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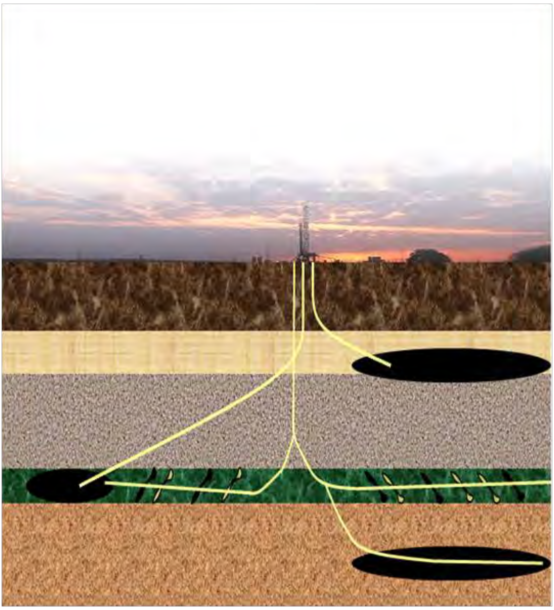

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INTRODUCTION

The **Supreme Source Energy Services, Inc. (SSES)** Operations Manual covers basic procedures and principals in the operation of **SSES** positive displacement mud motors This manual includes basic operating information, specifications and tool parameters and also provides general information for the user to operate our equipment safely and effectively. As always, specific applications may dictate changes in procedures, therefore this manual is to be used as a guideline only. If there are any questions, please contact your nearest **Supreme Source Energy Services, Inc. (SSES)** representative. This manual is divided into sections dealing with motors and includes basic engineering data for use at the rig. In addition, specifications for each motor power section are available to help the user identify the proper power section for optimum drilling performance.

Bearing Assembly
(A)

Each **SSES** drilling motor comes equipped with a fluid cooled marine bearing system. Bearings are configured to accommodate high speed/low torque or low speed/high torque, and Adjustable, fixed or short bit to bend without altering radial or axial loading.

Drive Shaft Assembly
(B)

The **SSES** drive shaft is used to convert the eccentric motion of the motor (rotor) to a smooth concentric motion required by the bearing section. The design of rugged hard faced steel, allows the motor to operate at high bent housing angles, yet still be able to handle high torque and speed. There are no boots or seals that could potentially fail in the design.

Adjustable Bent Housing/Fixed Housing/Short bend Bit to bend bearing housing
(C)

SSES adjustable housings are available in 0°-3° settings. The housing is easily adjustable and allows the operator to reset angles at the rig floor, eliminating the need to change assemblies or motors. Always follow the specifications for proper torqueing of the assembly
(See pg. 71 - 72 for proper procedures)

Power Sections
(D)

SSES power sections are made up of a lobed tungsten carbide coated rotor that fits inside a hard elastomer lined rubber housing (stator). The rotor has one less lobe than the stator, creating a continuously sealing chamber. Drilling fluid or gas is forced through the motor, thereby turning the rotor and generating torque.
Where drilling requirements call for circulation rates exceeding maximum recommended rates, rotors can be jetted to allow excessive fluid to flow down a parallel path, thereby reducing damage to the elastomer in the stator

Top Sub
(E)

ALL top subs are bored for a latch catch assembly and a float valve space above it.

BASIC PROCEDURE:

This section describes basic operating procedures, which are used in the field and will facilitate proper operation of SSES motors.

Bit Selection

An important aspect of any planned downhole motor run, is properly matching the bit and hydraulics to the motor in order to achieve the desired results. Attention must be given to TFA (total flow area) to see that proper parameters are maintained with regard to pressure drop across bit, annular velocity needed for hole cleaning, maximum standpipe pressure, and adequate hole cleaning at the bit\formation interface. Keep in minds that stall Pressure of a motor may approach pump relief valve limits in some cases. In larger hole sizes, a bored rotor may be necessary to accommodate fluid requirements mentioned above. Generally, all motor sizes have adequate torque to run any cone type bit. Abrasive PDC bits may cause stalling in rough and broken formations. If the purpose of the run is to build angle, or otherwise achieve significant deviation, short gauge length on the bit is very important. Gauge protection is necessary if the motor is bent, since continual side loading occurs at the bit.

Surface Testing (& Orientation)

The **SSES** motor is a marine bearing motor, so it may be safely surface tested with or without a bit attached. It is recommended that a bit not be attached if the motor is significantly bent, and needs to be positioned in the BOP's (blow-out preventers) or, below the BOP’s. If the downhole motor is tested without a bit, be sure to remove the bit box thread protector before lowering the motor into the hole. When the downhole motor is equipped with a float valve be sure that the valve is inserted so the plunger or flapper will open toward the bit box. Motor should vibrate the drill string or Kelly during the test.

When the pump is shut down, if the pressure doesn't bleed off, open the fill-up line on the standpipe to relieve the pressure. Pick the motor up, and attach the selected bit. If a bent housing adjustment is needed, lower the motor down to the adjustable housing, and make the needed change according to the accompanying setting procedure (see pg. 71 - 72). Upon completion of the setting procedure, mark the tool face, and slowly lower the motor into the hole, keeping the tool face alignment as you go. At this point, you can align and test whatever steering device is to be used, and proceed on in the hole. Please note, motors are pre-tested in water and should be properly thawed before surface testing when operating in sub-zero temperatures.

Running In

We recommend running a float valve with the downhole motor. This keeps trash out of the ID of the string. The float will also keep the motor from running backward as the pipe fills up. If heat is a factor, it is a good idea to break circulation in stages as you approach the high temperature depth. Pumping should be at a slow rate and kept up long enough to move some cool mud down to the motor. Reciprocation of the drill string up and down during the pumping operation will keep casing wear to a minimum, and decrease the likelihood of leaving a ledge if the motor is in open hole. If the motor bend is extreme, keep running speeds slowly to minimize the chance of creating ledges. Running speeds should also be slow when dealing with high mud weights and small liners, as pressure surges might knock the bottom out at the liner shoe.

Drilling

Drilling with a downhole motor is monitored mainly by changes in standpipe pressure. The amount of torque created at the bit face will be reflected by an increase in standpipe pressure over the **"off bottom"** pressure reading. This difference in pressure is called **"differential pressure".** The maximum motor differential pressure indicated in the downhole motor specifications is the total differential recommended. It takes from 10 to 15% of that total to turn the rotor in the off bottom position.

The difference is the amount that is usable with WOB (weight-on-bit).

When tagging bottom for the first time, keep in mind that a new bottom pattern needs to be established, especially if a different assembly, bit or a different bend is employed. Higher differential pressures will be noted with less bit weight if PDC (drag) bits are used. Regular diamond bits will increase standpipe pressure slightly when bottom is tagged due to the reduction in flow area around the bit face. Whether the drilling operation is sliding or rotating, we recommend keeping differential at **60-75% of the maximum motor differential noted in the specifications.** ROP (rate of penetration) is a function of rpm, bit geometry and formation.

Good weight transfer is normally accomplished with rotation of the drill string. Optimization of ROP can be attained with incremental changes of WOB.

We recommend (for sections of hole where long rotation periods are anticipated) that bends be kept to a maximum of 1.5° (actual) and surface rotary speed be kept below 90 rpm. Special precautions should be considered if high temperature is a factor in the well. The stator elastomer may swell and begin to fail. Pumps should be brought up to speed slowly to allow the rotor to begin turning, and then gradually increased to ease the shock loading of the swollen elastomer.

Stall Indication/ Reaction

A motor stall is indicated by a sudden increase in standpipe pressure while drilling. When a stall occurs, it is important to cut back pump strokes before lifting the motor off bottom. This reduces the pressure in the power section and will allow the driller to restart the motor.

Pulling Out

Care should be taken when pulling a bent housing motor through the BOP stack. A bent motor may damage the internal components of the stack. Check the bearing stack lateral and axial play to determine if the motor should be re-run. Then procedure to check is as follows:

When picking the motor up to break the bit off, fill the NMDC with water or a water hose can be tied off in the top of the motor (if a hollow lift nipple is available). Place the bit in the bit breaker, put the lead tongs on the bearing housing to hold back up, and carefully bump the rotary intermittently to the right. If the bit output shaft is locked, lay the motor down. If the bit turns freely, engage the rotary and turn the bit slowly, to flush the water through the downhole motor until it cleans up at the bit nozzles. Break the bit off the downhole motor. If a float valve is being used, be sure to pull the valve, clean and check the rubber and springs. If a re-run is being considered, a check of the lateral and radial play of the bearings is essential.

Motor Applications

SSES supplies some of the strongest and most durable motors available. It is this criteria that allows us the flexibility to participate in almost any application with maximum performance.

Performance\Straight Hole Drilling

With the continued development of PDC bits and more powerful power sections, it has become cost effective to pair the two when long straight hole sections are to be drilled. **SSES** offers a full line of motors that have proven themselves in very deep, hot, high mud weight, small hole applications. The savings recognized by operators due to reduced tubulars cost and savings in mud systems far outweighs the cost of conventional drilling at depth.

Directional\Steerable Drilling

SSES motors offer a surface adjustable bent housing that provides directional drillers with flexibility in the planning and execution of any directional drilling project. The 3° adjustable housing allows the drilling of any conventional open hole kick-off or sidetrack operation. The motors can be

oriented with single shot surveys, magnetic or gyroscopic wireline steering tools, measurement-while-drilling (MWD) tools and Electro magnetic (EM) MWD.

If a steerable system is to be used, **SSES** motors again display their versatility with the field replicable bearing housing stabilizer. Steerable systems are invaluable to wells that have multiple targets, or complex approach paths that are the result of geological constraints. The stabilization provided is normally 1/8 to 1/4 inch less than the hole gauge and can be tailored to the individual needs of the directional driller.

Supreme Source Energy Services, Inc. (SSES) Product Line

SSES's line of quality drilling tool sizes range from 4 3/4" OD to 6 1/2" OD, **SSES** also has access to drilling tools for any additional application (available upon request).

SSES has over 6 different configurations, **SSES** Mud Motors provide our customers with the versatility to tailor the motor to a specific bit and drilling application. With our combinations of power sections, rugged drive shafts and marine bearing assemblies **SSES** can build the exact tool to perform the job to the highest quality expected of their customers.

SSES Mud Motors have drilled thousands of feet of hole by marrying the power section you need with the bit required in the application.

SPECIFICATIONS:

The following sections show specifications recommended for the proper operation of **SSES** motors.

The performance graphs that accompany the specifications show maximum differential working (on/off bottom) pressure, torque, rpm, and horsepower as follows:

Maximum Pressure Differential: This is the maximum designed pressure dropped across the illustrated power section. It is indicated on the graph as 'MAX. DIFF.'. In this case, the pressure differential is 600 psi. For optimum performance and life, this pressure should not be exceeded.

Working Pressure: Due to losses from friction, turbulence, and pressure, the Working Pressure will be less than the Maximum Pressure Differential:

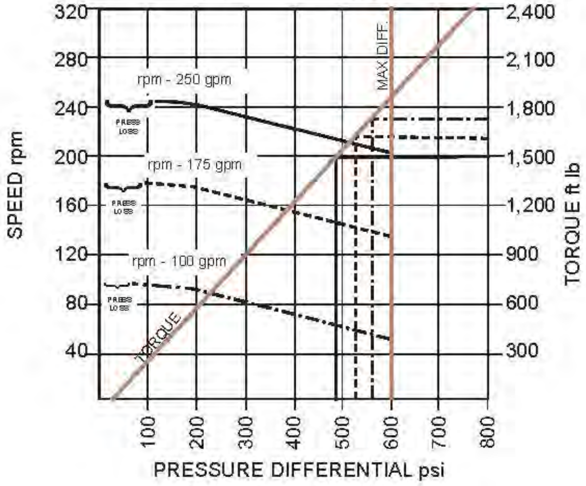
To determine the working pressure at 175 gpm, find the line marked 'rpm-175 gpm'. There is 75 psi indicated on the graph as 'Press. Loss'. This is the pressure loss through the motor at 175 gpm with no load on the bit. Therefore,
Effective Pressure = 600 psi - 75 psi = 525 psi

It is offset to the left of the 'MAX. DIFF.' line by an amount equal to the pressure loss (75 psi). Reading this line across the graph to the right will give you a **Torque** reading.
For this example, torque is 1600 ft-lb.

Rpm: To read rpm, find the line labeled 'rpm-175 gpm', and follow it to where it intersects the line labeled 'MAX. DIFF.'. Reading across the graph to the left, the rpm is 133 rpm

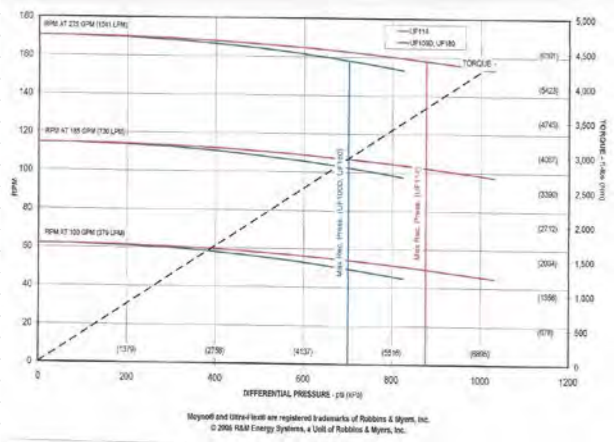
Horsepower: To determine the horsepower you must know the rpm and the torque at which you are running

$$hp = \frac{rpm \times torque}{5252} = \frac{133 \times 1600\ ft \cdot lb}{5252} = 40.5$$



Mud Motors:

4.75", 7:8 Lobe Ratio, 5.0 Stage Motor	
Physical Data	
Weight	**1100 lbs.**
Overall Length	**Standard-Fixed = 24.0 ft.**
	Standard-Adjustable = 25.0 ft.
Bend Length	**Standard-Fixed = 46.0"**
	Standard-Adjustable = 59.0"
Bit Box to NBS	**15.0"**
Tool OD	**4 7/8"**
Top Connection	**3 1/2 IF Box**
Bit Box Connection	**3 1/2 API Reg. Box**
Performance Data	
Flow Rate	**100-275 GPM**
Max. Flow With Bypass	**350 GPM**
Off Bottom Motor Speed	**62-170 RPM**
Off Bottom Rev./Gal.	**0.62**
Max. Recomm. Diff. Press.	**Standard Rubber = 700 psi**
	Hard Rubber = 900 psi
orque @ Max. Recomm. Diff. Press.	**Standard Rubber = 3000 ft-lbs.**
	Hard Rubber = 3800 ft-lbs
Operational Data	
Hole Size	**6 1/8"-7 7/8"**
Max. Bit Pressure Drop	**500 psi**
Max.Sustained WOB	**30,000 lbs.**
Max. Bit Overpull For Re-run	**200,000 lbs.**
Ultimate Bit Overpull	**350,000 lbs.**
Max. Body Overpull For Re-run	**275,000 lbs.**
Ultimate Body Overpull	**375,000 lbs.**



4.75", 5:6 Lobe Ratio, 8.3 Stage Motor

Physical Data

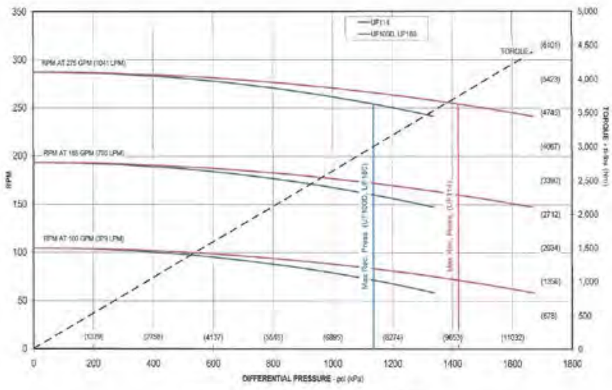
Weight	1175 lbs.
Overall Length	Standard-Fixed = 28.0 ft.
	Standard-Adjustable = 29.0 ft.
Bend Length	Standard-Fixed = 46.0"
	Standard-Adjustable = 59.0"
Bit Box to NBS	15.0"
Tool OD	4 7/8"
Top Connection	3 1/2 IF Box
Bit Box Connection	3 1/2 API Reg. Box

Performance Data

Flow Rate	100-275 GPM
Max. Flow With Bypass	350 GPM
Off Bottom Motor Speed	104-286 RPM
Off Bottom Rev./Gal.	1.04
Max. Recomm. Diff. Press.	Standard Rubber = 1150 psi
	Hard Rubber = 1420 psi
Torque @ Max. Recomm. Diff. Press.	Standard Rubber = 3200 ft-lbs.
	Hard Rubber = 3800 ft-lbs

Operational Data

Hole Size	6 1/8"-7 7/8"
Max. Bit Pressure Drop	500 psi
Max.Sustained WOB	30,000 lbs.
Max. Bit Overpull For Re-run	200,000 lbs.
Ultimate Bit Overpull	350,000 lbs.
Max. Body Overpull For Re-run	275,000 lbs.
Ultimate Body Overpull	375,000 lbs.



6.50", 7:8 Lobe Ratio, 6.4 Stage Motor

Physical Data

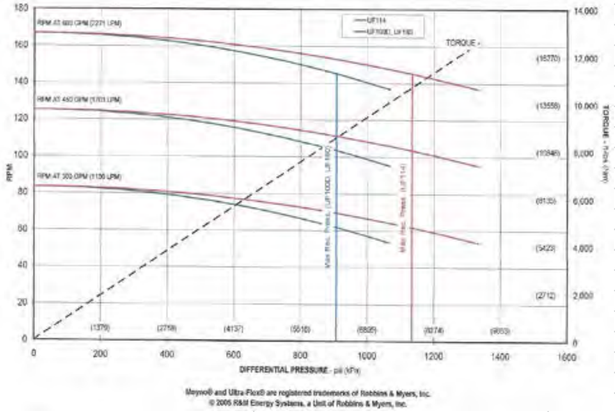
Weight	2820 lbs.
Overall Length	Standard-Fixed = 30.0 ft.
	Standard-Adjustable = 31.50 ft.
	Short Bit-To-Bend (Fixed) = 29.0 ft.
Bend Length	Standard-Fixed = 61.0"
	Standard-Adjustable = 76.0"
	Short Bit-To-Bend- Fixed = 44.0"
Bit Box to NBS	16.0"
Tool OD	6 5/8"
Top Connection	4 1/2 X-Hole
Bit Box Connection	4 1/2 API Reg. Box

Performance Data

Flow Rate	300-600 GPM
Max. Flow With Bypass	800 GPM
Off Bottom Motor Speed	85-170 RPM
Off Bottom Rev./Gal.	0.28
Max. Recomm. Diff. Press.	Standard Rubber = 920 psi
	Hard Rubber = 1150 psi
Torque @ Max. Recomm. Diff. Press.	Standard Rubber = 8,800 ft-lbs.
	Hard Rubber = 10,800 ft-lbs

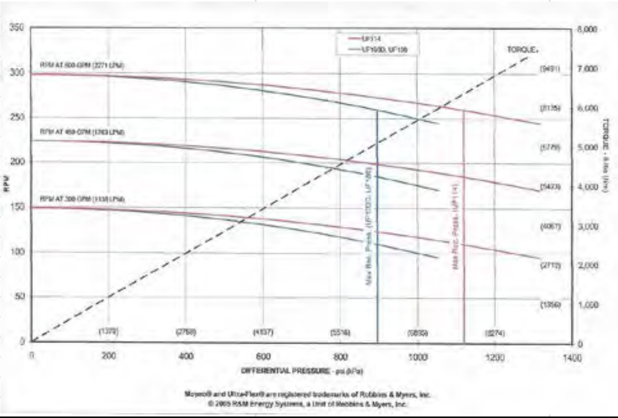
Operational Data

Hole Size	7 7/8"-9 7/8"
Max. Bit Pressure Drop	1000 psi
Max.Sustained WOB	75,000 lbs.
Max. Bit Overpull For Re-run	600,000 lbs.
Ultimate Bit Overpull	900,000 lbs.
Max. Body Overpull For Re-run	500,000 lbs.
Ultimate Body Overpull	750,000 lbs.



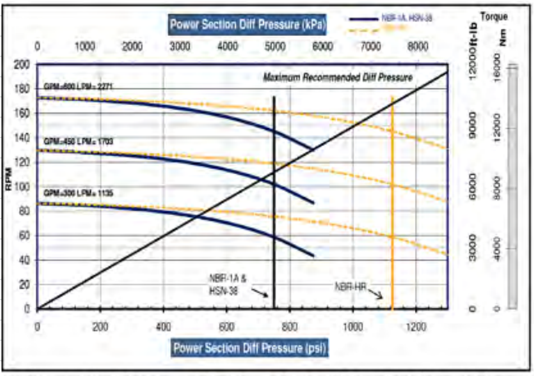
6.50", 4:5 Lobe Ratio, 7.0 Stage Motor

Physical Data	
Weight	**2240 lbs.**
Overall Length	**Standard-Fixed = 27.0 ft.**
	Standard-Adjustable = 28.50 ft.
	Short Bit-To-Bend (Fixed) = 26.0 ft.
Bend Length	**Standard-Fixed = 61.0"**
	Standard-Adjustable = 76.0"
	Short Bit-To-Bend- Fixed = 44.0"
Bit Box to NBS	**16.0"**
Tool OD	**6 5/8"**
Top Connection	**4 1/2 X-Hole**
Bit Box Connection	**4 1/2 API Reg. Box**
Performance Data	
Flow Rate	**300-600 GPM**
Max. Flow With Bypass	**800 GPM**
Off Bottom Motor Speed	**150-300 RPM**
Off Bottom Rev./Gal.	**0.5**
Max. Recomm. Diff. Press.	**Standard Rubber = 900 psi**
	Hard Rubber = 1100 psi
orque @ Max. Recomm. Diff. Press.	**Standard Rubber = 5000 ft-lbs.**
	Hard Rubber = 6500 ft-lbs
Operational Data	
Hole Size	**7 7/8"-9 7/8"**
Max. Bit Pressure Drop	**1000 psi**
Max.Sustained WOB	**75,000 lbs.**
Max. Bit Overpull For Re-run	**600,000 lbs.**
Ultimate Bit Overpull	**900,000 lbs.**
Max. Body Overpull For Re-run	**500,000 lbs.**
Ultimate Body Overpull	**750,000 lbs.**



6.50", 7:8 Lobe Ratio, 5.0 Stage Motor

Physical Data	
Weight	**2675 lbs.**
Overall Length	**Standard-Fixed = 26.0 ft.**
	Standard-Adjustable = 27.50 ft.
	Short Bit-To-Bend (Fixed) = 25.0 ft.
Bend Length	**Standard-Fixed = 61.0"**
	Standard-Adjustable = 76.0"
	Short Bit-To-Bend- Fixed = 44.0"
Bit Box to NBS	**16.0"**
Tool OD	**6 5/8"**
Top Connection	**4 1/2 X-Hole**
Bit Box Connection	**4 1/2 API Reg. Box**
Performance Data	
Flow Rate	**300-600 GPM**
Max. Flow With Bypass	**800 GPM**
Off Bottom Motor Speed	**86-170 RPM**
Off Bottom Rev./Gal.	**0.288**
Max. Recomm. Diff. Press.	**Standard Rubber = 750 psi**
	Hard Rubber = 1130 psi
Torque @ Max. Recomm. Diff. Press.	**Standard Rubber = 6,900 ft-lbs.**
	Hard Rubber = 10,460 ft-lbs
Operational Data	
Hole Size	**7 7/8"-9 7/8"**
Max. Bit Pressure Drop	**1000 psi**
Max.Sustained WOB	**75,000 lbs.**
Max. Bit Overpull For Re-run	**600,000 lbs.**
Ultimate Bit Overpull	**900,000 lbs.**
Max. Body Overpull For Re-run	**500,000 lbs.**
Ultimate Body Overpull	**750,000 lbs.**



Operating a power section above the maximum recommended differential pressure will reduce stator life. Performance Curves are for reference only. Actual power section performance may vary depending on the down hole temperature and rotor/stator fit. Performance data are subject to change without notice. Power calculation is based on maximum RPM and full torque. Stator sizes subject to change without notice.

FORMULAS:

HorsePower	Where:
Mechanical: HP = $\frac{TS}{5252}$	HP=horsepower (hp) T=torque (ft-lb) S=speed (rpm)

HorsePower Pressure	Where:
Across Bit: P= $\frac{Q^2W}{10858\ A^2}$ Expected: Px= $\frac{PyWy}{Wx}$ Hydrostatic: P= 0,052(TVD)W	P=pressure (psi) Q=flow rate (gpm) W=fluid weight (ppg) A=nozzle area (in2) Px=expected pressure drop, new mud (psi) TVD=total vert. depth,(ft.) Py=pressure drop original mud (psi) Wx=original mudweight, (ppg) Wy=new mud weight, (ppg)

Velocity	Where:
Annular: V= 0.4085Q D2 - D2 h s Jet: V= $\frac{0.3209Q}{A}$ Pump: AV= $\frac{SP}{C}$	V=velocity (ft/s) Q=flow rate (gpm) Dh=hole OD (in) Ds=drillstring OD (in) A=nozzle area (in2) S=pump speed (spm) AV=annular velocity, U (ft/min) L C=annular capacity,(gal/ft) A P=pump output,(gal/stroke

Motor Efficiency	Where:
% = $\frac{32.64TS}{QP}$	P=pressure (psi) T=torque (ft-lb) Q=flow rate (gpm) S=speed (rpm

Buoyancy	Where:
BF= $\frac{65.5\text{-}W}{65.5}$	BF=buoyancy factor W=mud weight (ppg)

Note: In order to calculate the correct drill collar string weight, the buoyancy factor must be taken into account. Using the table found on Section 12.29, take the mud weight value you are using and insert it in the above formula. Multiply the resulting buoyancy factor to the weight of the string in air. This will give you the weight of the string in the mud you are using.

Standard Equations:

SIN 0° = 0 COS 0° = 1

SIN 90° = 1 COS 90° = 0

360° CIRCUMFERENCE = 2pR

90° CIRCUMFERENCE = 2pR/4 = pR/2

Derivation:

IF BUR = 1°/100 ft. (30m)

THEN 0-90° = 9000 ft. (2700m) = pR/2

R = 9000 ft. (2700m) x 2/p = 5729.58 ft. (1718.87m)

TVD = 5730 ft. (1719m) (sin A2 - sin A1)/BUR

HD = 5730 ft. (1719m) (cos A1 - cos A2)/BUR

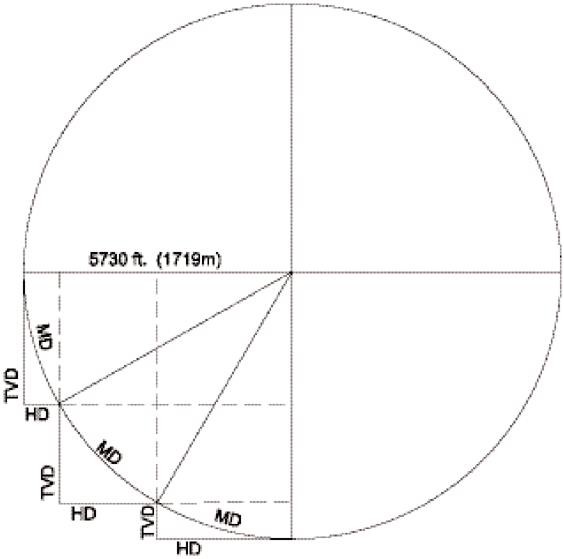
(A1 = Initial Angle)

(A2 = Final Angle)

BUR = 5730 ft. (1719m)/R

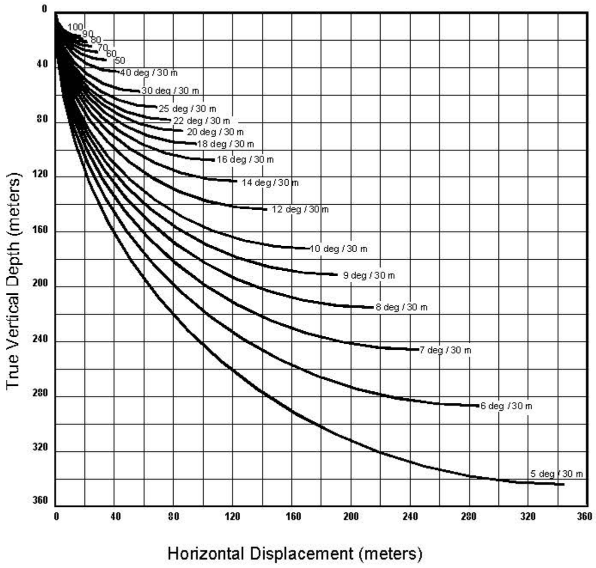
MD = ΔDrift x 100 ft. (30m)/BUR

DLS (°/100 ft.) x 0.984 = DLS (°/30m)

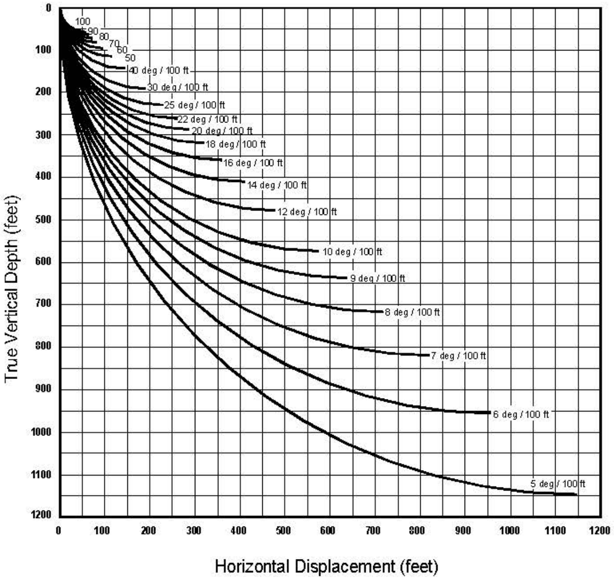


Radius of Curvature

Displacement Build Chart in Meters



Displacement Build Chart in Feet:



FLUIDS:

Proper selection of fluids will not only improve the drilling process but will prevent serious complications (due to friction and heat) from developing.

Below is the formula for figuring a jet size, if needed, to insert in top of rotor for greater GPM flow to the bit but not around the stator.

FLUID BYPASS CALCULATION

Flow thru a jet @ Known psi

$$TFA = \sqrt{\frac{Q^2 \times W}{\Delta P \times 10858}}$$

$$\text{Nozzle Size} = 64\sqrt{\frac{TFA}{\pi}}$$

Q = gpm to be bypassed

ΔP = diff across DHM

W = Weight in ppg

TFA = Total Flow Area in in^2

When choosing a drilling medium, you must take into account two areas in the motor that are most susceptible to damage from drilling mud:

1) the elastomer compound in the stator
2) the bearing stack.

Some muds are extremely harsh on certain rubber compounds. Many diesel based fluids can cause severe swelling in the rubber, resulting in anything from reduced power output to premature failure. Therefore, the type of medium must be chosen carefully. **Oil based muds should have an aromatic content no greater than 2%.**

The following fluids have been run with great success and are recommended for use with the SSES motor:

- Any oil based mud (with an aniline point above 200° F)
- Air * - nitrogen* - brine solutions - any water based mud

*(provided plenty of lubrication is used ie. soap, mist, graphite, etc.)

Any additive to be used, should also be carefully considered, in terms of its effect on the elastomer compound before being used. e.g. Highly Saturated Nitrile (HSN) is more suited for oil based fluids. Another important factor is mud weight. As a rule, heavier mud weights create more wear on the motors. Combined with high sand content, this could be extremely detrimental to the motor. Generally, when using heavier muds, e.g. 12 lb +, extreme care should be taken to keep sand content as low as possible to prevent washing in the motor. **Sand content should not be greater than 1/2% going in**. Contact a SSES representative for more information.

Temperature is also a factor in performance. In the case of hot hole applications, **SSES** will supply specialized power sections. DO NOT attempt to use these in areas of low temperature. These stators have a loose fit designed to incorporate swelling or specialty elastomers (e.g. HSN). If used in lower temperatures, it will only provide a small percentage of power specified.

FLUID TYPE	ELASTOMER RECOMMENDATIONS
ACE- khg/DAR	Both Standard Nitrile and HSN elastomer are suitable for use in this fluid. At higher temperatures, nitrile may have a tendency to chunk.
Can-Oil	HSN is most suitable for use with Can-Oil. Standard nitrile can be used but an oversize stator is recommended to compensate for volume swell.
CUTTER D	Standard Nitrile is **not** suitable for use with Cutter D, due to high volume swell.HSN should work well to 250 F, provided proper fit is maintained.
DIESEL	Standard Nitrile is **not** suitable for use with diesel, due to high volume swell.Oversize stators of HSN elastomer are well suited to diesel.
DISTILLATE 822	Due to the high volume swell nitrile is **not** recommended for this fluid. HSN should work well and is recommended. HSN is suitable for use in Invermule. Standard Nitrile is not suitable for Invermule mud.
HT40N (Mineral Oil)	Standard nitrile is recommended for use up to 250 F. HSN is recommended for temperatures above 150 F. Due to the high shrinkage rate, a standard size stator is recommended for use up to 250 F. At lower temperatures a high RPM drop is inevitable. Even with HSN, lower service life should be anticipated.
INVERMULE	HSN is suitable for use in Invermule. Standard Nitrile is **not** suitable for Invermule mud.
Keg River Crude	Both standard nitrile and HSN are suitable for use with this mud. However, oversize stators are recommended to compensate for volume swell. A special stator is required for temperatures above 200°F.

LIGNOSULPHONITE	Both Nitrile and HSN are suitable for use in Lignosulphonite. An oversize stator is recommended for Nitrile.
MENTOR 26	Both Nitrile and HSN are suitable for use in Mentor 26, up to temperatures of 350° F. An oversize stator is recommended for thermal expansion.
MSP-11	Because of volume swell, HSN is not recommended for high temperatures. Standard nitrile is recommended for this fluid for all temperatures within its normal working range.
MUDZYME	Both Nitrile and HSN are suitable for use in Mudzyme. An oversize stator is recommended for Nitrile at 250° F.
NITROGEN	Both Nitrile and HSN are suitable for drilling with Nitrogen with the addition of DA-001 as a lubricant.
PETROFREE	For temperatures to 150° F, Nitrile is suitable. for temperatures between 150 and 250° F, standard size stator with HSN can be used. Life of stator will be less, due to heat build up caused by stiffening elastomer.
POTASSIUM SILICATE	Below 150°F, both standard nitrile and HSN should work well, although mud caking is a concern. Operation between 150°F and 250°F may be a problem due to separation of liquid and severe caking in the stator. Operation at or close to 250°F is **not** recommended due to high swell and caking.
U-DIESEL	Standard Nitrile is **not** suitable for U-Diesel mud due to brittleness. HSN should work well in the mud.
ULTRA-STIM C732	Ultra-Stim C732 attacks elastomer very drastically. Neither standard nitrile or HSN are suitable for use.
WEYBURN NATIVE CRUDE	HSN should work well in this mud. Standard nitrile is very badly attacked by Weyburn Native Crude and is **not** suitable

MOTOR SHIPPING WEIGHTS:

Motor Size	Length		Weight	
	ft	m	lb	kg
4 ¾"	28.0	8.5	1175	533
6 ½"	30.0	9.1	2820	1279

BUILD RATES:

4 ¾" 7/8 Lobe 5.0 stage motor

4 3/4 ADJ Bend SLCK 7/8 5.0 Stage .62 rev/gal

Adjustable Bend	Slick Hole Size							
Bent Angle	5 7/8"		6 1/8"		6 1/2"		6 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.15	5.82	8.73	5.02	7.53	3.83	5.74	3.03	4.55
1.50	8.07	12.11	7.28	10.92	6.08	9.13	5.29	7.93
1.83	10.20	15.30	9.40	14.10	8.21	12.32	7.41	11.12
2.12	12.07	18.10	11.27	16.91	10.08	15.12	9.28	13.92
2.38	13.74	20.61	12.95	19.42	11.75	17.63	10.96	16.44
2.60	15.16	22.74	14.36	21.54	13.17	19.76	12.37	18.56
2.77	16.25	24.38	15.46	23.19	14.26	21.40	13.47	20.20
2.89	17.03	25.54	16.23	24.35	15.04	22.56	14.24	21.36
2.97	17.54	26.31	16.75	25.12	15.55	23.33	14.76	22.14
3.00	17.73	26.60	16.94	25.41	15.75	23.62	14.95	22.43

4 3/4 FXD Bend SLCK 7/8 5.0 Stage .62 rev/gal

Fixed Bend	Slick Hole Size							
Bent Angle	5 7/8"		6 1/8"		6 1/2"		6 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.50	10.43	15.64	9.06	13.60	7.01	10.52	5.65	8.47
1.75	12.62	18.93	11.26	16.89	9.21	13.81	7.84	11.76
2.00	14.82	22.23	13.45	20.18	11.40	17.10	10.04	15.05
2.25	17.01	25.51	15.64	23.47	13.60	20.39	12.23	18.34

4 3/4 Short Bit to Bend SLCK 7/8 5.0 Stage .62 rev/gal

Short Bit to Bend	Slick Hole Size							
Bent Angle	5 7/8"		6 1/8"		6 1/2"		6 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.85	18.85	28.28	16.44	24.66	12.82	19.24	10.41	15.62
2.00	20.77	31.16	18.36	27.54	14.74	22.12	12.33	18.50
2.25	23.97	35.96	21.56	32.34	17.94	26.92	15.53	23.30

4 ¾" 5/6 Lobe 8.3 stage motor

4 3/4 ADJ Bend SLCK 5/6 8.3 Stage 1.04 rev/gal

Adjustable Bend	Slick Hole Size							
Bent Angle	5 7/8"		6 1/8"		6 1/2"		6 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.15	5.15	7.73	4.45	6.67	3.39	5.09	2.69	4.03
1.50	7.15	10.73	6.45	9.67	5.39	8.08	4.69	7.03
1.83	9.03	13.55	8.33	12.49	7.27	10.91	6.57	9.85
2.12	10.69	16.03	9.98	14.98	8.93	13.39	8.22	12.33
2.38	12.17	18.26	11.47	17.20	10.41	15.62	9.71	14.56
2.60	13.43	20.14	12.72	19.08	11.67	17.50	10.96	16.44
2.77	14.40	21.60	13.69	20.54	12.64	18.95	11.93	17.90
2.89	15.08	22.62	14.38	21.57	13.32	19.98	12.62	18.92
2.97	15.54	23.31	14.83	22.25	13.78	20.67	13.07	19.61
3.00	15.71	23.56	15.01	22.51	13.95	20.92	13.24	19.87

4 3/4 FXD Bend SLCK 5/6 8.3 Stage 1.04 rev/gal

Fixed Bend	Slick Hole Size							
Bent Angle	5 7/8"		6 1/8"		6 1/2"		6 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.50	9.22	13.82	8.01	12.01	6.20	9.30	4.99	7.49
1.75	11.15	16.73	9.95	14.92	8.14	12.21	6.93	10.40
2.00	13.09	19.64	11.89	17.83	10.08	15.11	8.87	13.30
2.25	15.03	22.55	13.82	20.74	12.01	18.02	10.81	16.21

4 3/4 Short Bit to Bend SLCK 5/6 8.3 Stage 1.04 rev/gal

Short Bit to Bend	Slick Hole Size							
Bent Angle	5 7/8"		6 1/8"		6 1/2"		6 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.85	16.71	25.07	14.58	21.86	11.37	17.05	9.23	13.85
2.00	18.42	27.62	16.28	24.42	13.07	19.61	10.93	16.40
2.25	21.25	31.88	19.11	28.67	15.91	23.86	13.77	20.65

6 ½" 7/8 Lobe 6.4 stage motor

6 1/2 ADJ Bend Slick 7/8 6.4 Stage .28 rev/gal

Adjustable Bend	Slick Hole Size							
Bent Angle	7 7/8"		8 1/2"		8 3/4"		9 7/8"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.15	4.45	6.68	3.24	4.86	2.76	4.14	0.58	0.87
1.50	6.25	9.37	5.04	7.56	4.56	6.83	2.38	3.57
1.83	7.94	11.91	6.73	10.10	6.25	9.37	4.07	6.11
2.12	9.43	14.15	8.22	12.33	7.74	11.61	5.56	8.34
2.38	10.77	16.15	9.56	14.33	9.07	13.61	6.90	10.34
2.60	11.89	17.84	10.69	16.03	10.20	15.30	8.03	12.04
2.77	12.77	19.15	11.56	17.34	11.07	16.61	8.90	13.35
2.89	13.38	20.07	12.17	18.26	11.69	17.54	9.51	14.27
2.97	13.79	20.69	12.58	18.88	12.10	18.15	9.92	14.89
3.00	13.95	20.92	12.74	19.11	12.25	18.38	10.08	15.12

6 1/2 FXD Bend Slick 7/8 6.4 Stage .28 rev/gal

Fixed Bend	Slick Hole Size							
Bent Angle	7 7/8"		8 1/2"		8 3/4"		9 7/8"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.50	7.94	11.92	5.87	8.80	5.04	7.56	1.30	1.95
1.75	9.68	14.52	7.61	11.41	6.78	10.16	3.04	4.56
2.00	11.42	17.13	9.35	14.02	8.52	12.77	4.78	7.17
2.25	13.16	19.74	11.08	16.63	10.25	15.38	6.52	9.78

6 1/2 Short Bit to Bend Slick 7/8 6.4 Stage .28 rev/gal

Short Bit to Bend	Slick Hole Size					
Bent Angle	7 7/8"		8 1/2"		8 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.85	14.07	21.10	9.27	13.91	7.35	11.03
2.00	15.67	23.51	10.88	16.32	8.96	13.44
2.25	18.35	27.53	13.56	20.33	11.64	17.46

6 ½" 7/8 Lobe 6.4 stage motor

6 1/2 ADJ Bend Slick 4/5 7.0 Stage .50 rev/gal

Adjustable Bend	Slick Hole Size							
Bent Angle	7 7/8"		8 1/2"		8 3/4"		9 7/8"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.15	4.82	7.24	3.51	5.27	2.99	4.48	0.63	0.95
1.50	6.77	10.16	5.46	8.19	4.94	7.40	2.58	3.87
1.83	8.61	12.91	7.30	10.94	6.77	10.16	4.41	6.62
2.12	10.22	15.33	8.91	13.36	8.38	12.58	6.03	9.04
2.38	11.66	17.50	10.35	15.53	9.83	14.74	7.47	11.21
2.60	12.89	19.33	11.58	17.37	11.05	16.58	8.70	13.04
2.77	13.83	20.75	12.52	18.78	12.00	18.00	9.64	14.46
2.89	14.50	21.75	13.19	19.78	12.67	19.00	10.31	15.46
2.97	14.94	22.42	13.63	20.45	13.11	19.67	10.75	16.13
3.00	15.11	22.67	13.80	20.70	13.28	19.92	10.92	16.38

6 1/2 FXD Bend Slick 4/5 7.0 Stage .50 rev/gal

Fixed Bend	Slick Hole Size							
Bent Angle	7 7/8"		8 1/2"		8 3/4"		9 7/8"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.50	8.62	12.93	6.37	9.55	5.47	8.20	1.41	2.12
1.75	10.50	15.76	8.25	12.38	7.35	11.03	3.30	4.95
2.00	12.39	18.59	10.14	15.21	9.24	13.86	5.19	7.78
2.25	14.28	21.42	12.03	18.04	11.12	16.69	7.07	10.61

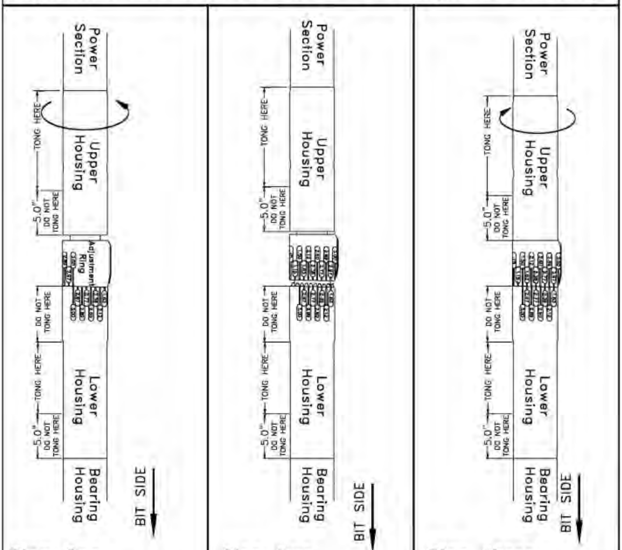
6 1/2 Short Bit to Bend Slick 4/5 7.0 Stage .50 rev/gal

Short Bit to Bend	Slick Hole Size					
Bent Angle	7 7/8"		8 1/2"		8 3/4"	
	Min°/100'	Max°/100'	Min°/100'	Max°/100'	Min°/100'	Max°/100'
1.85	15.29	22.94	10.08	15.12	8.00	11.99
2.00	17.04	25.56	11.83	17.74	9.74	14.61
2.25	19.95	29.93	14.74	22.01	12.66	18.98

Setting Procedures for ABH:

4 ¾" Adjustable Bent Housing (0°-3°)

Adjustment Procedure For 4.750" SSES Adjustable Housing



Step One

Place the tongs on the designated areas. Break the Upper Housing connection in the shown direction. Back the Upper connection off for at least two, but no more than three turns.

Step Two

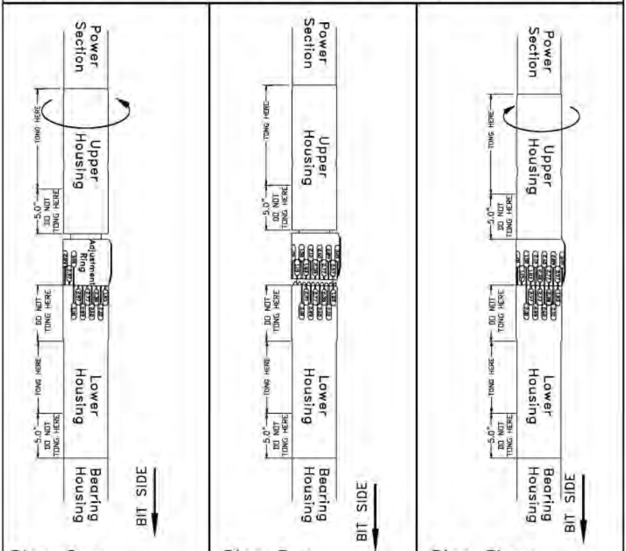
Slide the Adjustment Ring upward to disengage the splines. Rotate the ring in the direction of the shortest path to align the desired scribe lines. Slide the ring down to engage the splines.

Step Three

Place the tongs on the designated areas. Apply 13,000 ft-lbs of torque to the Upper Housing.

6 ½" Adjustable Bent Housing (0°-3°)

Adjustment Procedure For 6.50" SSES Adjustable Housing



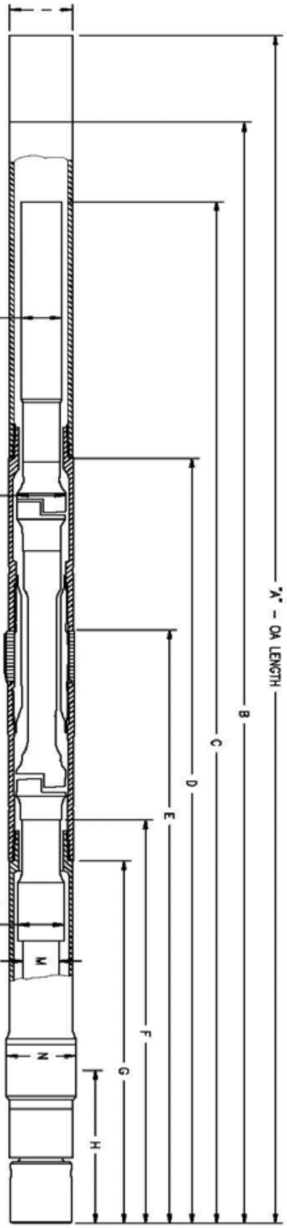
Step One	Step Two	Step Three
Place the tongs on the designated areas. Break the Upper Housing connection in the shown direction. Back the Upper connection off for at least two, but no more than three turns.	Slide the Adjustment Ring upward to disengage the splines. Rotate the ring in the direction of the shortest path to align the desired scribe lines. Slide the ring down to engage the splines.	Place the tongs on the designated areas. Apply 28,000 ft-lbs of torque to the Upper Housing.

FISHING DRAWINGS AND MEASUREMENTS

REV. "A"

FISHING DIMENSIONS FOR STANDARD ADJUSTABLE-BEND MOTOR

12/21/12

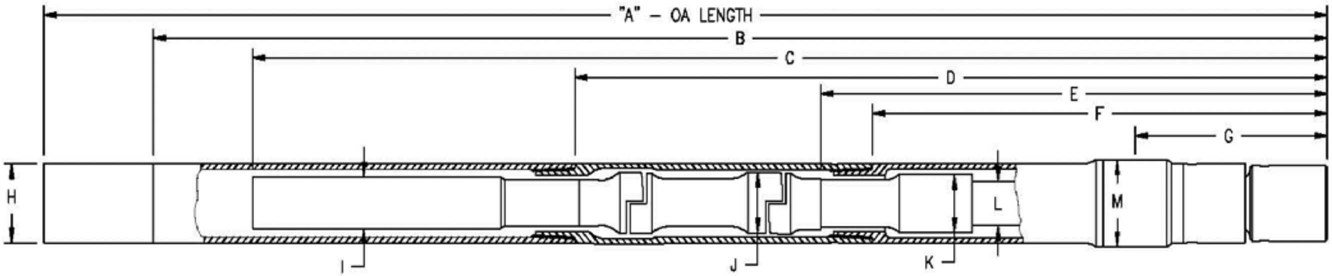


MOTOR SIZE	LOBES	STAGES	A	B	C	D	E	F	G	H	I	J	K	L	M	N
6.50"	4:5	7.0	342.0"	315.0"	307.0"	106.0"	83.0"	61.0"	53.0"	21.0"	6.65"	4.22"	5.12"	5.0"	3.70"	7.31"
6.50"	7:8	6.4	377.0"	350.0"	345.0"	106.0"	83.0"	61.0"	53.0"	21.0"	6.65"	4.52"	5.12"	5.0"	3.70"	7.31"
4.75"	5:6	8.3	344.0"	322.0"	309.0"	80.0"	64.0"	45.0"	40.0"	15.0"	4.88"	2.92"	3.62"	3.50"	2.50"	5.38"
4.75"	7:8	5.0	296.0"	274.0"	266.0"	80.0"	64.0"	45.0"	40.0"	15.0"	4.88"	3.04"	3.62"	3.50"	2.50"	5.38"

REV. "A"

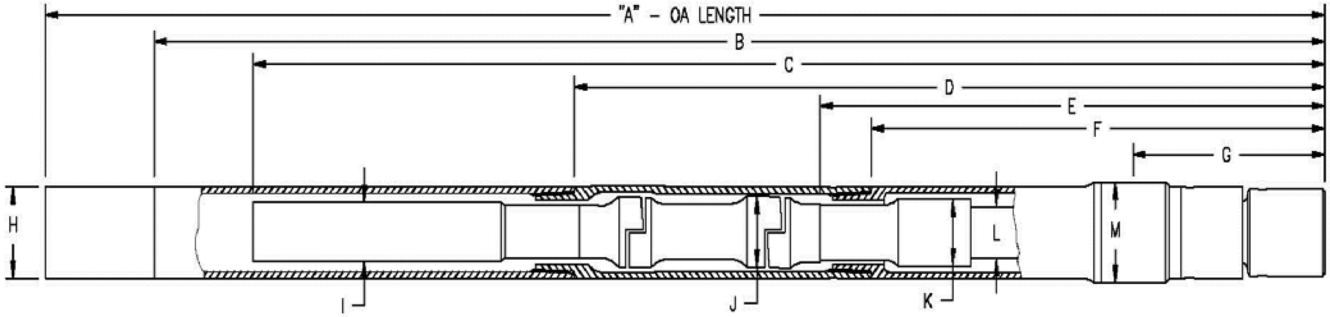
FISHING DIMENSIONS FOR FIXED BEND STANDARD MOTOR

12/21/12



MOTOR SIZE	LOBES	STAGES	A	B	C	D	E	F	G	H	I	J	K	L	M
6.50"	4:5	7.0	325.0"	298.0"	290.0"	89.0"	61.0"	53.0"	21.0"	6.65"	4.22"	5.12	5.0"	3.70"	7.31"
6.50"	7:8	6.4	360.0"	333.0"	328.0"	89.0"	61.0"	53.0"	21.0"	6.65"	4.52"	5.12	5.0"	3.70"	7.31"
4.75"	5:6	8.3	333.0"	311.0"	298.0"	69.0"	45.0"	40.0"	15.0"	4.88"	2.92	3.62"	3.5"	2.50"	5.38"
4.75"	7:8	5.0	285.0"	263.0"	255.0"	69.0"	45.0"	40.0"	15.0"	4.88"	3.04"	3.62"	3.5"	2.50"	5.38"

REV. "A" | FISHING DIMENSIONS FOR SHORT BIT-TO-BEND MOTOR | 12/21/12



MOTOR SIZE	LOBES	STAGES	A	B	C	D	E	F	G	H	I	J	K	L	M
6.50"	4:5	7.0	312.0"	285.0"	277.0"	76.0"	66.0"	55.0"	22.0"	6.65"	4.22"	5.12	5.0"	3.70"	7.31"
6.50"	7:8	6.4	347.0"	320.0"	315.0"	76.0"	66.0"	55.0"	22.0"	6.65"	4.52"	5.12	5.0"	3.70"	7.31"

HELPFUL TABLES AND INFORMATION

CASING DIMENSIONS & BIT CLEARANCES:

OD (in)	Wt. (lb.ft)	Wall (in)	ID (in)	OD (in)	Drift (in)	Bit Size (in)	Bit Size (in)	Clearance (in)
4 ½								
	9.5	0.205	4.090	5.000	3.965	3 7/8	3.875	0.090
	11.6	0.250	4.000	5.000	3.875	3 7/8	3.875	0.000
	13.5	0.290	3.920	5.000	3.795	3 3/4	3.750	0.045
	15.1	0.337	3.826	5.000	3.701	3 5/8	3.625	0.076
5								
	11.5	0.220	4.560	5.563	4.435	4 1/4	4.250	0.185
	13.0	0.253	4.494	5.563	4.369	4 1/4	4.250	0.119
	15.0	0.296	4.408	5.563	4.283	4 1/4	4.250	0.033
	18.0	0.362	4.276	5.563	4.151	4 1/8	4.125	0.026
5 ½								
	13.0	0.228	5.044	6.050	4.919	4 3/4	4.750	0.169
	14.0	0.244	5.012	6.050	4.887	4 3/4	4.750	0.137
	15.5	0.275	4.950	6.050	4.825	4 3/4	4.750	0.075
	17.0	0.304	4.892	6.050	4.767	4 3/4	4.750	0.017
	20.0	0.361	4.778	6.050	4.653	4 5/8	4.625	0.028
	23.0	0.415	4.670	6.050	4.545	4 1/2	4.500	0.045

OD (in)	Wt. (lb.ft)	Wall (in)	ID (in)	OD (in)	Drift (in)	Bit Size (in)	Bit Size (in)	Clearance (in)
6								
	15.0	0.238	5.524	6.625	5.399	5 3/8	5.375	0.024
	18.0	0.288	5.425	6.625	5.299	5 1/8	5.125	0.174
	20.0	0.324	5.352	6.625	5.227	5 1/8	5.125	0.102
	23.0	0.380	5.240	6.625	5.115	4 7/8	4.875	0.240
	26.0	0.434	5.132	6.625	5.007	4 7/8	4.875	0.132
6 5/8								
	17.0	0.245	6.135	7.390	6.010	6	6.000	0.010
	20.0	0.288	6.049	7.390	5.924	5 7/8	5.875	0.049
	24.0	0.352	5.921	7.390	5.796	5 3/4	5.750	0.046
	28.0	0.417	5.791	7.390	5.666	5 5/8	5.625	0.041
	32.0	0.475	5.675	7.390	5.550	5 3/8	5.375	0.175
7								
	17.0	0.231	6.538	7.656	6.413	6 3/8	6.375	0.038
	20.0	0.272	6.456	7.656	6.331	6 1/4	6.250	0.081
	23.0	0.317	6.366	7.656	6.241	6 1/8	6.125	0.116
	26.0	0.362	6.276	7.656	6.151	6 1/8	6.125	0.026
	29.0	0.408	6.184	7.656	6.059	6	6.000	0.059
	32.0	0.453	6.094	7.656	5.969	5 7/8	5.875	0.094
	35.0	0.498	6.004	7.656	5.879	5 7/8	5.875	0.004
	38.0	0.540	5.920	7.656	5.795	5 3/4	5.750	0.045

OD (in)	Wt. (lb.ft)	Wall (in)	ID (in)	OD (in)	Drift (in)	Bit Size (in)	Bit Size (in)	Clearance (in)
7 5/8								
	20.0	0.250	7.125	8.500	7.000	6 3/4	6.750	0.250
	24.0	0.300	7.025	8.500	6.900	6 3/4	6.750	0.150
	26.4	0.328	6.969	8.500	6.844	6 3/4	6.750	0.094
	29.7	0.375	6.875	8.500	6.750	6 3/4	6.750	0.000
	33.7	0.430	6.765	8.500	6.640	6 5/8	6.625	0.015
	39.0	0.500	6.625	8.500	6.500	6 3/8	6.375	0.125
8 5/8								
	24.0	0.264	8.097	9.625	7.972	7 7/8	7.875	0.097
	28.0	0.304	8.017	9.625	7.892	7 7/8	7.875	0.017
	32.0	0.352	7.921	9.625	7.796	7 3/4	7.750	0.046
	36.0	0.400	7.825	9.625	7.700	7 5/8	7.625	0.075
	40.0	0.450	7.725	9.625	7.600	7 3/8	7.375	0.225
	44.0	0.500	7.625	9.625	7.500	7 3/8	7.375	0.125
	49.0	0.557	7.511	9.625	7.386	7 3/8	7.375	0.011
9 5/8								
	29.3	0.281	9.063	10.625	8.907	8 3/4	8.750	0.157
	32.3	0.312	9.001	10.625	8.845	8 3/4	8.750	0.095
	36.0	0.352	8.921	10.625	8.765	8 3/4	8.750	0.015
	40.0	0.395	8.835	10.625	8.697	8 5/8	8.625	0.072
	43.5	0.435	8.755	10.625	8.599	8 1/2	8.500	0.099
	47.0	0.472	8.681	10.625	8.525	8 1/2	8.500	0.025
	53.5	0.545	8.535	10.625	8.379	8 3/8	8.375	0.004

OD (in)	Wt. (lb.ft)	Wall (in)	ID (in)	OD (in)	Drift (in)	Bit Size (in)	Bit Size (in)	Clearance (in)
10 3/4								
	32.8	0.279	10.192	11.750	10.036	9 7/8	9.875	0.161
	40.5	0.350	10.050	11.750	9.894	9 7/8	9.875	0.019
	45.5	0.400	9.950	11.750	9.794	9 3/4	9.750	0.044
	51.0	0.450	9.850	11.750	9.694	9 5/8	9.625	0.069
	55.5	0.495	9.760	11.750	9.604	9	9.000	0.604
	60.7	0.545	9.660	11.750	9.504	9	9.000	0.504
	65.7	0.595	9.560	11.750	9.404	9	9.000	0.404
20								
	94.0	0.438	19.124	21.000	18.936	17 1/2	17.500	1.436

Rotary Connection Cross Reference:

Common Name	Size (in.)	Equivalent Connection
Internal flush (IF)	2 3/8	2 7/8 slimhole; NC 26
	2 7/8	3 1/2 slimhole; NC 31
	3 1/2	4 1/2 slimhole; NC 38
	4	4 1/2 extra hole; NC 46
		5 double streamline
Full hole (FH)	4	4 1/2 double streamline; NC 40
Extra hole (XH) (EH)	2 7/8	3 1/2 double streamline
	3 1/2	4 slimhole
		4 1/2 external flush
	4 1/2	4 internal flush; NC 46
	5	4 1/2 internal flush; NC 50
		5 1/2 double streamline
Slimhole (SH)	2 7/8	2 3/8 internal flush; NC 26
	3 1/2	2 7/8 internal flush; NC 31
	4	3 1/2 extra hole
		4 1/2 external flush
	4 1/2	3 1/2 internal flush; NC 3
Double Streamline (DSL)	3 1/2	2 7/8 extra hole
	4 1/2	4 full hole; NC 40
	5 1/2	4 1/2 internal flush
		5 extra hole; NC 50
Numbered connection (N	26	2 3/8 internal flush
		2 7/8 slimhole
	31	2 7/8 internal flush
		3 1/2 slimhole
	38	3 1/2 internal flush
		4 1/2 slimhole
	40	4 full hole
		4 1/2 double streamline
	46	4 internal flush
		4 1/2 extra hole
	50	4 1/2 internal flush
		5 extra hole
		5 1/2 double streamline
External flush (EF)	4 1/2	4 slimhole
	3 1/2	extra hole

Drill Collar Weights:

Drill Collar OD	Collar Bore (in.)												
(in.)	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 13/16	3	3 1/4	3 1/2	3 3/4	4
2 7/8	19	18	16										
3	21	20	18										
3 1/8	22	22	20										
3 1/4	26	24	22										
3 1/2	30	29	27										
3 3/4	35	33	32										
4	40	39	37	35	32	29							
4 1/8	43	41	39	37	35	32							
4 1/4	46	44	42	40	38	35							
4 1/2	51	50	48	46	43	41							
4 3/4			54	52	50	47	44						
5			61	59	56	53	50						
5 1/4			68	65	63	60	57						
5 1/2			75	73	70	67	64	60					
5 3/4			82	80	78	75	72	67	64	60			
6			90	88	85	83	79	75	72	68			

Drill Collar OD	Collar Bore (in.)												
(in.)	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 13/16	3	3 1/4	3 1/2	3 3/4	4
6 1/4			98	96	94	91	88	83	80	76	72		
6 1/2			107	105	102	99	96	91	89	85	80		
6 3/4			116	114	111	108	105	100	98	93	89		
7					120	117	114	110	107	103	98	93	84
7 1/4					130	127	124	119	116	112	108	103	93
7 1/2					139	137	133	129	126	122	117	113	102
7 3/4					150	147	144	139	136	132	128	123	112
8					160	157	154	150	147	143	138	133	122
8 1/4					171	168	165	160	158	154	149	144	133
8 1/2					182	179	176	172	169	165	160	155	150
9						203	200	195	192	188	184	179	174
9 1/2						227	224	220	216	212	209	206	198
9 3/4						240	237	232	229	225	221	216	211
10						254	251	246	243	239	235	230	225
11						310	307	302	299	295	291	286	281
12						371	368	364	361	357	352	347	342

Annular Capacities:

Drill Pipe (in.)	Hole Size (in.)	Annular Capacity (gal/ft)
5	12 1/4	5.1
	9 7/8	2.96
	8 3/4	2.1
	8 1/2	1.93
4 1/2	12 1/4	5.3
	9 7/8	3.15
	8 1/2	2.12
	7 7/8	1.7
3 1/2	6 3/4	1.36
	6 1/2	1.22
	6 1/8	1.04
2 7/8	4 3/4	0.58
	4 1/2	0.49
	4 1/8	0.36
	3 7/8	0.27

$$\text{annular capacity (gal/ft)} = \frac{D_h^2 - D_p^2}{24.51}$$

Hole Capacity:

OD (in.)	ft3/ft	ft/ft3	bbl/ft	ft/bbl	gal/ft	ft/gal
1	0.0055	183.347	0.001	1029.46	0.0408	24.5109
1 1/8	0.0069	144.866	0.0012	813.399	0.0516	19.3666
1 1/4	0.0085	117.342	0.0015	658.853	0.0637	15.687
1 3/8	0.0103	96.9767	0.0018	544.507	0.0771	12.9644
1 1/2	0.0123	81.4873	0.0022	457.537	0.0918	10.8937
1 5/8	0.0144	69.433	0.0026	389.854	0.1077	9.2822
1 3/4	0.0167	59.8682	0.003	336.15	0.1249	8.0036
1 7/8	0.0192	52.1519	0.0034	292.824	0.1434	6.972
2	0.0218	45.8366	0.0039	257.365	0.1632	6.1277
2 1/8	0.0246	40.6027	0.0044	227.977	0.1842	5.428
2 1/4	0.0276	36.2166	0.0049	203.35	0.2065	4.8417
2 3/8	0.0308	32.5046	0.0055	182.508	0.2301	4.3454
2 1/2	0.0341	29.3354	0.0061	164.713	0.255	3.9217
2 5/8	0.0376	26.6081	0.0067	149.4	0.2811	3.5571
2 3/4	0.0412	24.2442	0.0073	136.127	0.3085	3.2411
2 7/8	0.0451	22.1818	0.008	124.547	0.3372	2.9654
3	0.0491	20.3718	0.0087	114.384	0.3672	2.7234
3 1/8	0.0533	18.7747	0.0095	105.417	0.3984	2.5099
3 1/4	0.0576	17.3582	0.0103	97.4635	0.4309	2.3206
3 3/8	0.0621	16.0963	0.0111	90.3777	0.4647	2.1518
3 1/2	0.0668	14.9671	0.0119	84.0374	0.4998	2.0009
3 5/8	0.0717	13.9526	0.0128	78.3416	0.5361	1.8653
3 3/4	0.0767	13.038	0.0137	73.2059	0.5737	1.743
3 7/8	0.0819	12.2104	0.0146	68.5591	0.6126	1.6324
4	0.0873	11.4592	0.0155	64.3411	0.6528	1.5319
4 1/8	0.0928	10.7752	0.0165	60.5008	0.6942	1.4405
4 1/4	0.0985	10.1507	0.0175	56.9942	0.7369	1.357
4 3/8	0.1044	9.5789	0.0186	53.7839	0.7809	1.2806
4 1/2	0.1104	9.0541	0.0197	50.8374	0.8262	1.2104
4 5/8	0.1167	8.5713	0.0208	48.1266	0.8727	1.1459
4 3/4	0.1231	8.1262	0.0219	45.627	0.9205	1.0864
4 7/8	0.1296	7.7148	0.0231	43.3171	0.9696	1.0314
5	0.1364	7.3339	0.0243	41.1783	1.02	0.9804
5 1/8	0.1433	6.9805	0.0255	39.1941	1.0716	0.9332
5 1/4	0.1503	6.652	0.0268	37.35	1.1245	0.8893
5 3/8	0.1576	6.3462	0.0281	35.6329	1.1787	0.8484
5 1/2	0.165	6.061	0.0294	34.0317	1.2341	0.8103
5 5/8	0.1726	5.7947	0.0307	32.536	1.2909	0.7747
5 3/4	0.1803	5.5455	0.0321	31.1367	1.3489	0.7414
5 7/8	0.1883	5.312	0.0335	29.8259	1.4082	0.7101
6	0.1963	5.093	0.035	28.5961	1.4687	0.6809
6 1/8	0.2046	4.8872	0.0364	27.4408	1.5306	0.6534
6 1/4	0.2131	4.6937	0.0379	26.3541	1.5937	0.6275
6 3/8	0.2217	4.5114	0.0395	25.3308	1.6581	0.6031
6 1/2	0.2304	4.3396	0.041	24.3659	1.7237	0.5801
6 5/8	0.2394	4.1773	0.0426	23.4551	1.7907	0.5585
6 3/4	0.2485	4.0241	0.0443	22.5944	1.8589	0.538
6 7/8	0.2578	3.8791	0.0459	21.7803	1.9284	0.5186

OD (in.)	ft3/ft	ft/ft3	bbl/ft	ft/bbl	gal/ft	ft/gal
7	0.2673	3.7418	0.0476	21.0093	1.9991	0.5002
7 1/8	0.2769	3.6116	0.0493	20.2786	2.0711	0.4828
7 1/4	0.2867	3.4882	0.0511	19.5854	2.1445	0.4663
7 3/8	0.2967	3.3709	0.0528	18.9271	2.219	0.4506
7 1/2	0.3068	3.2595	0.0546	18.3015	2.2949	0.4357
7 5/8	0.3171	3.1535	0.0565	17.7063	2.372	0.4216
7 3/4	0.3276	3.0526	0.0583	17.1398	2.4504	0.4081
7 7/8	0.3382	2.9565	0.0602	16.6	2.5301	0.3952
8	0.3491	2.8648	0.0622	16.0853	2.6111	0.383
8 1/8	0.3601	2.7773	0.0641	15.5942	2.6933	0.3713
8 1/4	0.3712	2.6938	0.0661	15.1252	2.7768	0.3601
8 3/8	0.3826	2.614	0.0681	14.6771	2.8616	0.3495
8 1/2	0.3941	2.5377	0.0702	14.2486	2.9477	0.3393
8 5/8	0.4057	2.4646	0.0723	13.8385	3.035	0.3295
8 3/4	0.4176	2.3947	0.0744	13.446	3.1236	0.3201
8 7/8	0.4296	2.3277	0.0765	13.0699	3.2135	0.3112
9	0.4418	2.2635	0.0787	12.7094	3.3047	0.3026
9 1/8	0.4541	2.2019	0.0809	12.3635	3.3971	0.2944
9 1/4	0.4667	2.1428	0.0831	12.0317	3.4908	0.2865
9 3/8	0.4794	2.0861	0.0854	11.7129	3.5858	0.2789
9 1/2	0.4922	2.0315	0.0877	11.4067	3.682	0.2716
9 5/8	0.5053	1.9791	0.09	11.1124	3.7796	0.2646
9 3/4	0.5185	1.9287	0.0923	10.8293	3.8784	0.2578
9 7/8	0.5319	1.8802	0.0947	10.5569	3.9785	0.2514
10	0.5454	1.8335	0.0971	10.2946	4.0798	0.2451
10 1/8	0.5591	1.7885	0.0996	10.042	4.1824	0.2391
10 1/4	0.573	1.7451	0.1021	9.7985	4.2864	0.2333
10 3/8	0.5871	1.7033	0.1046	9.5638	4.3915	0.2277
10 1/2	0.6013	1.663	0.1071	9.3375	4.498	0.2223
10 5/8	0.6157	1.6241	0.1097	9.1191	4.6057	0.2171
10 3/4	0.6303	1.5866	0.1123	8.9082	4.7147	0.2121
10 7/8	0.645	1.5503	0.1149	8.7046	4.825	0.2073
11	0.66	1.5153	0.1175	8.5079	4.9366	0.2026
11 1/8	0.675	1.4814	0.1202	8.3178	5.0494	0.198
11 1/4	0.6903	1.4487	0.1229	8.134	5.1635	0.1937
11 3/8	0.7057	1.417	0.1257	7.9562	5.2789	0.1894
11 1/2	0.7213	1.3864	0.1285	7.7842	5.3956	0.1853
11 5/8	0.7371	1.3567	0.1313	7.6177	5.5135	0.1814
11 3/4	0.753	1.328	0.1341	7.4565	5.6327	0.1775
11 7/8	0.7691	1.3002	0.137	7.3003	5.7532	0.1738
12	0.7854	1.2732	0.1399	7.149	5.8749	0.1702
12 1/8	0.8018	1.2471	0.1428	7.0024	5.998	0.1667
12 1/4	0.8185	1.2218	0.1458	6.8602	6.1223	0.1633
12 3/8	0.8353	1.1972	0.1488	6.7223	6.2479	0.1601
12 1/2	0.8522	1.1734	0.1518	6.5885	6.3747	0.1569
12 5/8	0.8693	1.1503	0.1548	6.4587	6.5028	0.1538
12 3/4	0.8866	1.1279	0.1579	6.3327	6.6323	0.1508
12 7/8	0.9041	1.1061	0.161	6.2103	6.7629	0.1479

Drill Pipe Capacities:

OD (in)	ID (in)	NOMINAL WEIGHT (lb/ft)	STEEL DISPLACEMENT (gal/ft)	CAPACITY (gal/ft)
2 3/8	1.815	6.65	0.10542	0.1344
2 7/8	2.151	10.4	0.16674	0.18858
3 1/2	2.764	13.3	0.21084	0.31164
3 1/2	2.602	15.5	0.24486	0.27636
4	3.34	14	0.231	0.45528
4 1/2	3.826	16.6	0.2751	0.59724
4 1/2	3.64	20	0.32676	0.54054
5	4.276	19.5	0.315	0.74592
5	4	25.6	0.39144	0.65268

Drill Pipe Properties:

STANDARD HEAVY-WALL DRILLPIPE PROPERTIES

Nominal Size (in.)	Pipe ID (in.)	Nominal Weight (lb./ft.)	Tool Joint Connection
3 1/2	2.063	25.3	3 1/2 IF or NC 38
4	2.563	29.7	4 FH or NC 40
4 1/2	2.75	39.9	4 IF or NC 46
5	3	48.5	4 1/2 IF or NC 50

SPIRAL-WEIGHT™ HEAVY-WALL DRILLPIPE PROPERTIES

Nominal Size (in.)	Pipe ID (in.)	Nominal Weight (lb./ft.)	Tool Joint Connection
3 1/2	2.125	28.3	3 1/2 IF or NC 38
4	2.563	33.8	4 FH or NC 40
4 1/2	2.75	44	4 IF or NC 46
5	3	55.3	4 1/2 IF or NC 50
5 1/2	3.25	63	5 FH
6 5/8	5	57	6 5/8 FH

Nozzle Flow Areas:

Nozzle Size (32nds)	1 (In2)	2 (In2)	3 (In2)	4 (In2)	5 (In2)	6 (In2)	7 (In2)	8 (In2)	9 (In2)	10 (In2)
7	0.038	0.076	0.114	0.152	0.19	0.228	0.266	0.304	0.342	0.38
8	0.049	0.098	0.147	0.196	0.245	0.294	0.343	0.392	0.441	0.49
9	0.062	0.124	0.186	0.248	0.31	0.372	0.434	0.496	0.558	0.62
10	0.077	0.154	0.231	0.308	0.385	0.462	0.539	0.616	0.693	0.77
11	0.093	0.186	0.279	0.372	0.465	0.558	0.651	0.744	0.837	0.93
12	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.1
13	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.17	1.3
14	0.15	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5
15	0.172	0.344	0.516	0.688	0.86	1.032	1.204	1.376	1.548	1.72
16	0.196	0.392	0.588	0.784	0.98	1.176	1.372	1.568	1.764	-
17	0.221	0.442	0.663	**0.884**	1.105	1.326	1.547	1.768	-	-
18	0.249	0.498	0.747	0.996	1.245	1.494	1.743	-	-	-
20	0.307	0.614	0.921	1.228	1.535	-	-	-	-	-
22	0.371	0.742	1.113	1.484	-	-	-	-	-	-
24	0.441	0.882	1.323	1.764	-	-	-	-	-	-
26	0.519	1.038	1.557	-	-	-	-	-	-	-
28	0.601	1.202	-	-	-	-	-	-	-	-
30	0.69	1.38	-	-	-	-	-	-	-	-
1”	0.785	1.57	-	-	-	-	-	-	-	-
1 1/8”	0.994	-	-	-	-	-	-	-	-	-
1 1/4”	1.227	-	-	-	-	-	-	-	-	-

Mud Weights:

lb/gal	lb/f t3	kg/m3	Specific Gravity	Gradient Depth (psi/f t)	Gradient Depth (kPa/m)
8.34	62.38	999.3	1	0.434	9.8
8.5	63.58	1018.5	1.02	0.442	10
8.6	64.32	1030.5	1.03	0.447	10.1
8.7	65.07	1042.4	1.04	0.452	10.2
8.8	65.82	1054.4	1.05	0.458	10.4
8.9	66.57	1066.4	1.07	0.463	10.5
9	67.31	1078.4	1.08	0.468	10.6
9.1	68.06	1090.4	1.09	0.473	10.7
9.2	68.81	1102.3	1.1	0.478	10.8
9.3	69.56	1114.3	1.12	0.484	10.9
9.4	70.31	1126.3	1.13	0.489	11.1
9.5	71.05	1138.3	1.14	0.494	11.2
9.6	71.8	1150.3	1.15	0.499	11.3
9.7	72.55	1162.3	1.16	0.504	11.4
9.8	73.3	1174.2	1.18	0.51	11.5
9.9	74.05	1186.2	1.19	0.515	11.6
10	74.79	1198.2	1.2	0.52	11.8
10.1	75.54	1210.2	1.21	0.525	11.9
10.2	76.29	1222.2	1.22	0.53	12
10.3	77.04	1234.2	1.24	0.536	12.1
10.4	77.79	1246.1	1.25	0.541	12.2
10.5	78.53	1258.1	1.26	0.546	12.4
10.6	79.28	1270.1	1.27	0.551	12.5
10.7	80.03	1282.1	1.28	0.556	12.6
10.8	80.78	1294.1	1.29	0.562	12.7
10.9	81.53	1306	1.31	0.567	12.8
11	82.27	1318	1.32	0.572	12.9
11.1	83.02	1330	1.33	0.577	13.1
11.2	83.77	1342	1.34	0.582	13.2
11.3	84.52	1354	1.36	0.588	13.3
11.4	85.27	1366	1.37	0.593	13.4
11.5	86.01	1377.9	1.38	0.598	13.5
11.6	86.76	1389.9	1.39	0.603	13.6
11.7	87.51	1401.9	1.4	0.608	13.8
11.8	88.26	1413.9	1.41	0.614	13.9
11.9	89.01	1425.9	1.43	0.619	14
12	89.75	1437.8	1.44	0.624	14.1
12.1	90.5	1449.8	1.45	0.629	14.2
12.2	91.25	1461.8	1.46	0.634	14.4
12.3	92	1473.8	1.48	0.64	14.5

lb/gal	lb/f t3	kg/m3	Specific Gravity	Gradient Depth (psi/f t)	Gradient Depth (kPa/m)
12.4	92.74	1485.8	1.49	0.645	14.6
12.5	93.49	1497.8	1.5	0.65	14.7
12.6	94.24	1509.7	1.51	0.655	14.8
12.7	94.99	1521.7	1.52	0.66	14.9
12.8	95.74	1533.7	1.53	0.666	15.1
12.9	96.48	1545.7	1.55	0.671	15.2
13	97.23	1557.7	1.56	0.676	15.3
13.1	97.98	1569.6	1.57	0.681	15.4
13.2	98.73	1581.6	1.58	0.686	15.5
13.3	99.48	1593.6	1.6	0.692	15.6
13.4	100.22	1605.6	1.61	0.697	15.8
13.5	100.97	1617.6	1.62	0.702	15.9
13.6	101.72	1629.6	1.63	0.707	16
13.7	102.47	1641.5	1.64	0.712	16.1
13.8	103.22	1653.5	1.65	0.718	16.2
13.9	103.96	1665.5	1.67	0.723	16.4
14	104.71	1677.5	1.68	0.728	16.5
14.1	105.46	1689.5	1.69	0.733	16.6
14.2	106.21	1701.5	1.7	0.738	16.7
14.3	106.96	1713.4	1.72	0.744	16.8
14.4	107.7	1725.4	1.73	0.749	16.9
14.5	108.45	1737.4	1.74	0.754	17.1
14.6	109.2	1749.4	1.75	0.759	17.2
14.7	109.95	1761.4	1.76	0.764	17.3
14.8	110.7	1773.3	1.78	0.77	17.4
14.9	111.44	1785.3	1.79	0.775	17.5
15	112.19	1797.3	1.8	0.78	17.6
15.1	112.94	1809.3	1.81	0.785	17.8
15.2	113.69	1821.3	1.82	0.79	17.9
15.3	114.44	1833.3	1.84	0.796	18
15.4	115.18	1845.2	1.85	0.801	18.1
15.5	115.93	1857.2	1.86	0.806	18.2
15.6	116.68	1869.2	1.87	0.811	18.3
15.7	117.43	1881.2	1.88	0.816	18.5
15.8	118.18	1893.2	1.9	0.822	18.6
15.9	118.92	1905.1	1.91	0.827	18.7
16	119.67	1917.1	1.92	0.832	18.8
16.1	120.42	1929.1	1.93	0.837	18.9
16.2	121.17	1941.1	1.94	0.842	19.1
16.3	121.91	1953.1	1.96	0.848	19.2

lb/gal	lb/f t3	kg/m3	Specific Gravity	Gradient Depth (psi/f t)	Gradient Depth (kPa/m)
16.4	122.66	1965.1	1.97	0.853	19.3
16.5	123.41	1977	1.98	0.858	19.4
16.6	124.16	1989	2	0.863	19.5
16.7	124.91	2001	2.01	0.868	19.6
16.8	125.65	2013	2.02	0.874	19.8
16.9	126.4	2025	2.03	0.879	19.9
17	127.15	2036.9	2.04	0.884	20
17.1	127.9	2048.9	2.05	0.889	20.1
17.2	128.65	2060.9	2.06	0.894	20.2
17.3	129.39	2072.9	2.08	0.9	20.3
17.4	130.14	2084.9	2.09	0.905	20.5
17.5	130.89	2096.9	2.1	0.91	20.6
17.6	131.64	2108.8	2.11	0.915	20.7
17.7	132.39	2120.8	2.12	0.92	20.8
17.8	133.13	2132.8	2.14	0.926	20.9
17.9	133.88	2144.8	2.15	0.931	21.1
18	134.63	2156.8	2.16	0.936	21.2
18.1	135.38	2168.8	2.17	0.941	21.3
18.2	136.13	2180.7	2.18	0.946	21.4
18.3	136.87	2192.7	2.2	0.952	21.5
18.4	137.62	2204.7	2.21	0.957	21.6
18.5	138.37	2216.7	2.22	0.962	21.8
18.6	139.12	2228.7	2.23	0.967	21.9
18.7	139.87	2240.6	2.24	0.972	22
18.8	140.61	2252.6	2.26	0.978	22.1
18.9	141.36	2264.6	2.27	0.983	22.2
19	142.11	2276.6	2.28	0.988	22.3
19.1	142.86	2288.6	2.29	0.993	22.5
19.2	143.61	2300.6	2.3	0.998	22.6
19.3	144.35	2312.5	2.32	1.004	22.7
19.4	145.1	2324.5	2.33	1.009	22.8
19.5	145.85	2336.5	2.34	1.014	22.9
19.6	146.6	2348.5	2.35	1.019	23.1
19.7	147.34	2360.5	2.36	1.024	23.2
19.8	148.09	2372.4	2.38	1.03	23.3
19.9	148.84	2384.4	2.39	1.035	23.4
20	149.59	2396.4	2.4	1.04	23.5

Conversions:

Multiplying Factor	Prefix	Symbol
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto	h
10 = 10^1	deca	da
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ

OILFIELD QUICK REFERENCE
1 Cubic Meter = 1000 Liters
1 Cubic Meter = 264.2 US Gallons
1 Cubic Meter = 220 Imperial Gallons
1 Cubic Meter = 6.28 US Barrels
1 Cubic Meter = 5.0 Imperial Barrels
PSI x 6.89 = KPA
100 PSI X6.89 = 6890 KPA

UNITS	MULTIPLY BY	TO OBTAIN
ac	43560	ft^2
ac	4047	m^2
ac	0.001562	mi^2
atm	33.94	ft of water
atm	14.7	lb/in^2
atm	1.013×10^5	pascals
atm	1.033	kg/cm2
bbl (British, dry)	5.78	ft^3
bbl (British, dry)	0.1637	m^3
bbl (British, dry)	36	gal (British)
bbl, cement	170.6	kg
bbl, cement	376	lb (cement)
bbl, oil	42	gal (U.S.)
bbl (U.S., liquid)	4.211	ft^3
bbl (U.S., liquid)	0.1192	m^3
bbl (U.S., liquid)	31.5	gal (U.S.)
bbl/min	42	gal/min
bbl/day	0.02917	gal/min
cm^3	3.531×10^{-5}	ft^3
daN	2.2467	lbs
deg (angle)	60	min
deg (angle)	0.01745	rad
deg (angle)	3600	s
deg/s	0.1667	rpm
deg/s	2.778×10^{-3}	rev/s
ft	12	in
ft	0.3048	m
ft	1.89394×10^{-4}	mi
ft^2	0.0929	m^2
ft^3	1728	in^3
ft^3	0.02832	m^3
ft^3	7.481	gal (U.S.)
ft^3	28.32	liters
ft^3 of water	(60 deg. F) 62.37	lb
ft^3/min	4.72×10^{-4}	m^3/s
ft^3/min	0.1247	gal/s
ft^3/min	0.472	liters/s
ft^3/s	448.83	gal/min
ft^3- atm	2116.3	ft-lb
ft-lb	1.286×10^{-3}	Btu
ft-lb	0.1383	Kg-m
ft-lb	1.355818	N-m

UNITS	MULTIPLY BY	TO OBTAIN
ft/min	0.508	cm/s
ft/min	0.01667	ft/s
ft/min	0.01829	km/hr
ft/min	0.3048	m/min
ft/min	0.01136	mi/hr
ft-lb/min	0.01667	ft-lb/s
ft-lb/min	2.26×10^{-5}	KW
ft-lb/s	1.356×10^{-3}	KW
ft-lb/s	1.818×10^{-3}	hp
g	0.001	kg
gal (British)	1.20094	gal (U.S.)
gal	3785	cm^3
gal	0.1337	ft^3
gal	231	in^3
gal	3.785	liters
gal/min	2.228×10^{-3}	ft^3/s
gal/min	3.785	liters/min
$g\text{-}cm^2$	3.4172×10^{-4}	$lb\text{-}in^2$
hp	0.7457	kW
in	25.4	mm
in^2	645.2	mm^2
in^2	6.452	cm^2
in^2	6.944×10^{-3}	ft^2
in^3	1.639 x 10	m^3
in^3	5.787×10^{-4}	ft^3
in^3	4.329×10^{-3}	gal
in^3	0.01639	liters
kg	2.2046	lb
kg-m	7.233	ft-lb
kg/m^3	0.06243	lb/ft^3
kg/m	0.672	lb/ft
kW	44250	ft-lb/min
kW-hr	2.655 x 106	ft-lb
lb	4.45 x 105	dynes
lb	4.448	newtons
lb	4.535×10^{-4}	tons (metric)
lb/ft^3	16.02	kg/m^3
lb/ft^3	5.787×10^{-4}	lb/in^3
lb/ft^2	4.882	kg/m
lb/ft^2	6.945×10^{-3}	lb/in
lb/gal	7.48	lb/ft^3
lb/gal	0.12	specific grav.
lb/gal	0.1198	g/cm^3

UNITS	MULTIPLY BY	TO OBTAIN
lb/in^2	6.894757	kPa
liter	0.03531	ft^3
liter	0.001	m^3
liter	0.2642	gal
liter	0.001	m^3
liter	0.2642	gal
m	3.2808	ft
m^2	10.764	ft^2
m^3	264.2	gal
m^3/s	15850	gal/min
m^3/s	60000	liters/min
mi^2	2.788×10^7	ft^2
mi^2	2.59	km^2
rad	57.3	deg
rad/s	0.1592	rev/s
rad/s	9.549	rpm
temp. (°C)	1.8 (°C)+32	temp. °F
temp. (°F)	(°F - 32) 5/9	temp. °C
tons (metric)	1000	kg
watts	0.7376	ft-lb/s
watts	1.341×10^{-3}	hp
yds	3	ft
yds	0.9144	m

SUPREME SOURCE ENERGY SERVICES, INC. IS LOCATED IN KATY TEXAS.

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FAX -281-395-5204

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