3	14.7	15.3
2.50	13.9	13.4	13.0	12.3	15.3	15.7	16.1	16.8
2.75	15.3	14.8	14.3	13.7	16.7	17.2	17.6	18.2
3.00	16.6	16.1	15.7	15.0	18.2	18.7	19.1	19.7

SuperHawk SH80
8 in O.D.

General Data

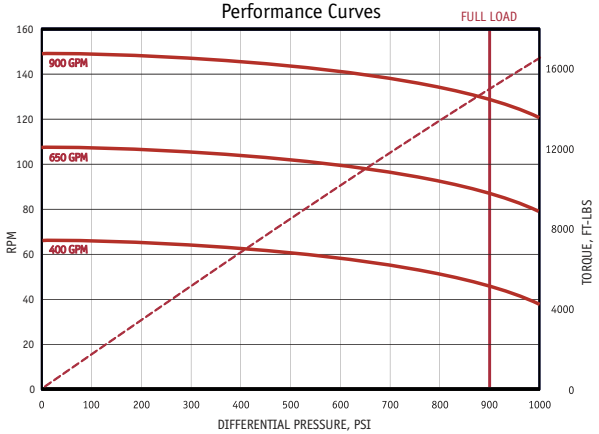
Bit Sizes	9 7/8 - 12 1/4 in
Std Bit Connection (1)	6 5/8 Reg
Std Top Connection (1)	6 5/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	133,000 lbs
Max WOB (continuous) (2)	66,500 lbs
Max Bit Pull (3)	540,000 lbs
Max Body Pull (3)	1,200,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 8 in O.D.
7:8 Lobes, 4.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	88.50 in
Bit to Bend Length (Fixed)	68.50 in
Nominal Length	333 in
Weight	3875 lbs
Performance Data	
Bit Speed (No Load)	66-150 rpm
Flow Range	400-900 gpm
Max Operating Pressure	900 psi
Max Power	401 hp
Max Torque	14,930 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	9.875	10.625	11.250	12.250	9.875	10.625	11.250	12.250
0.25	2.0	1.5	1.1	0.4	1.9	2.4	2.8	3.4
0.50	3.3	2.8	2.4	1.6	3.4	3.8	4.2	4.9
0.75	4.7	4.2	3.8	3.1	4.8	5.3	5.7	6.3
1.00	6.0	5.5	5.1	4.4	6.3	6.8	7.2	7.8
1.25	7.3	6.9	6.4	5.8	7.8	8.2	8.6	9.3
1.50	8.7	8.2	7.8	7.1	9.2	9.7	10.1	10.7
1.75	10.0	9.5	9.1	8.5	10.7	11.2	11.6	12.2
2.00	11.4	10.9	10.5	9.8	12.2	12.6	13.0	13.7
2.25	12.7	12.2	11.8	11.2	13.6	14.1	14.5	15.1
2.50	14.1	13.6	13.2	12.5	15.1	15.6	16.0	16.6
2.75	15.4	14.9	14.5	13.8	16.6	17.0	17.4	18.1
3.00	16.7	16.2	15.8	15.2	18.0	18.5	18.9	19.5

SuperHawk SH96
9 5/8 in O.D.

General Data

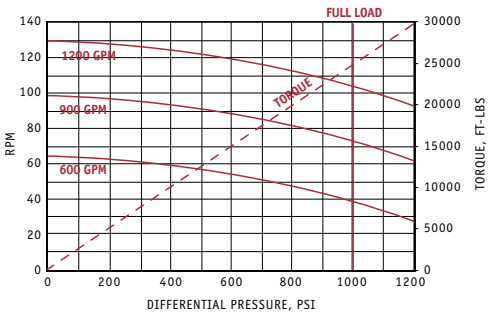
Bit Sizes	12 1/4 - 17 1/2 in
Std Bit Connection (1)	7 5/8 Reg
Std Top Connection (1)	7 5/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	140,000 lbs
Max WOB (continuous) (2)	70,000 lbs
Max Bit Pull (3)	800,000 lbs
Max Body Pull (3)	1,450,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 9 5/8 in O.D.
5:6 Lobes, 4.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	101.0 in
Bit to Bend Length (Fixed)	77.0 in
Nominal Length	380 in
Weight	5750 lbs
Performance Data	
Bit Speed (No Load)	65-130 rpm
Flow Range	600-1200 gpm
Max Operating Pressure	1000 psi
Max Power	480 hp
Max Torque	23,990 ft-lbs

Performance Curves

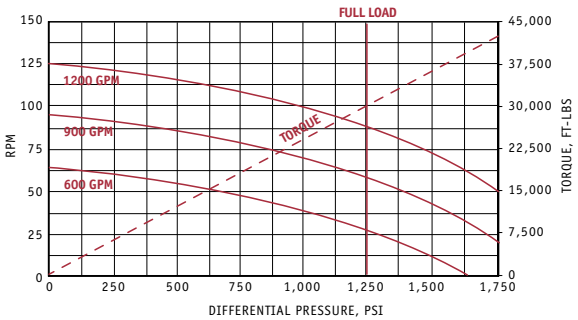


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	12.250	13.500	14.750	17.500	12.250	13.500	14.750	17.500
0.25	1.3	0.6			2.1	2.7	3.3	4.7
0.50	2.4	1.8	1.1		3.4	4.0	4.6	6.0
0.75	3.6	3.0	2.3	0.9	4.7	5.3	5.9	7.3
1.00	4.8	4.1	3.5	2.0	6.0	6.6	7.2	8.6
1.25	6.0	5.3	4.7	3.2	7.3	7.9	8.5	9.9
1.50	7.1	6.5	5.8	4.4	8.6	9.2	9.9	11.2
1.75	8.3	7.7	7.0	5.6	9.9	10.5	11.2	12.5
2.00	9.5	8.8	8.2	6.7	11.2	11.9	12.5	13.8
2.25	10.7	10.0	9.4	7.9	12.5	13.2	13.8	15.1
2.50	11.9	11.2	10.5	9.1	13.9	14.5	15.1	16.5
2.75	13.0	12.4	11.7	10.3	15.2	15.8	16.4	17.8
3.00	14.2	13.5	12.9	11.4	16.5	17.1	17.7	19.1

SuperHawk 6 5/8 in O.D.
6:7 Lobes, 3.5 Stages HR

Physical Data	
Bit to Bend Length (ABH)	101.0 in
Bit to Bend Length (Fixed)	77.0 in
Nominal Length	360 in
Weight	5700 lbs
Performance Data	
Bit Speed (No Load)	65-125 rpm
Flow Range	600-1200 gpm
Max Operating Pressure	1,300 psi
Max Power	518 hp
Max Torque	32,275 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	12.250	13.500	14.750	17.500	12.250	13.500	14.750	17.500
0.25	1.4	0.8	0.2		2.1	2.7	3.3	4.7
0.50	2.7	2.1	1.5		3.4	4.0	4.6	6.0
0.75	3.9	3.3	2.7	1.4	4.7	5.3	5.9	7.3
1.00	5.2	4.5	3.9	2.6	6.0	6.6	7.2	8.6
1.25	6.4	5.8	5.2	3.8	7.3	7.9	8.5	9.9
1.50	7.6	7.0	6.4	5.1	8.6	9.2	9.9	11.2
1.75	8.9	8.3	7.7	6.3	9.9	10.5	11.2	12.5
2.00	10.1	9.5	8.9	7.6	11.2	11.9	12.5	13.8
2.25	11.3	10.7	10.1	8.8	12.5	13.2	13.8	15.1
2.50	12.6	12.0	11.4	10.0	13.9	14.5	15.1	16.5
2.75	13.8	13.2	12.6	11.3	15.2	15.8	16.4	17.8
3.00	15.1	14.4	13.8	12.5	16.5	17.1	17.7	19.1

SuperHawk SS47
4 3/4 in O.D.

General Data

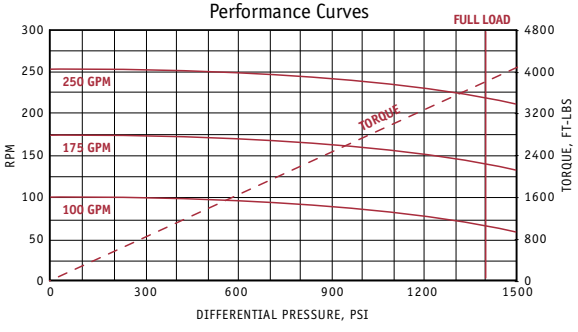
Bit Sizes	6 - 7 7/8 in
Std Bit Connection (1)	3 1/2 Reg
Std Top Connection (1)	3 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	28,750 lbs
Max WOB (continuous) (2)	14,500 lbs
Max Bit Pull (3)	190,000 lbs
Max Body Pull (3)	403,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 4 3/4 in O.D.
4:5 Lobes, 6.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	51.45 in
Bit to Bend Length (Fixed)	38.63 in
Nominal Length	287 in
Weight	1,125 lbs
Performance Data	
Bit Speed (No Load)	102-260 rpm
Flow Range	100-250 gpm
Max Operating Pressure	1,420 psi
Max Power	177 hp
Max Torque	3,870 ft-lbs

Performance Curves

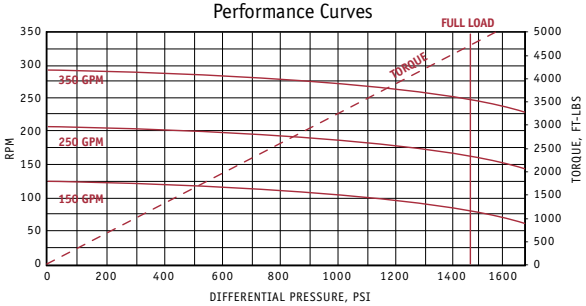


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	0.7	0.5			1.7	1.8	2.3	3.3
0.50	2.3	2.0	0.7		3.6	3.7	4.2	5.2
0.75	3.9	3.6	2.3	0.0	5.4	5.5	6.0	7.0
1.00	5.4	5.2	3.9	1.5	7.3	7.4	7.9	8.9
1.25	7.0	6.7	5.4	3.1	9.1	9.2	9.7	10.7
1.50	8.6	8.3	7.0	4.6	11.0	11.1	11.6	12.6
1.75	10.1	9.9	8.6	6.2	12.8	12.9	13.5	14.4
2.00	11.7	11.5	10.1	7.8	14.7	14.8	15.3	16.3
2.25	13.3	13.0	11.7	9.3	16.5	16.6	17.2	18.1
2.50	14.9	14.6	13.3	10.9	18.4	18.5	19.0	20.0
2.75	16.4	16.2	14.9	12.5	20.2	20.3	20.9	21.8
3.00	18.0	17.7	16.4	14.1	22.1	22.2	22.7	23.7

SuperHawk 4 3/4 in O.D.
5:6 Lobes, 6.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	51.45 in
Bit to Bend Length (Fixed)	38.63 in
Nominal Length	278 in
Weight	1,100 lbs
Performance Data	
Bit Speed (No Load)	127-296 rpm
Flow Range	150-350 gpm
Max Operating Pressure	1,500 psi
Max Power	220 hp
Max Torque	4,596 ft-lbs

Performance Curves

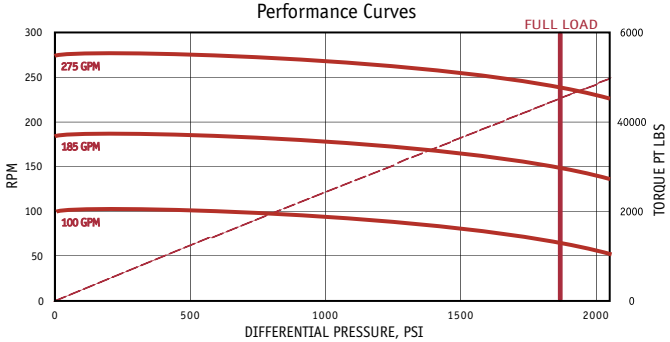


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	0.8	0.5			1.8	1.9	2.5	3.5
0.50	2.4	2.1	0.8		3.7	3.8	4.4	5.4
0.75	4.0	3.8	2.4	0.1	5.6	5.7	6.3	7.3
1.00	5.6	5.4	4.1	1.7	7.5	7.6	8.2	9.2
1.25	7.3	7.0	5.7	3.3	9.4	9.5	10.1	11.1
1.50	8.9	8.6	7.3	4.9	11.3	11.4	12.0	13.0
1.75	10.5	10.2	8.9	6.5	13.2	13.3	13.9	14.9
2.00	12.1	11.9	10.5	8.2	15.1	15.2	15.8	16.8
2.25	13.7	13.5	12.2	9.8	17.0	17.1	17.7	18.7
2.50	15.4	15.1	13.8	11.4	18.9	19.0	19.6	20.6
2.75	17.0	16.7	15.4	13.0	20.8	20.9	21.5	22.5
3.00	18.6	18.3	17.0	14.6	22.7	22.8	23.4	24.4

SuperHawk 4 3/4 in O.D.
5:6 Lobes, 8.3 Stages HR

Physical Data	
Bit to Bend Length (ABH)	51.45 in
Bit to Bend Length (Fixed)	38.63 in
Nominal Length	323 in
Weight	1,160 lbs
Performance Data	
Bit Speed (No Load)	100-280 rpm
Flow Range	100-275 gpm
Max Operating Pressure	1,870 psi
Max Power	239 hp
Max Torque	4,810 ft-lbs

Performance Curves

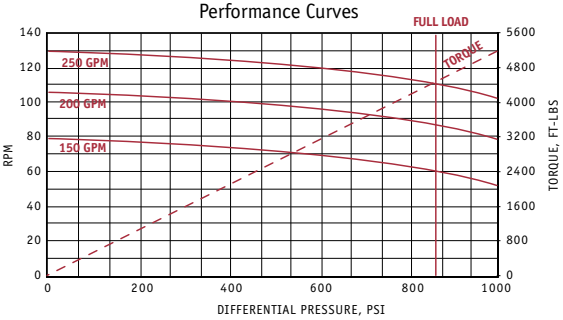


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	0.5	0.2			1.4	1.5	1.9	2.7
0.50	1.9	1.6	0.4		3.1	3.2	3.6	4.4
0.75	3.3	3.0	1.8		4.8	4.9	5.3	6.0
1.00	4.7	4.5	3.2	0.9	6.4	6.5	6.9	7.7
1.25	6.1	5.9	4.6	2.3	8.1	8.2	8.6	9.4
1.50	7.5	7.3	6.0	3.7	9.8	9.9	10.3	11.0
1.75	8.9	8.7	7.4	5.1	11.4	11.5	12.0	12.7
2.00	10.3	10.1	8.8	6.5	13.1	13.2	13.6	14.4
2.25	11.7	11.5	10.2	7.9	14.8	14.9	15.3	16.0
2.50	13.1	12.9	11.6	9.3	16.5	16.5	17.0	17.7
2.75	14.5	14.3	13.0	10.7	18.1	18.2	18.6	19.4
3.00	16.0	15.7	14.4	12.1	19.8	19.9	20.3	21.1

SuperHawk 4 3/4 in O.D.
7:8 Lobes, 3.8 Stages HR

Physical Data	
Bit to Bend Length (ABH)	51.45 in
Bit to Bend Length (Fixed)	38.63 in
Nominal Length	278 in
Weight	1,100 lbs
Performance Data	
Bit Speed (No Load)	80-140 rpm
Flow Range	150-250 gpm
Max Operating Pressure	860 psi
Max Power	104 hp
Max Torque	4,450 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	0.8	0.5			1.8	1.9	2.5	3.5
0.50	2.4	2.1	0.8		3.7	3.8	4.4	5.4
0.75	4.0	3.8	2.4	0.1	5.6	5.7	6.3	7.3
1.00	5.6	5.4	4.1	1.7	7.5	7.6	8.2	9.2
1.25	7.3	7.0	5.7	3.3	9.4	9.5	10.1	11.1
1.50	8.9	8.6	7.3	4.9	11.3	11.4	12.0	13.0
1.75	10.5	10.2	8.9	6.5	13.2	13.3	13.9	14.9
2.00	12.1	11.9	10.5	8.2	15.1	15.2	15.8	16.8
2.25	13.7	13.5	12.2	9.8	17.0	17.1	17.7	18.7
2.50	15.4	15.1	13.8	11.4	18.9	19.0	19.6	20.6
2.75	17.0	16.7	15.4	13.0	20.8	20.9	21.5	22.5
3.00	18.6	18.3	17.0	14.6	22.7	22.8	23.4	24.4

SuperHawk Short SS50
5 in O.D.

General Data

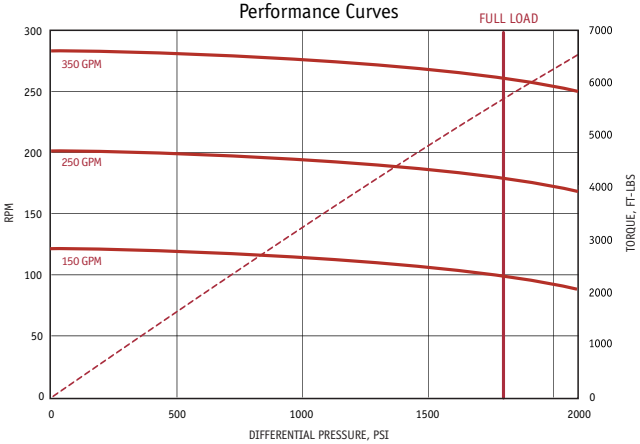
Bit Sizes	6 - 7 7/8 in
Std Bit Connection (1)	3 1/2 Reg
Std Top Connection (1)	3 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	30,750 lbs
Max WOB (continuous) (2)	15,375 lbs
Max Bit Pull (3)	200,000 lbs
Max Body Pull (3)	425,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

SuperHawk 5 in O.D.
6:7 Lobes, 8.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	52.00 in
Bit to Bend Length (Fixed)	39.00 in
Nominal Length	327 in
Weight	1,260 lbs
Performance Data	
Bit Speed (No Load)	121-290 rpm
Flow Range	150-350 gpm
Max Operating Pressure	1,200 psi
Max Power	206 hp
Max Torque	3,810 ft-lbs

Performance Curves

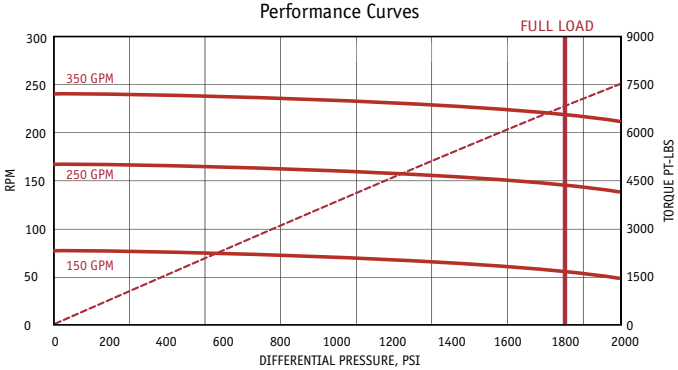


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.0	0.7			1.2	1.3	1.7	2.4
0.50	2.4	2.1	0.9		2.8	2.9	3.3	4.1
0.75	3.8	3.5	2.3	0.0	4.5	4.5	5.0	5.7
1.00	5.2	4.9	3.7	1.4	6.1	6.2	6.6	7.3
1.25	6.5	6.3	5.0	2.8	7.8	7.8	8.2	9.0
1.50	7.9	7.7	6.4	4.2	9.4	9.5	9.9	10.6
1.75	9.3	9.1	7.8	5.6	11.0	11.1	11.5	12.3
2.00	10.7	10.5	9.2	7.0	12.7	12.8	13.2	13.9
2.25	12.1	11.8	10.6	8.3	14.3	14.4	14.8	15.5
2.50	13.5	13.2	12.0	9.7	16.0	16.0	16.5	17.2
2.75	14.9	14.6	13.4	11.1	17.6	17.7	18.1	18.8
3.00	16.3	16.0	14.8	12.5	19.2	19.3	19.7	20.5

SuperHawk 5 in O.D.
7:8 Lobes, 8.2 Stages HR

Physical Data	
Bit to Bend Length (ABH)	52.00 in
Bit to Bend Length (Fixed)	39.00 in
Nominal Length	331 in
Weight	1,278 lbs
Performance Data	
Bit Speed (No Load)	105-250 rpm
Flow Range	150-350 gpm
Max Operating Pressure	1,850 psi
Max Power	299 hp
Max Torque	6,700 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	6.000	6.125	6.750	7.875	6.000	6.125	6.750	7.875
0.25	1.0	0.7			1.2	1.2	1.6	2.4
0.50	2.3	2.1	0.8		2.8	2.9	3.3	4.0
0.75	3.7	3.5	2.2	0.0	4.4	4.5	4.9	5.6
1.00	5.1	4.8	3.6	1.4	6.0	6.1	6.5	7.2
1.25	6.5	6.2	5.0	2.7	7.7	7.7	8.1	8.9
1.50	7.8	7.6	6.3	4.1	9.3	9.4	9.8	10.5
1.75	9.2	9.0	7.7	5.5	10.9	11.0	11.4	12.1
2.00	10.6	10.3	9.1	6.8	12.5	12.6	13.0	13.7
2.25	11.9	11.7	10.5	8.2	14.2	14.2	14.6	15.4
2.50	13.3	13.1	11.8	9.6	15.8	15.9	16.3	17.0
2.75	14.7	14.4	13.2	11.0	17.4	17.5	17.9	18.6
3.00	16.1	15.8	14.6	12.3	19.0	19.1	19.5	20.2

SuperHawk Short SS67
6 3/4 in O.D.

General Data

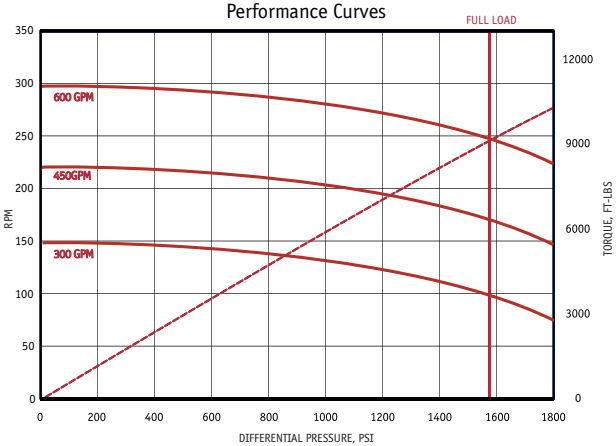
Bit Sizes	7 7/8 - 9 7/8 in
Std Bit Connection (1)	4 1/2 Reg
Std Top Connection (1)	4 1/2 IF
Make-Up Torques	See 4-22
Max WOB (operating)	70,000 lbs
Max WOB (continuous) (2)	35,000 lbs
Max Bit Pull (3)	380,000 lbs
Max Body Pull (3)	832,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

Short SuperHawk 6 3/4 in O.D.
4:5 Lobes, 7.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	65.32 in
Bit to Bend Length (Fixed)	43.00 in
Nominal Length	319 in
Weight	2,425 lbs
Performance Data	
Bit Speed (No Load)	149-300 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,580 psi
Max Power	482 hp
Max Torque	9,090 ft-lbs

Performance Curves

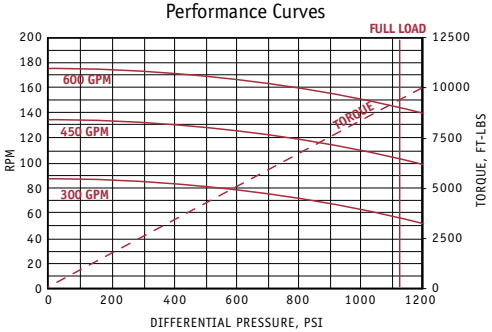


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.9	1.9	1.5		1.5	1.9	2.1	2.9
0.50	4.3	3.3	2.9		3.2	3.6	3.8	4.5
0.75	5.7	4.7	4.3	2.4	4.8	5.3	5.4	6.2
1.00	7.1	6.1	5.7	3.8	6.5	6.9	7.1	7.9
1.25	8.5	7.5	7.1	5.3	8.2	8.6	8.8	9.5
1.50	9.9	8.9	8.5	6.7	9.8	10.3	10.4	11.2
1.75	11.3	10.3	9.9	8.1	11.5	11.9	12.1	12.9
2.00	12.7	11.7	11.3	9.5	13.2	13.6	13.8	14.5
2.25	14.2	13.1	12.7	10.9	14.8	15.2	15.4	16.2
2.50	15.6	14.5	14.1	12.3	16.5	16.9	17.1	17.9
2.75	17.0	15.9	15.5	13.7	18.1	18.6	18.7	19.5
3.00	18.4	17.4	16.9	15.1	19.8	20.2	20.4	21.2

Short SuperHawk 6 3/4 in O.D.
6:7 Lobes, 5.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	65.32 in
Bit to Bend Length (Fixed)	43.00 in
Nominal Length	294 in
Weight	2,275 lbs
Performance Data	
Bit Speed (No Load)	87-180 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,130 psi
Max Power	290 hp
Max Torque	9,350 ft-lbs

Performance Curves

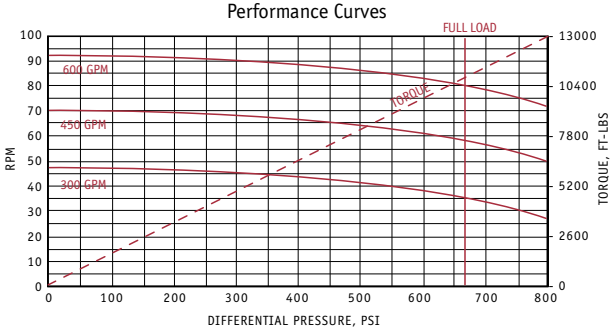


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	3.2	2.1	1.7		1.7	2.2	2.4	3.3
0.50	4.7	3.7	3.3		3.5	4.0	4.2	5.1
0.75	6.2	5.2	4.8	2.9	5.2	5.8	6.0	6.9
1.00	7.7	6.7	6.3	4.4	7.0	7.5	7.7	8.7
1.25	9.2	8.2	7.8	6.0	8.8	9.3	9.5	10.4
1.50	10.8	9.7	9.3	7.5	10.6	11.1	11.3	12.2
1.75	12.3	11.3	10.8	9.0	12.4	12.9	13.1	14.0
2.00	13.8	12.8	12.4	10.5	14.2	14.7	14.9	15.8
2.25	15.3	14.3	13.9	12.0	16.0	16.5	16.7	17.6
2.50	16.8	15.8	15.4	13.5	17.7	18.3	18.5	19.4
2.75	18.4	17.3	16.9	15.1	19.5	20.0	20.2	21.2
3.00	19.9	18.8	18.4	16.6	21.3	21.8	22.0	23.0

Short SuperHawk 6 3/4 in O.D.
7:8 Lobes, 3.0 Stages SS HR

Physical Data	
Bit to Bend Length (ABH)	65.32 in
Bit to Bend Length (Fixed)	43.00 in
Nominal Length	298 in
Weight	2,280 lbs
Performance Data	
Bit Speed (No Load)	46-93 rpm
Flow Range	300-600 gpm
Max Operating Pressure	680 psi
Max Power	180 hp
Max Torque	10,800 ft-lbs

Performance Curves

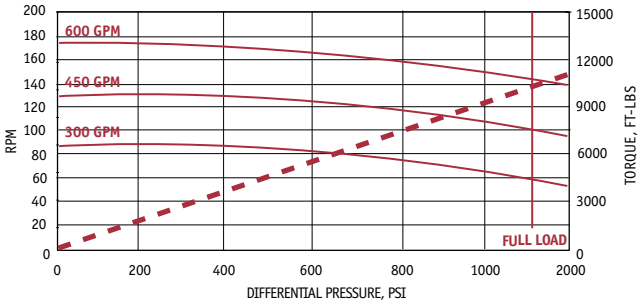


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	3.1	2.1	1.7		1.6	2.1	2.3	3.2
0.50	4.6	3.6	3.2		3.4	3.9	4.1	5.0
0.75	6.1	5.1	4.7	2.8	5.2	5.7	5.9	6.8
1.00	7.6	6.6	6.2	4.3	6.9	7.4	7.6	8.5
1.25	9.1	8.1	7.7	5.8	8.7	9.2	9.4	10.3
1.50	10.6	9.6	9.2	7.3	10.5	11.0	11.2	12.1
1.75	12.1	11.1	10.7	8.8	12.2	12.7	12.9	13.8
2.00	13.6	12.6	12.2	10.3	14.0	14.5	14.7	15.6
2.25	15.1	14.1	13.7	11.8	15.8	16.3	16.5	17.4
2.50	16.6	15.6	15.2	13.3	17.5	18.0	18.2	19.1
2.75	18.1	17.1	16.7	14.8	19.3	19.8	20.0	20.9
3.00	19.6	18.6	18.2	16.3	21.1	21.6	21.8	22.7

Short SuperHawk 6 3/4 in O.D.
7:8 Lobes, 5.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	65.32 in
Bit to Bend Length (Fixed)	43.00 in
Nominal Length	294 in
Weight	2,270 lbs
Performance Data	
Bit Speed (No Load)	86-180 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,130 psi
Max Power	323 hp
Max Torque	10,460 ft-lbs

Performance Curves

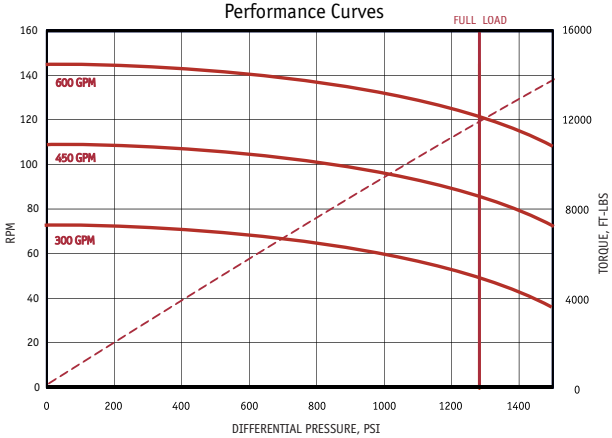


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	3.2	2.1	1.7		1.7	2.2	2.4	3.3
0.50	4.7	3.7	3.3		3.5	4.0	4.2	5.1
0.75	6.2	5.2	4.8	2.9	5.2	5.8	6.0	6.9
1.00	7.7	6.7	6.3	4.4	7.0	7.5	7.7	8.7
1.25	9.2	8.2	7.8	6.0	8.8	9.3	9.5	10.4
1.50	10.8	9.7	9.3	7.5	10.6	11.1	11.3	12.2
1.75	12.3	11.3	10.8	9.0	12.4	12.9	13.1	14.0
2.00	13.8	12.8	12.4	10.5	14.2	14.7	14.9	15.8
2.25	15.3	14.3	13.9	12.0	16.0	16.5	16.7	17.6
2.50	16.8	15.8	15.4	13.5	17.7	18.3	18.5	19.4
2.75	18.4	17.3	16.9	15.1	19.5	20.0	20.2	21.2
3.00	19.9	18.8	18.4	16.6	21.3	21.8	22.0	23.0

Short SuperHawk 6 3/4 in O.D.
7:8 Lobes, 5.7 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	48.13 in
Nominal Length	343 in
Weight	2,725 lbs
Performance Data	
Bit Speed (No Load)	72-150 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,280 psi
Max Power	355 hp
Max Torque	13,720 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	7.875	8.500	8.750	9.875	7.875	8.500	8.750	9.875
0.25	2.7	1.7	1.3		1.4	1.7	1.9	2.6
0.50	4.0	3.0	2.6		2.9	3.3	3.4	4.1
0.75	5.3	4.3	3.9	2.1	4.5	4.9	5.0	5.7
1.00	6.6	5.6	5.2	3.4	6.0	6.4	6.6	7.2
1.25	7.9	6.9	6.5	4.7	7.6	8.0	8.1	8.8
1.50	9.2	8.2	7.8	6.0	9.2	9.5	9.7	10.4
1.75	10.6	9.6	9.2	7.3	10.7	11.1	11.3	11.9
2.00	11.9	10.9	10.5	8.6	12.3	12.7	12.8	13.5
2.25	13.2	12.2	11.8	10.0	13.9	14.2	14.4	15.1
2.50	14.5	13.5	13.1	11.3	15.4	15.8	15.9	16.6
2.75	15.8	14.8	14.4	12.6	17.0	17.4	17.5	18.2
3.00	17.1	16.1	15.7	13.9	18.5	18.9	19.1	19.7

SuperHawk SH70
7 in O.D.

General Data

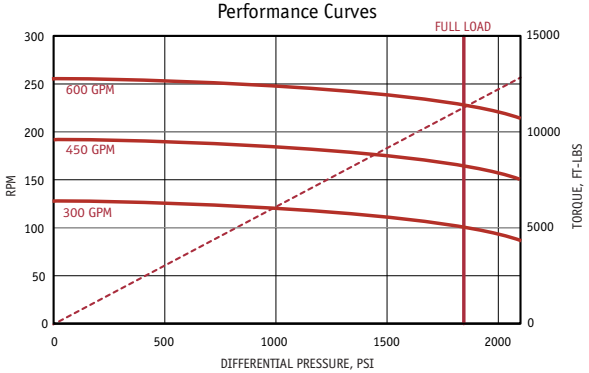
Bit Sizes	8 1/2 - 10 5/8 in
Std Bit Connection (1)	4 1/2, 6 5/8 Reg
Std Top Connection (1)	4 1/2 IF, 6 5/8 Reg
Make-Up Torques	See 4-22
Max WOB (operating)	90,000 lbs
Max WOB (continuous) (2)	45,000 lbs
Max Bit Pull (3)	400,000 lbs
Max Body Pull (3)	975,000 lbs

(1) Other connections available upon request.
(2) Optimum motor life.
(3) Exceeding these values may cause motor components to remain in hole.

Short SuperHawk 7 in O.D.
4:5 Lobes, 7.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	48.13
Nominal Length	303 in
Weight	2,450 lbs
Performance Data	
Bit Speed (No Load)	149-300 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,580 psi
Max Power	482 hp
Max Torque	9,090 ft-lbs

Performance Curves

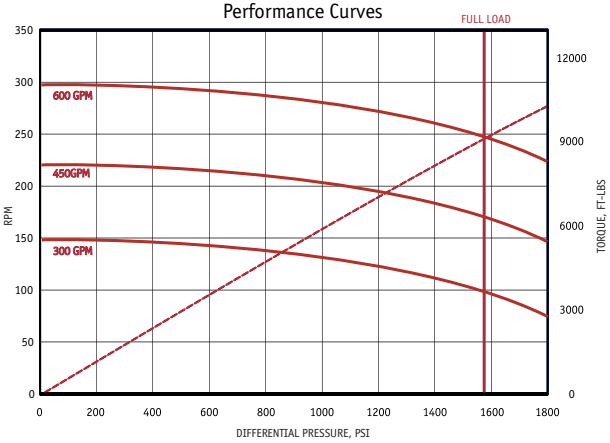


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	8.500	8.750	9.875	10.625	8.500	8.750	9.875	10.625
0.25	2.5	2.1	0.6		1.9	2.1	2.9	3.5
0.50	3.9	3.6	2.1		3.6	3.8	4.6	5.2
0.75	5.4	5.1	3.5	2.5	5.3	5.5	6.3	6.9
1.00	6.9	6.6	5.0	4.0	7.0	7.2	8.0	8.6
1.25	8.4	8.0	6.5	5.4	8.7	8.9	9.7	10.3
1.50	9.9	9.5	8.0	6.9	10.4	10.6	11.5	12.0
1.75	11.3	11.0	9.4	8.4	12.1	12.3	13.2	13.7
2.00	12.8	12.5	10.9	9.9	13.8	14.0	14.9	15.4
2.25	14.3	13.9	12.4	11.3	15.5	15.7	16.6	17.2
2.50	15.8	15.4	13.9	12.8	17.2	17.4	18.3	18.9
2.75	17.2	16.9	15.3	14.3	18.9	19.1	20.0	20.6
3.00	18.7	18.4	16.8	15.8	20.6	20.8	21.7	22.3

Short SuperHawk 7 in O.D.
5:6 Lobes, 8.2 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	48.13 in
Nominal Length	346 in
Weight	2,995 lbs
Performance Data	
Bit Speed (No Load)	127-260 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,850 psi
Max Power	523 hp
Max Torque	11,270 ft-lbs

Performance Curves

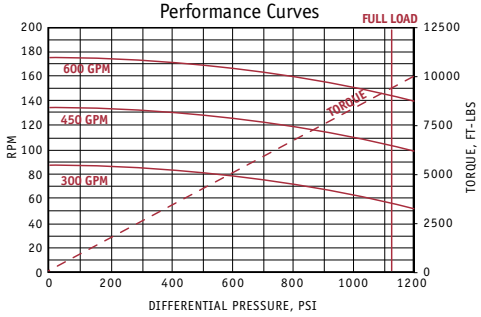


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	8.500	8.750	9.875	10.625	8.500	8.750	9.875	10.625
0.25	2.1	1.7	0.2		1.5	1.7	2.4	2.8
0.50	3.4	3.0	1.5		3.1	3.2	3.9	4.3
0.75	4.7	4.3	2.8	1.7	4.6	4.7	5.4	5.8
1.00	6.0	5.6	4.1	3.0	6.1	6.3	6.9	7.4
1.25	7.3	6.9	5.4	4.3	7.6	7.8	8.4	8.9
1.50	8.6	8.2	6.7	5.6	9.2	9.3	10.0	10.4
1.75	9.9	9.5	8.0	6.9	10.7	10.8	11.5	11.9
2.00	11.2	10.8	9.3	8.3	12.2	12.4	13.0	13.5
2.25	12.5	12.2	10.6	9.6	13.7	13.9	14.5	15.0
2.50	13.8	13.5	11.9	10.9	15.3	15.4	16.1	16.5
2.75	15.1	14.8	13.2	12.2	16.8	16.9	17.6	18.0
3.00	16.4	16.1	14.5	13.5	18.3	18.5	19.1	19.6

Short SuperHawk 7 in O.D.
6:7 Lobes, 5.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	48.13 in
Nominal Length	298 in
Weight	2,450 lbs
Performance Data	
Bit Speed (No Load)	87-180 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,130 psi
Max Power	290 hp
Max Torque	9,350 ft-lbs

Performance Curves

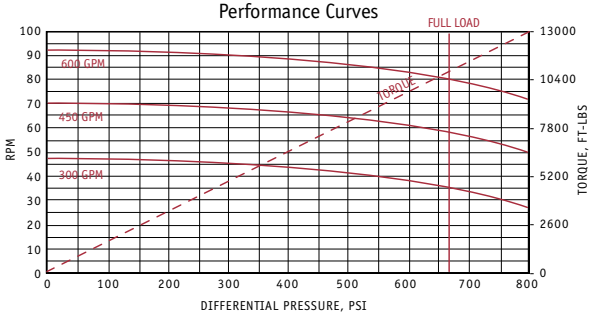


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	8.500	8.750	9.875	10.625	8.500	8.750	9.875	10.625
0.25	2.5	2.2	0.6		1.9	2.1	3.0	3.6
0.50	4.0	3.7	2.1		3.6	3.8	4.7	5.3
0.75	5.5	5.2	3.6	2.6	5.4	5.6	6.5	7.1
1.00	7.0	6.7	5.1	4.1	7.1	7.3	8.2	8.8
1.25	8.5	8.2	6.6	5.6	8.8	9.0	9.9	10.5
1.50	10.0	9.7	8.1	7.1	10.6	10.8	11.7	12.3
1.75	11.5	11.2	9.6	8.6	12.3	12.5	13.4	14.0
2.00	13.0	12.7	11.1	10.1	14.0	14.2	15.1	15.7
2.25	14.5	14.2	12.6	11.6	15.8	16.0	16.9	17.4
2.50	16.0	15.7	14.1	13.1	17.5	17.7	18.6	19.2
2.75	17.5	17.2	15.6	14.6	19.2	19.4	20.3	20.9
3.00	19.0	18.7	17.1	16.1	21.0	21.2	22.0	22.6

Short SuperHawk 7 in O.D.
7:8 Lobes, 3.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	48.13 in
Nominal Length	302 in
Weight	2,470 lbs
Performance Data	
Bit Speed (No Load)	46-93 rpm
Flow Range	300-600 gpm
Max Operating Pressure	680 psi
Max Power	180 hp
Max Torque	10,800 ft-lbs

Performance Curves

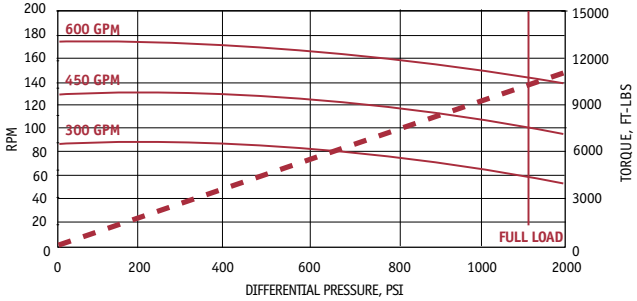


Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	8.500	8.750	9.875	10.625	8.500	8.750	9.875	10.625
0.25	2.5	2.1	0.6		1.9	2.1	2.9	3.5
0.50	4.0	3.6	2.1		3.6	3.8	4.7	5.2
0.75	5.4	5.1	3.5	2.5	5.3	5.5	6.4	6.9
1.00	6.9	6.6	5.0	4.0	7.0	7.2	8.1	8.7
1.25	8.4	8.1	6.5	5.5	8.7	8.9	9.8	10.4
1.50	9.9	9.5	8.0	7.0	10.4	10.6	11.5	12.1
1.75	11.4	11.0	9.5	8.4	12.1	12.3	13.2	13.8
2.00	12.8	12.5	10.9	9.9	13.9	14.1	14.9	15.5
2.25	14.3	14.0	12.4	11.4	15.6	15.8	16.6	17.2
2.50	15.8	15.5	13.9	12.9	17.3	17.5	18.3	18.9
2.75	17.3	16.9	15.4	14.4	19.0	19.2	20.1	20.6
3.00	18.8	18.4	16.9	15.8	20.7	20.9	21.8	22.3

SuperHawk 7 in O.D.
7:8 Lobes, 5.0 Stages HR

Physical Data	
Bit to Bend Length (ABH)	N/A
Bit to Bend Length (Fixed)	48.13 in
Nominal Length	298 in
Weight	2,420 lbs
Performance Data	
Bit Speed (No Load)	86-180 rpm
Flow Range	300-600 gpm
Max Operating Pressure	1,130 psi
Max Power	323 hp
Max Torque	10,460 ft-lbs

Performance Curves



Theoretical Build Rates - Degrees/100 ft. (Fixed Bend)								
Angle	Hole Size (in.) - Slick				Hole Size (in.) - Stabilized			
(Deg.)	8.500	8.750	9.875	10.625	8.500	8.750	9.875	10.625
0.25	2.5	2.2	0.6		1.9	2.1	3.0	3.6
0.50	4.0	3.7	2.1		3.6	3.8	4.7	5.3
0.75	5.5	5.2	3.6	2.6	5.4	5.6	6.5	7.1
1.00	7.0	6.7	5.1	4.1	7.1	7.3	8.2	8.8
1.25	8.5	8.2	6.6	5.6	8.8	9.0	9.9	10.5
1.50	10.0	9.7	8.1	7.1	10.6	10.8	11.7	12.3
1.75	11.5	11.2	9.6	8.6	12.3	12.5	13.4	14.0
2.00	13.0	12.7	11.1	10.1	14.0	14.2	15.1	15.7
2.25	14.5	14.2	12.6	11.6	15.8	16.0	16.9	17.4
2.50	16.0	15.7	14.1	13.1	17.5	17.7	18.6	19.2
2.75	17.5	17.2	15.6	14.6	19.2	19.4	20.3	20.9
3.00	19.0	18.7	17.1	16.1	21.0	21.2	22.0	22.6

Table 4.1 - SuperHawk Motor Specifications									
Motor Size	Rec. Hole Size	Std. Bit Connection	Std. Top Connection	Max. WOB** Operating	Max. Continuous WOB*	Max. Bit Pull**	Max. Body Pull **	Bit to Bend ABH	Bit to Bend Fixed
(in.)	(in.)			(lbs)	(lbs)	(lbs)	(lbs)	(in)	(in)
SH 1-11/16"	1 13/16" - 3"	1" MT	1" MT	5,600	2,800	30,000	45,500	N/A	N/A
SH 2 1/8"	2 5/8" - 3 1/4"	1 1/2" MT	1 1/2" MT	9,700	4,850	39,000	90,000	N/A	N/A
SH 2 3/8"	2 7/8" - 3 1/2"	1 1/2" MT	1 1/2" MT	9,900	4,950	45,000	105,000	31.38	22.38
SH 2 7/8"	3 1/2" - 4 3/4"	2 3/8" Reg	2 3/8" Reg	10,400	5,200	70,000	165,000	31.25	27.75
SH 3 1/8"	3 3/4" - 5"	2 3/8" Reg	2 3/8" Reg	11,300	5,650	75,000	180,000	31.25	27.75
SH 3 1/2"	4 3/4" - 5 7/8"	2 7/8" Reg	2 7/8" Reg	16,000	8,000	150,000	238,000	50.50	40.50
SH 3 3/4"	4 3/4" - 5 7/8"	2 7/8" Reg	2 7/8" Reg	16,000	8,000	150,000	318,000	50.50	40.50
SH 4 3/4"	6" - 7 7/8"	3 1/2" Reg	3 1/2" IF	38,500	19,250	190,000	403,000	63.00	52.69
SH 5"	6" - 7 7/8"	3 1/2" Reg	3 1/2" IF	40,500	20,250	200,000	425,000	63.38	51.13
SH 6 1/4"	7 7/8" - 9 7/8"	4 1/2" Reg	4 1/2" Reg	68,500	34,250	300,000	625,000	66.75	62.25
SH 6 1/2"	7 7/8" - 9 7/8"	4 1/2" Reg	4 1/2" IF	110,000	55,000	380,000	675,000	82.50	64.25
SH 6 3/4"	7 7/8" - 9 7/8"	4 1/2" Reg	4 1/2" IF	110,000	55,000	380,000	832,000	82.50	64.25
SH 7"	8 1/2" - 10 5/8"	4 1/2", 6 5/8" Reg	4 1/2" IF, 6 5/8" Reg	110,000	55,000	380,000	832,000	82.50	64.25
SH 7 3/4"	9 7/8" - 12 1/4"	6 5/8" Reg	6 5/8" Reg	116,000	58,000	450,000	1,000,000	88.50	68.50
SH 8"	9 7/8" - 12 1/4"	6 5/8" Reg	6 5/8" Reg	133,000	66,500	540,000	1,200,000	88.50	68.50
SH 9 5/8"	12 1/4"-17 1/2"	7 5/8" Reg	6 5/8" Reg	140,000	70,000	800,000	1,450,000	101.00	77.00
SS 4 3/4"	6" - 7 7/8"	3 1/2" Reg	3 1/2" IF	28,750	14,500	190,000	403,000	51.45	38.63
SS 5"	6" - 7 7/8"	3 1/2" Reg	3 1/2" IF	30,750	15,375	200,000	425,000	52.00	39.00
SS 6 3/4"	7 7/8" - 9 7/8"	4 1/2" Reg	4 1/2" IF	70,000	35,000	380,000	832,000	65.32	43.00
SS 7"	8 1/2" - 10 5/8"	4 1/2", 6 5/8" Reg	4 1/2" IF, 6 5/8" Reg	90,000	45,000	400,000	975,000	n/a	48.13

SH = SuperHawk Motor
SS = Short SuperHawk Motor

*Optimum Motor Life
**Possible damage if exceeded (Do Not Re-run Motor)

Table 4.2 - SuperHawk Motor Torque and Compression Values										
Motor Size	Compression	Stop Ring	Flow Div.	Driver	End Nut	Housing	Talon ABH	Stabilizer	Rotor Catch	Catch Ring
(in.)	(in.)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)	(Ft-lbs)
SH 1- 11/16"	.020 - .025	150	150	150	325	325			20	
SH 2 1/8"	.025 - .030	250	375	375	900	900			25	
SH 2 3/8"	.025 - .030	300	400	400	1,100	1,100	1,250		30	
SH 2 7/8"	.030 - .035	750	900	900	2,200	2,200	2,750		100	
SH 3 1/8"	.030 - .035	900	1,000	1,000	2,450	2,450	3,250		125	350
SH 3 1/2"	.035 - .040	1,000	1,350	1,000	3,000	3,000	4,850		300	450
SH 3 3/4"	.035 - .040	1,000	1,350	1,000	5,000	5,000	5,750		300	450
SH 4 3/4"	.055 - .065	7,500	5,000	4,250	7,500	8,500	9,000	4,000	650	650
SH 5"	.065 - .070	8,000	5,250	4,500	8,000	9,250	10,000	5,000	650	700
SH 6 1/4"	.065 - .075	13,500	12,750	7,000	14,500	18,500	19,500	10,500	950	2,250
SH 6 1/2"	.070 - .080	16,500	15,000	12,500	18,500	18,500	26,500	12,000	1,500	2,500
SH 6 3/4"	.070 - .080	16,500	15,000	12,500	18,500	25,000	28,500	12,000	1,500	2,500
SH 7"	.075 - .085	17,500	18,500	12,500	20,000	28,500	31,500	14,000	1,500	2,500
SH 7 3/4"	.085 - .095	28,500	20,000	17,500	37,500	38,500	43,500	20,000	1,750	2,750
SH 8"	.090 - .100	30,000	22,500	17,500	38,500	40,000	45,000	22,000	1,750	2,750
SH 9 5/8"	.100 - .110	47,500	40,000	35,000	49,500	65,000	70,000	30,000	3,750	5,000
SS 4 3/4"	.045 - .055	7,500	5,000	4,250	7,500	8,500	9,000	4,000	650	650
SS 5"	.055 - .065	8,000	5,250	4,500	8,000	9,250	10,000	5,000	650	700
SS 6 3/4"	.060 - .070	16,500	15,000	12,500	18,500	25,000	28,500	12,000	1,500	2,500
SS 7"	.065 - .075	17,500	18,500	12,500	20,000	28,500	31,500	14,000	1,500	2,500

SH = SuperHawk Motor

SS = Short SuperHawk Motor

FORMULAS

Horsepower

Mechanical

$$HP_m = \frac{T \times N}{5252}$$

HP_m = motor mechanical horsepower (hp)
T = torque (ft-lbs)
N = speed (rpm)

Hydraulic

$$HP_h = \frac{P \times Q}{1714}$$

HP_h = hydraulic horsepower at bit
P = pressure drop (psi)
Q = flow rate (gpm)

Pressure

Bit Pressure Drop

$$P = \frac{Q^2 \times W}{10{,}858 \times A^2}$$

P = pressure drop (psi)
Q = flow rate (gpm)
W = fluid (mud)weight (ppg)
A = total flow area (in^2)

Hydrostatic

$$P = 0.052 \times D \times W$$

D = vertical depth (ft)

Velocity

Jet

$$V = \frac{0.32086 \times Q}{A}$$

V = velocity (ft/s)
Q = flow rate (gpm)
A = jet flow area (in^2)

Annular

$$V = \frac{0.4085 \times Q}{D_h^2 - D_p^2}$$

D_h = hole diameter (in)
D_p = drillstring OD (in)

Motor Efficiency

Motor Efficiency

$$\% = \frac{32.64 \times T}{Q \times P} \times N$$

T = torque (ft-lbs)
N = speed (rpm)
Q = flow rate (gpm)
P = pressure drop (psi)

CONVERSION TABLES

CONVERSION TABLES			
Acceleration (Acc. of gravity)	Units	Multiply By	To Obtain
	ft/sec^2	0.3048	m/sec^2
	32.2 ft/sec^2	0.3048	9.81 m/sec^2
	m/sec^2	3.2808	ft/sec^2
Angle	deg (angle)	60	min
	deg (angle)	0.01745	rad
	deg (angle)	3600	sec
Area	in^2	6.944×10^{-3}	ft^2
	in^2	6.4516	cm^2
	in^2	645.16	mm^2
	ft^2	0.0929	m^2
	ft^2	144	in^2
	cm^2	0.155	in^2
	mm^2	0.00155	in^2
	m^2	10.764	ft^2
Density	lb/gal	119.82	kg/m^3
	lb/gal	0.11982	g/cm^3
	lb/gal	7.48	lb/ft^3
	lb/ft^3	5.787×10^{-4}	lbs/in^3
	lb/ft^3	16.02	kg/m^3
	lb/in^3	27679.7	kg/m^3
	lb/in^3	27.6797	g/cm^3
	kg/m^3	8.346×10^{-3}	lb/gal
	g/cm^3	8.346	lb/gal
	kg/m^3	3.61×10^{-5}	lb/in^3
	kg/m^3	0.06243	lb/ft^3
	g/cm^3	0.03613	lb/in^3
Energy	joule	0.737557	ft-lb
	ft-lb	1.35583	joule
	ft-lb	1.286×10^{-3}	Btu
	Btu	777.6	ft-lb

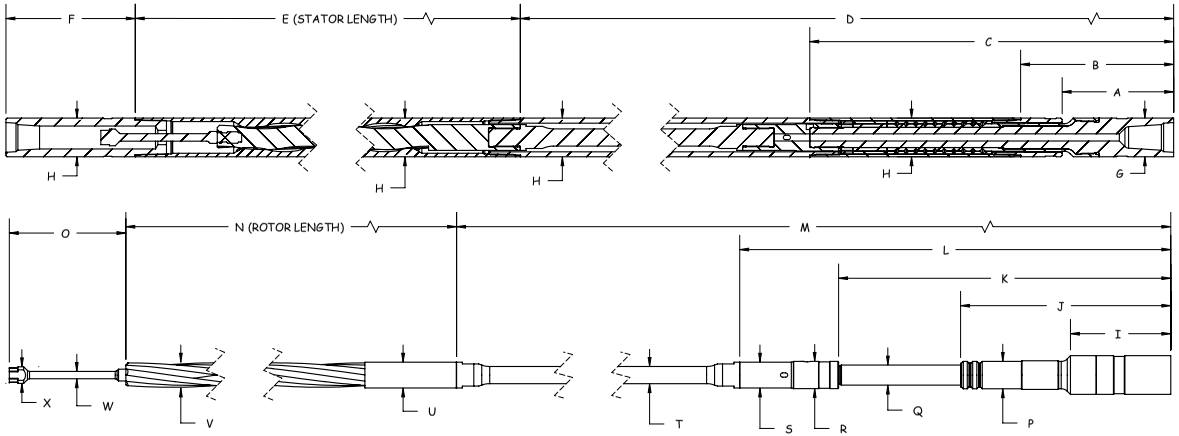
CONVERSION TABLES CONT'D			
	Units	Multiply By	To Obtain
Flowrate	bbl/min	42	gpm
	bbl/day	0.02917	gpm
	gpm	0.02381	bbl/min
	gpm	34.286	bbl/day
	gpm	3.785	lpm
	gpm	3.785×10^{-3}	m^3/min
	bbl/min	0.158899	m^3/min
	ft^3/min	4.72×10^{-4}	m^3/sec
	ft^3/min	0.1247	gal/sec
	ft^3/min	0.472	liters/sec
	ft^3/sec	448.83	gpm
	lpm	0.2642	gpm
	m^3/min	264.2	gpm
	m^3/min	6.2933	bbl/min
	m^3/sec	2118.6	ft^3/min
	gal/sec	8.0515	ft^3/min
	liters/sec	2.1186	ft^3/min
	gpm	0.002228	ft^3/sec
Force	lbf	4.448	N
	lbf	4.448×10^{-3}	kN
	lbf	0.4536	kgf
	N	0.22481	lbf
	kN	224.82	lbf
	kgf	2.20459	lbf
Length	in	25.4	mm
	in	2.54	cm
	ft	0.30479	m
	ft	5280	mi
	mi	1.609	km
	mm	0.03937	in
	cm	0.3937	in
	m	3.2808	ft
	km	0.6215	mi

CONVERSION TABLES CONT'D			
	Units	Multiply By	To Obtain
Mass	lb	0.453597	kg
	lb	4.535 x 10^{-4}	ton (metric)
	kg	2.2046	lb
Nozzles	1/32 in	0.79375	mm
	mm	1.2598	1/32 in
Power	hp	0.7457	kw
	ft-lb/min	2.259 x 10^{-5}	kw
	ft-lb/s	1.3557	w
	kw	1.34102	hp
	kw	44250	ft-lb/min
	w	0.7376	ft-lb/s
Pressure	psi	6.8948	kPa
	psi	0.0068948	Mpa
	psi	0.0680462	atm
	psi	0.068948	bar
	atm	14.6959	psi
	bar	14.50326	psi
	kPa	0.14504	psi
	Mpa	145.03684	psi
Stress	psi	0.0068948	MPa
	psi	0.068948	bar
	psi	0.0068948	N/mm^2
	bar	14.50326	psi
	MPa	145.03684	psi
	N/mm^2	145.03684	psi
Temperature	° F	(° F- 32) / 1.8	° C
	° C	(° C x 1.8) + 32	° F
	° F	° F + 459.69	° R
	° C	° C + 273.16	K
Torque	ft-lb	1.35582	Nm
	ft-lb	0.00135582	kNm
	ft-lb	0.1382	kgm
	Nm	0.737561	ft-lb
	kNm	737.561	ft-lb
	kgm	7.23589	ft-lb
Velocity	ft/min	0.508	cm/s
	ft/min	0.01667	ft/sec
	ft/min	0.01829	km/hr
	ft/min	0.3048	m/min
	ft/min	0.01136	mi/hr
	cm/s	1.9685	ft/min
	ft/sec	59.988	ft/min
	km/hr	54.67	ft/min
	m/min	3.281	ft/min
	mi/hr	88.028	ft/min
Volume	gal (US)	3.785	l
	gal (US)	0.003785	m^3
	ft^3	0.02831	m^3
	bbl	0.1589	m^3

TomaHawk
DOWNHOLE

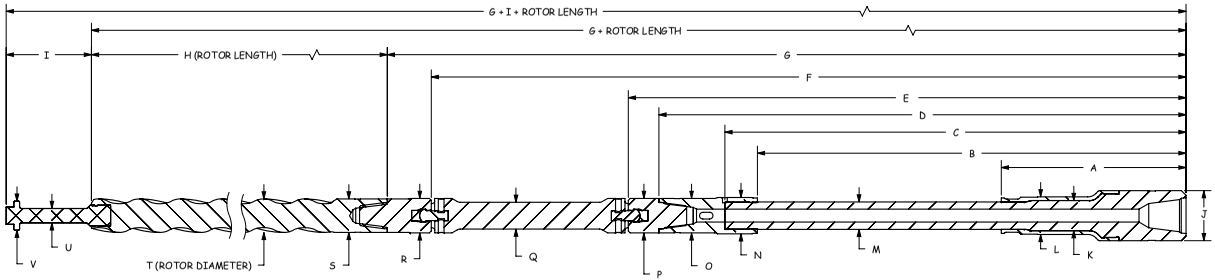
FISHING DIMENSIONS

SuperHawk High Pull Fishing Dimensions



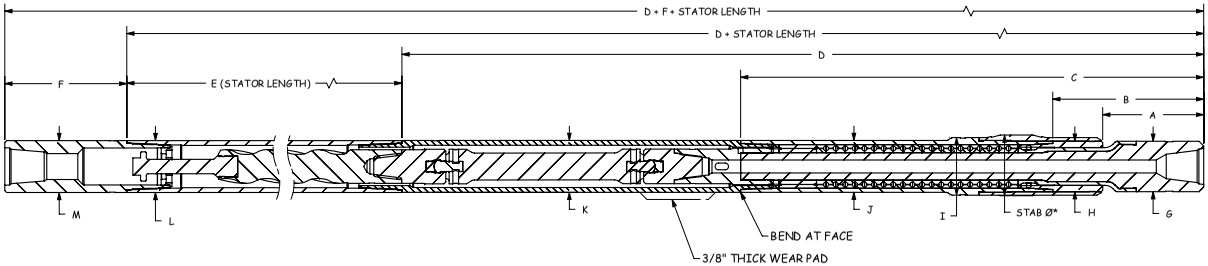
Mtr Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1 11/16"	4.86	6.68	15.87	35.56	SL	5.64	1.69	1.69	4.86	9.17	14.50	18.80	35.56	RL	5.08	1.20	0.88	1.19	1.13	0.75	1.13	RD	0.33	0.73
2 1/8"	6.35	8.53	19.38	41.10	SL	7.56	2.13	2.13	5.63	11.47	17.97	22.35	41.10	RL	6.00	1.40	1.06	1.44	1.31	0.88	1.25	RD	0.50	0.95
2 3/8"	6.35	8.53	20.38	44.38	SL	7.50	2.38	2.38	5.63	11.97	18.47	23.47	44.38	RL	7.13	1.65	1.31	1.69	1.56	0.94	1.50	RD	0.56	0.95
2 7/8"	8.00	10.12	24.60	52.01	SL	6.62	2.88	2.88	6.99	14.28	22.22	29.01	52.01	RL	5.13	1.88	1.38	1.88	1.75	1.13	1.63	RD	0.61	1.13
3 1/8"	8.00	10.86	25.44	57.97	SL	8.00	3.13	3.13	7.00	15.03	23.09	29.96	57.97	RL	6.73	2.28	1.62	2.19	2.00	1.25	2.00	RD	0.75	1.75

SuperHawk Inner Fishing Dimensions



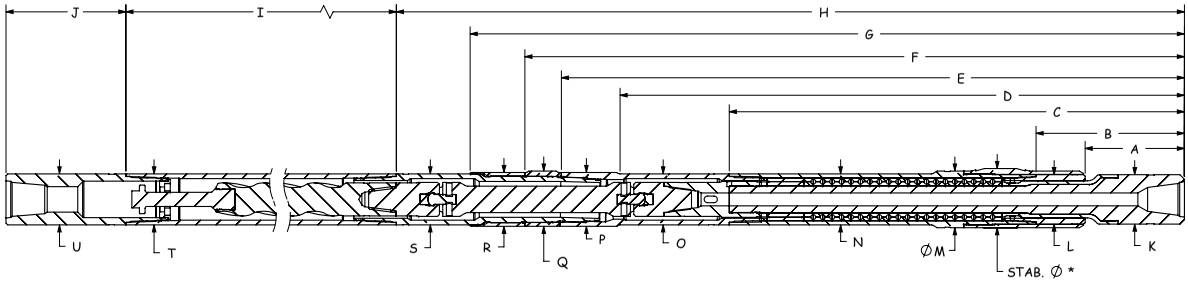
Motor Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
SH 3 1/2"	15.74	35.55	38.44	42.50	45.18	62.06	65.06	RL	7.74	3.50	2.00	2.53	1.81	2.38	2.19	2.43	2.00	2.43	2.00	RD	0.88	1.75
SH 3 3/4"	15.74	35.55	38.44	42.50	45.18	62.06	65.06	RL	7.74	3.75	2.00	2.53	1.81	2.38	2.19	2.43	2.00	2.43	2.00	RD	0.88	1.75
SH 4 3/4"	20.30	43.19	46.72	52.94	55.89	76.94	81.53	RL	9.00	4.70	2.88	3.54	2.62	3.38	3.25	3.25	2.50	3.25	3.13	RD	1.15	2.38
SH 5"	20.30	37.60	41.17	53.12	56.12	77.12	81.69	RL	9.00	4.88	3.03	3.69	2.77	3.53	3.38	3.50	2.75	3.50	3.13	RD	1.15	2.38
SH 6 1/4"	22.35	52.27	56.27	63.77	67.77	93.00	99.14	RL	9.00	6.13	3.71	4.19	3.15	4.25	4.00	4.25	3.50	4.25	3.75	RD	1.88	3.50
SH 6 1/2"	24.15	56.03	60.28	68.88	72.38	99.18	104.40	RL	11.15	6.50	3.77	4.74	3.41	4.58	4.25	4.50	3.50	4.50	4.38	RD	1.88	3.80
SH 6 3/4"	24.15	56.03	60.28	68.88	72.38	99.18	104.40	RL	11.15	6.55	3.94	4.92	3.58	4.75	4.50	4.50	3.50	4.50	4.38	RD	1.88	3.80
SH 7"	22.39	52.46	56.71	65.34	69.34	94.99	100.75	RL	11.15	6.80	4.10	5.07	3.74	5.00	4.67	5.00	4.00	5.00	4.38	RD	1.88	3.80
SH 7 3/4"	26.75	62.00	66.63	74.89	78.89	105.38	111.13	RL	7.65	7.65	4.69	5.78	4.12	5.63	5.00	5.38	4.00	5.38	5.00	RD	2.06	4.06
SH 8"	26.75	62.00	66.63	74.89	78.89	105.38	111.13	RL	9.34	7.85	4.69	5.78	4.12	5.63	5.00	5.38	4.00	5.38	5.00	RD	2.06	4.06
SH 9 5/8"	29.80	66.97	72.51	83.27	88.39	123.88	131.87	RL	10.50	9.45	5.69	7.03	5.41	6.88	5.88	6.25	5.00	6.25	5.88	RD	2.25	5.25

SuperHawk Outer Fishing Dimensions Fixed Bend



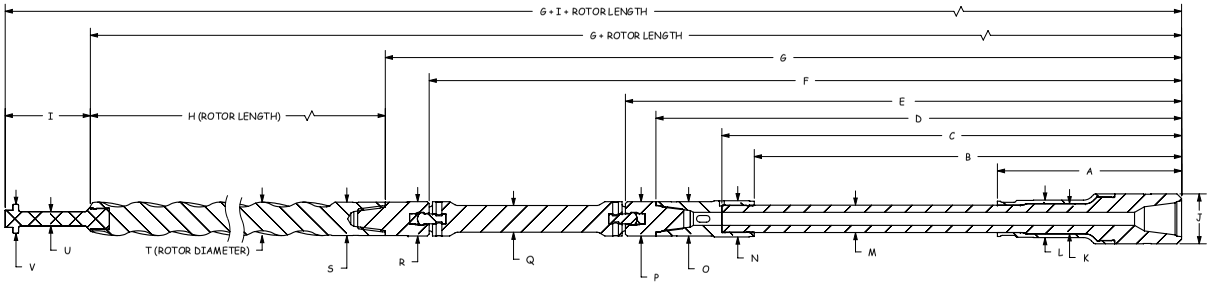
Mtr Size	A	B	C	D	E	F	G	H	Stab Ø	I	J	K	L	M
SH 3 1/2"	9.61	12.86	38.43	55.19	SL	10.12	3.5	3.5	Stab Ø	N/A	3.5	3.5	3.5	3.5
SH 3 3/4"	9.61	12.86	38.43	55.19	SL	10.12	3.75	3.75	Stab Ø	N/A	3.75	3.75	3.75	3.75
SH 4 3/4"	12.05	16.80	46.69	80.02	SL	11.38	4.70	4.70	Stab Ø	5.56	4.75	4.75	4.75	4.75
SH 5"	11.74	16.55	46.94	81.64	SL	11.25	4.88	4.88	Stab Ø	5.75	5.00	5.00	5.00	5.00
SH 6 1/4"	12.10	18.10	56.27	97.77	SL	14.25	6.13	6.13	Stab Ø	7.00	6.25	6.25	6.25	6.25
SH 6 1/2"	13.15	19.65	60.28	104.25	SL	15.88	6.50	6.50	Stab Ø	7.50	6.50	6.50	6.50	6.50
SH 6 3/4"	13.15	19.65	60.28	104.25	SL	15.88	6.55	6.55	Stab Ø	7.50	6.75	6.75	6.75	6.75
SH 7"	13.03	17.90	56.71	100.77	SL	15.88	6.80	6.80	Stab Ø	7.76	7.00	7.00	7.00	7.00
SH 7 3/4"	14.75	21.88	66.63	111.13	SL	16.00	7.65	7.65	Stab Ø	8.63	7.75	7.75	7.75	7.75
SH 8"	14.75	21.88	66.63	112.63	SL	16.00	7.85	7.85	Stab Ø	8.83	8.00	8.00	8.00	8.00
SH 9 5/8"	16.30	23.80	72.47	131.85	SL	17.50	9.45	9.45	Stab Ø	10.63	9.63	9.63	9.63	9.63

SuperHawk Outer Fishing Dimensions ABH



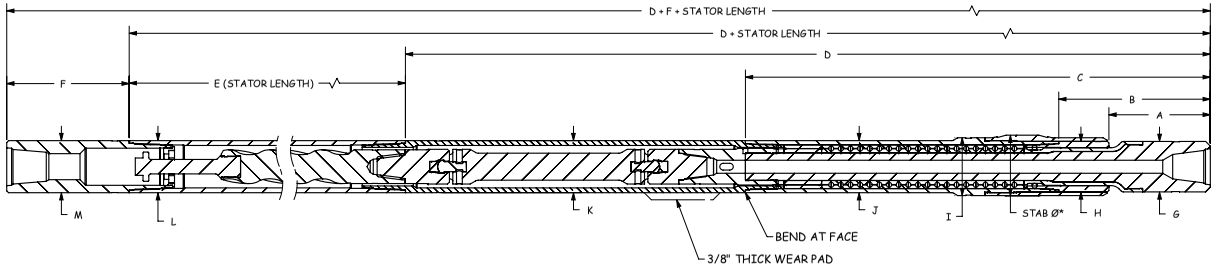
Mtr Size	A	B	C	D	E	F	G	H	I	J	K	L	Stab Ø	M	N	O	P	Q	R	S	T	U
SH 3 1/2"	9.61	12.86	38.43	45.43	50.56	53.83	59.82	66.35	SL	10.12	3.50	3.50	stab Ø	n/a	3.50	3.50	3.75	4.13	3.75	3.50	3.50	3.50
SH 3 3/4"	9.61	12.86	38.43	45.43	50.56	53.83	59.82	66.35	SL	10.12	3.75	3.75	stab Ø	n/a	3.75	3.75	4.00	4.25	4.00	3.75	3.75	3.75
SH 4 3/4"	12.05	16.80	46.69	56.69	66.73	66.73	73.75	80.52	SL	11.38	4.70	4.70	stab Ø	5.56	4.75	4.75	5.13	5.38	5.13	4.75	4.75	4.75
SH 5"	11.74	16.55	46.94	56.94	67.23	67.23	74.24	81.76	SL	11.25	4.88	4.88	stab Ø	5.75	5.00	5.00	5.38	5.62	5.38	5.00	5.00	5.00
SH 6 1/4"	12.10	18.10	56.27	68.27	78.36	83.02	90.27	97.65	SL	14.25	6.13	6.13	stab Ø	7.00	6.25	6.25	6.63	6.88	6.63	6.25	6.25	6.25
SH 6 1/2"	13.15	19.65	60.28	74.72	82.60	87.34	94.59	104.35	SL	15.88	6.50	6.50	stab Ø	7.50	6.50	6.50	6.88	7.13	6.88	6.50	6.50	6.50
SH 6 3/4"	13.15	19.65	60.28	74.72	82.60	87.34	94.59	104.35	SL	15.88	6.55	6.55	stab Ø	7.50	6.75	6.75	7.13	7.31	7.13	6.75	6.75	6.75
SH 7"	13.03	17.90	56.71	70.71	78.50	84.00	92.20	100.77	SL	15.88	6.80	6.80	stab Ø	7.76	7.00	7.00	7.38	7.75	7.38	7.00	7.00	7.00
SH 7 3/4"	14.75	21.88	66.63	80.40	88.76	94.37	101.70	111.13	SL	16.00	7.65	7.65	stab Ø	8.63	7.75	7.75	8.13	8.43	8.13	7.75	7.75	7.75
SH 8"	14.75	21.88	66.63	80.40	88.76	94..37	101.70	111.13	SL	16.00	7.85	7.85	stab Ø	8.83	8.00	8.00	8.38	8.65	8.38	8.00	8.00	8.00
SH 9 5/8"	16.30	23.80	72.47	89.59	101.19	107.76	117.11	131.84	SL	17.50	9.45	9.45	stab Ø	10.63	9.63	9.63	10.13	10.51	10.13	9.63	9.63	9.63

Short SuperHawk Inner Fishing Dimensions



Motor Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
SS 4 3/4"	16.75	31.70	35.20	41.44	44.38	65.43	70.33	RL	9.00	4.70	2.88	3.54	2.62	3.38	3.25	3.25	2.50	3.25	3.13	RD	1.15	2.38
SS 5"	16.75	31.70	35.20	41.44	44.38	65.43	70.33	RL	9.00	4.88	3.03	3.69	2.77	3.53	3.38	3.50	2.75	3.50	3.13	RD	1.15	2.38
SS 6 3/4"	21.63	38.75	43.00	51.60	55.10	81.90	87.12	RL	11.15	6.55	3.94	4.92	3.58	4.75	4.50	4.50	3.50	4.50	4.38	RD	1.88	3.80
SS 7"	22.39	39.96	44.21	52.84	56.84	82.49	88.24	RL	11.15	6.80	4.10	5.07	3.74	5.00	4.67	5.00	4.00	5.00	4.38	RD	1.88	3.80

Short SuperHawk Outer Fishing Dimensions



Mtr Size	A	B	C	D	E	F	G	H	Stab Ø	I	J	K	L	M
SS 4 3/4"	10.00	13.25	35.20	69.00	SL	11.38	4.70	4.70	Stab Ø	5.56	4.75	4.75	4.75	4.75
SS 5"	9.74	13.00	35.50	69.30	SL	11.25	4.88	4.88	Stab Ø	5.75	5.00	5.00	5.00	5.00
SS 6 3/4"	12.38	17.38	43.00	83.07	SL	15.88	6.55	6.55	Stab Ø	7.50	6.75	6.75	6.75	6.75
SS 7"	13.03	17.90	44.21	88.17	SL	15.88	6.80	6.80	Stab Ø	7.76	7.00	7.00	7.00	7.00

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