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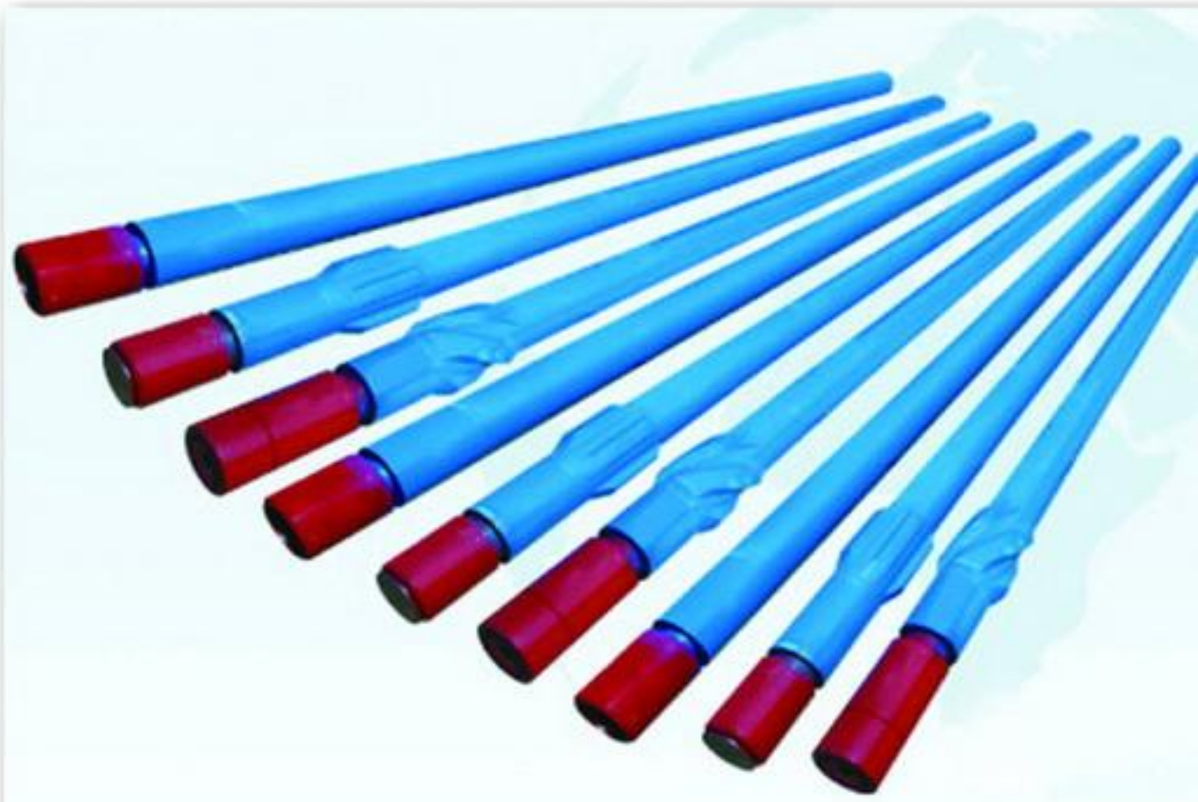
新永佳石油机械
XINYONGJIA PETROLEUM MACHINERY

螺杆钻具
说 明 书

DOWNHOLE MOTOR MANUAL



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1. 前言

本手册主要介绍螺杆钻具的性能和使用要求以及注意事项，便于用户更好地了解螺杆钻具，根据钻井的需要，选好、用好、维护好钻具，发挥其应有的技术性能，提高钻井经济效益。

2. 螺杆钻具工作原理

螺杆钻具是以泥浆为动力的一种井下动力钻具。泥浆泵泵出的泥浆液流经旁通阀进入马达，在马达进出口处形成一定压差推动马达的转子旋转，并将扭矩和转速通过万向轴和传动轴传递给钻头。螺杆钻具的性能主要取决于螺杆马达的性能参数。

3. 螺杆钻具的组成

螺杆钻具由旁通阀、防掉、马达、万向轴和传动轴五大总成组成。(如图1)

1. Introduction

This manual mainly introduces downhole motor's property, application and cautions, so the customers can know well our downhole motors, and to do better selection, application repair and maintenance of downhole motor according to drilling demand. thus to bring into full play in its reliable technical function and to enhance drilling economic efficiency.

2. Principle

Downhole motor is a kind of downhole dynamic drilling tool upon the power of drilling mud. Mud stream from the outlet of mud pump flows through a by-pass valve into the motor. This stream produces pressure loss at both inlet and outlet of the pump to push the rotor into rotating,and to transmit the torque and speed onto the bit. The downhole motor property mainly depends upon its property parameters

3. Constitution

Downhole motor is composed of five assemblies: by-pass valve, motor, anti-drop, cardan shaft and drive shaft(see Fig. 1).

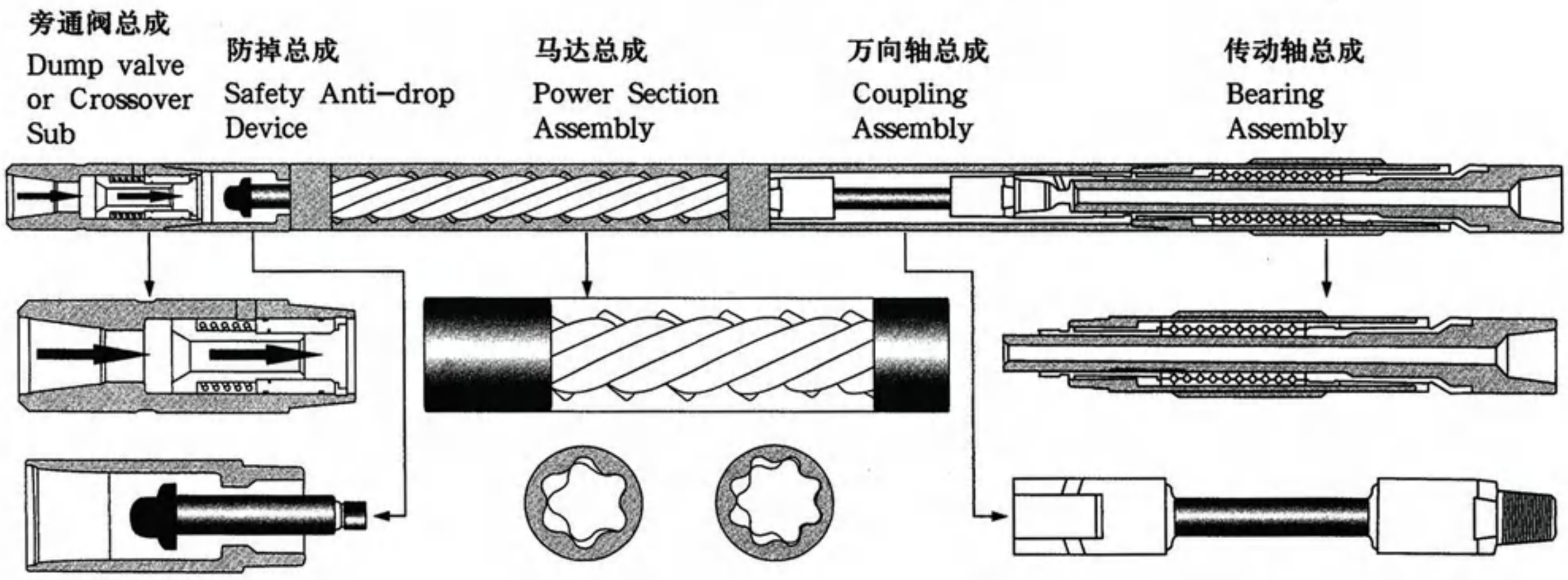


图1(Fig.1)

3.1旁通阀总成

它有旁通和关闭两个位置(如图2)在起下钻作业过程中处于旁通位置，使钻柱中泥浆循环绕过不工作马达进入环空，这样起下钻时泥浆不溢于井台上。当泥浆流量和压力达到标准设定值时，阀芯下移，关闭旁通阀孔，此时泥浆流经马达，把压力能转变成机械能。当泥浆流量值过小或停泵时，所产生的压力不足以克服弹簧力和静摩擦力时，弹簧把阀芯顶起，旁通阀孔又处于开启位置。一般情况下，深井、大斜度井、水平井以及使用中空转子时多采用代用接头。(如图2-1)

3.2马达总成

它由定子和转子组成。定子是在钢管内壁上压注橡胶衬套而成。橡胶内孔是具有一定几何参数的螺旋。转子是一根有镀铬硬层的螺杆。

转子与定子相互啮合，是用两者的导程差而形成的螺旋密封线，同时形成密封腔。随着转子在定子中的转动，密封腔沿着轴向移动，不断的生成与消失，完成其能量转换，这就是螺杆马达的基本工作原理。

马达转子的螺旋线有单头和多头之分(定子的螺旋线头数比转子多1个)。转子的头数越少，转速越高，扭矩越小；头数越多，转速越低，扭矩越大。(如图3)是几种典型马达配合的截面轮廓：

3.1 By–pass Valve Assembly

It has two positions:by-pass and close (SeeFig. 2). It is in by-pass position during trip operation, and circulates mud fluid in the drill string into the annular space by-passing the idle motor，so that no mud may spray out onto the platform during the trip operation. When mud flow rate and pressure reach the setting value，the valve stem moves down and closes the valve. Meanwhile, mud stream flows through the motor,and converts the pressure energy into mechanical energy. As mud flow rate is too low，or mud pump stops, and as the pressure produced is not enough to overcome the spring force and the static friction force，the spring presses the stem upward，and by-pass is in open position. In general，the cross—over subs are used in deep well, large angle well, horizontal well or when hollow rotor is selected (see Fig. 2-1).

3.2 Power Section Assembly

It consists of stator and rotor. Stator is made by squeezing rubber sleeve on the wall of the steel tube. There forms spiral structure with a certain geometric parameter. Rotor is a crome-plated screw rod.

The basic principle of downhole motor goes like this: Stator and rotor matches with each other，to form spiral line and seal cavity through their guide rail difference. With rotor running in the stator，the seal cavity is moving along its axial direction, continuously forms and disappears to complete its energy conversion.

Spiral sealline on rotor is divided into single end and multi-end(stator with one more end than rotor). The less ends the rotor has，the higher speed and the lower torque is. The more ends it has，the lower speed and the higher torque is figure3 shows the sectional profile of several typical motors.

图2(Fig.2) 旁通阀(By–pass Valve)

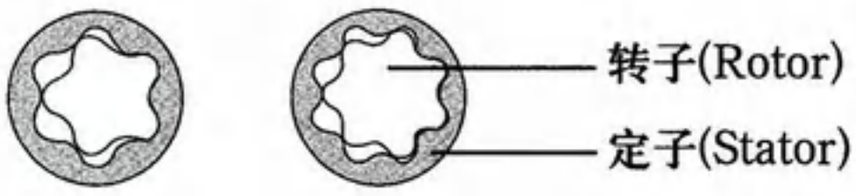
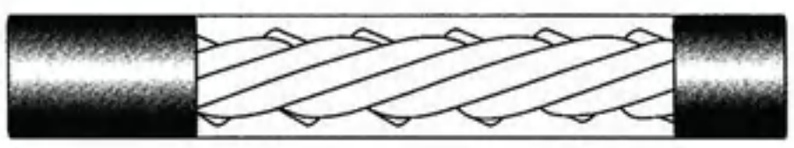


图3(Fig.3)



马达总成(Power Section)

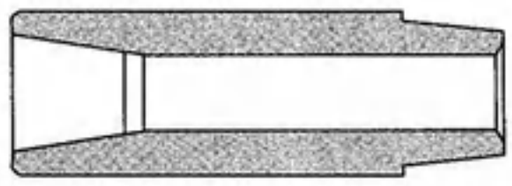
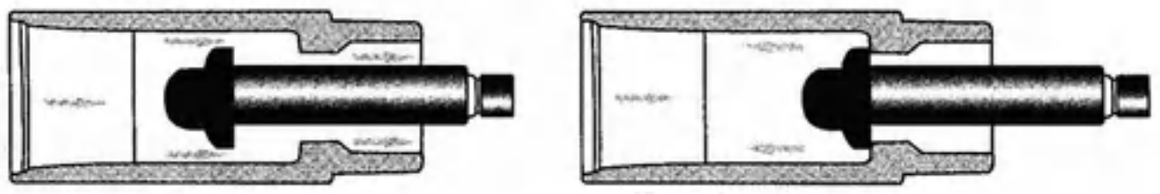


图2-1(Fig.2-1) 代用接头(Cross-Over Sub)



防掉装置(Anti-Drop Device)

马达定子一个导程组成一个密封腔，也称为一级。每级额定工作压降为0.8Mpa，最大压降为额定工作压力的1.4倍，如四级马达，额定压降应为3.2Mpa，最大压降为4.2Mpa。压降超过此值马达就会产生泄漏，转速很快下降，严重时会完全停止转动，甚至造成马达损坏，用户应特别注意。

为了确保马达的密封效果，转子与定子之间的配合尺寸与不同井深的温度有关，因此在选择钻具时应尽可能准确地提供给厂家钻具应用场所的井温情况，以便推荐使用松紧配合状态适合的马达。现场使用的泥浆流量应在推荐的范围之内，否则将影响马达效率，甚至马达磨损加快。

马达的输出扭矩与马达的压降成正比，输出转速与输入泥浆量成正比，随着负载的增加，钻具的转速有所降低，因此在地面只要根据压力表控制压力，根据流量计控制泵的流量，就可以控制井下钻具的扭矩和转速。

A guide rail forms a seal cavity in motor stator. This is called one stage. The rated working pressure loss of each stage is 0.8 Mpa, while the maximum pressure loss is 1.3 times of the rated pressure. Take a 4-stage motor as an example, the rated pressure loss shall be 3.2Mpa, and the maximum pressure loss shall be 4.2Mpa. The users are cautioned:if the pressure loss is over such value, motor may bring about leakage and speed will quickly slow down. More seriously. it may bring the motor into a complete stop, even cause the motor to be damaged.

The matching size between rotor and stator relates closely to depth temperature. To ensure motor seal in good condition,specific downhole temperature shall be provided to the manufacturer for reliable selection of appropriate motor. The actual mud flow rate is required to be within the recommended range. Otherwise incorrect flow rate may affect the motor efficiency, even speed up motor wear.

Motor torque is proportional to its pressure loss, but its outlet speed is inversely proportional to mud flow rate. With load increasing. screw drill speed decreases. Thus, pressure can be controlled by the pressure gauge and flow rate can be controlled by the flow rate gauge on surface. Thus, both torque and speed of downhole screw drill may be controlled.

3.2.1中空转子马达

为了增加钻头的马力和泥浆的上返速度，将转子加工成为带喷嘴的中空转子。此马达的总流量应等于流经马达密封腔流量和流经转子喷嘴流量的总和，每种规格的马达都有其推荐的最大和最小流量值。如果流量过大，转子会超速运转，定子和转子会出现提前损坏，如果流量过小，马达将停止转动。因此在选择转子喷嘴尺寸时，应确保马达密封腔流量始终保持或高于最小推荐流量值，这样才能使马达正常运转。(如图4)

3.2.1 Hollow Rotor Motor

To increase the hydraulic horsepower and the upward speed of mud stream，rotor is manufactured into hollow rotor with nozzles. Thus，motor total flow rate is equal to the sum of the flow rate through seal cavity and rotor. Each type of motor has its own recommended maximum and minimum flow rate value. If flow rate is too high，rotor may be running at over speed, earlier damage would occur onto stator and rotor. If it is too low, motor will stop operating. Therefore, the flow rate through seal cavity shall be ensured or even higher than the recommended maintenance value while selecting nozzle size. only in this way，can motor be kept in normal operation. (see Fig-4)

图4(Fig.4)

中空转子(Hollw Rotor)

在泥浆密度、喷嘴尺寸和马达流量为定量时，流经转子喷嘴的流量和流经马达密封腔的流量总是随负载变化而变化的。钻头离开井底，马达负载近似为零，此时流经转子喷嘴流量最小，而流经马达密封腔的流量最大。钻头钻进，使马达压差不断增加，使流经转子喷嘴流量增加，而此时流经马达密封腔流量减少。

When mud density，nozzle size and total flow rate is a constant value，the flow rate through nozzle and seal cavity always changes with the load. when the bit-leaves the hole bottom，the load is next to zero. Meanwhile, the flow rate through nozzle on the rotor becomes minimum，but the flow rate through the seal cavity becomes maximum. While the bit dropping down, motor-pressure loss will continuously increase，and the flow rate through rotor nozzle will become higher. but the flow rate through the seal cavity will become lower.

流经马达密封腔的流量为Qm，通过马达喷嘴的流量Qz。

即：总流量Q=Qm+Qz

设定马达转速n值计算Qm值

$$QM=\frac{nq}{\eta v\times 60}(L/S)$$

容积效率ηv取0.90

∴Qz=Q-QM(L/S)

喷嘴直径

$$d=\sqrt[4]{\frac{898pQ_2^2}{\triangle P}}(mm)$$

Qm—马达密封腔流量(L / S)

Qz—转子喷嘴的流量(L / S)

Q—中空转子马达的总流量(L / S)

ηv—容积效率

马达压降△P=△Pst+△Pop

△Pst—马达启动压降(Mpa)

△Pop—马达工作压降(Mpa)

p—泥浆比重(kg/L.)

计算公式中q为中空转子马达的每转排量(L / r)

其数值参(如表1)。

Flow rate through seal cavity is Qm，flow rate through nozzle is Qz.

then, total flow rate Q=Qm+Qz

Suppose motor speedisn，calculate Qm

$$QM=\frac{nq}{\eta v\times 60}(L/S)$$

Volumetric efficiency ηv is 0.90

So Qz=Q-Qm(L/s)

Nozzle diameter

$$d=\sqrt[4]{\frac{898pQ_2^2}{\triangle P}}(mm)$$

Qm—Flow rate of motor seal cavity(L / S)

Qz—Flow rate of rotor nozzle(L / S)

Q—Total flow rate of motor with hollow rotor (L/S)

ηv--Volumetric efficiency

Motor pressure loss △P=△Pst+△Pop

△Pst—Motor start pressure loss(Mpa)

△Pop—Motor operating pressure loss(Mpa)

ρ-Mud density(kg/L)

In the equation, q is flow rate of hollow rotor motor(L/r)

For the parameters，(see table-1)

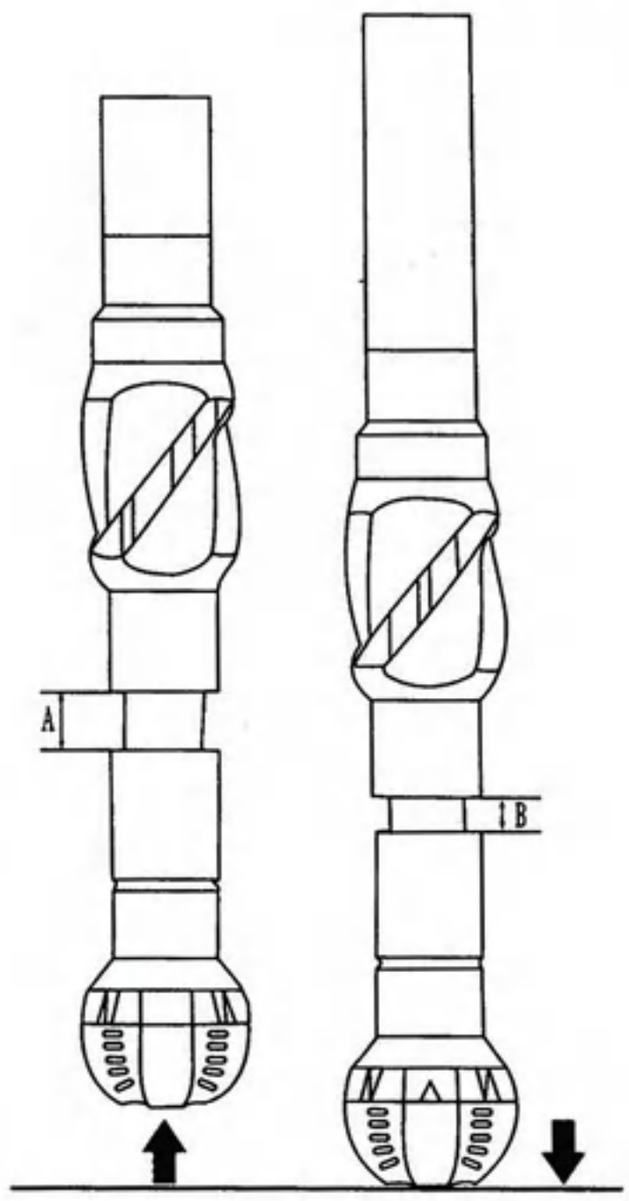
表1 中空转子马达每转排量估算：(Table.1)Estimation of Flow Rate of Hollow Rotor Motor

5LZ 244×7.0		q=20.3
5LZ 216×7.0		q=17.1
5LZ 197×7.0	5LZ 197×14.0	q=14.0
5LZ 185×7.0		q=13.0
5LZ 172×7.0		q=10.2
5LZ 165×7.0	5LZ 165×14.0	q=8.5
5LZ 120×7.0	5LZ 120×14.0	q=5.0
5LZ 95×7.0		q=2.6
7LZ 95×7.0		q=3.3
5LZ 89×7.0		q=2.4
5LZ 73×7.0		q=1.3

按以上推荐计算公式，用户可以根据使用需要随时更换不同直径的喷嘴，从而达到理想的效果。

Based on the above recommended equation, the customers can timely change different diameter nozzles according to the actual demand, so as to reach the desirable effect.

最大允许轴向轴承间隙说明：见图表2
Allowed Maximal Clearance of Axial Bearing:(see Table.2)



间隙=A−B
Clearance=A−B

表2(Table.2)

钻具型号 Size	间隙 Clearance
ϕ43mm	3mm
ϕ54mm	3mm
ϕ73mm	3mm
ϕ89mm	4mm
ϕ95mm	4mm
ϕ105mm	4mm
ϕ120mm	5mm
ϕ165mm	6mm
ϕ172mm	6mm
ϕ185mm	6mm
ϕ197mm	7mm
ϕ203mm	7mm
ϕ216mm	7mm
ϕ244mm	8mm

3.3万向轴总成

万向轴的作用是将马达的行星运动转变为传动轴的定轴转动，将马达产生的扭矩及转速传递给传动轴至钻头。万向轴大多采用花瓣式，也有采用挠轴式的。我公司钻具的花瓣型万向轴采用线切割技术制成，切口平行度高，粗糙度可达 $\frac{6.3}{\sqrt{}}$ 且不破坏金属化学成分，因此使用寿命高、机械损失小(如图5)。

3.3 Cardan Shaft Assembly

The function of the cardan shaft is to convert planetary motion into fixed constant rotation of the drive shaft, to transmit torque and speed from motor on the drive shaft, and to the bit. Cardan shaft mostly uses flat shaft, but some are flexible shafts. Our flat type shaft used on our downhole motor is made by linear cutting technology. So the cut has high parallelism, roughness can reach $\frac{6.3}{\sqrt{}}$ and it doesn't damage metal chemical composition. Thus, it has a longer running life and less mechanical loss (seeFig.5).

钻具使用后，应立即拆卸，检查万向轴，如磨损量超过维修标准，应及时更换有关易损件，否则会因万向轴的使用过度致使钻具无法正常工作。

图5(Fig.5)

球形万向轴(Ball Drive Universal Shaft)

3.4传动轴总成

传动轴的作用是将马达的旋转动力传递给钻头，同时承受钻压所产生的轴向和径向负荷。我公司制造的钻具传动轴总成有两种结构：

(1)钻头水眼压降为7.0Mpa，采用硬质合金径向轴承和中间有一组推力轴承的传动轴总成(如图6)；

(2)钻头水眼压降为14.0Mpa，采用硬质合金径向轴承和金刚石复合片（PDC）的平面止推轴承，其寿命更长、承载能力更高。

Downhole motor shall be disassembled as quickly as possible after use to examine cardan shaft. If it is found out that wear degree is over maintenance standard, relevant consumable components shall be changed promptly. If not,downhole motor can not be running normally due to overrun of the cardan shaft.

图5(Fig.5)

瓣形万向轴(Flat Universal Shaft)

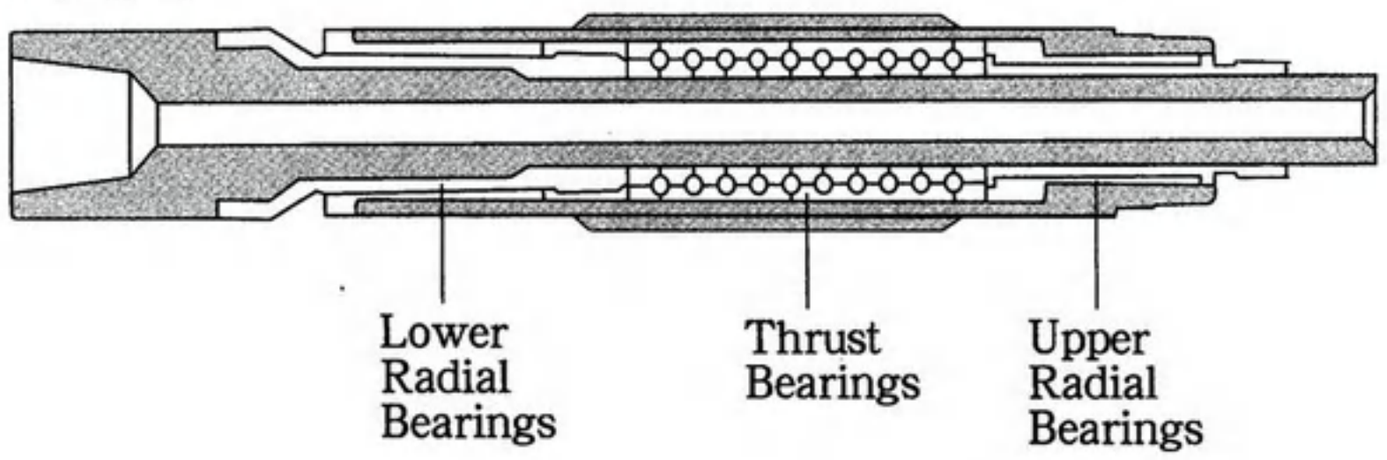
3.4 Drive Shaft Assembly

Drive shaft is to transmit motor rotary dynamic force onto the bit, meanwhile to withstand axial and radial load from drilling weight. We have the following two types of drive shafts:

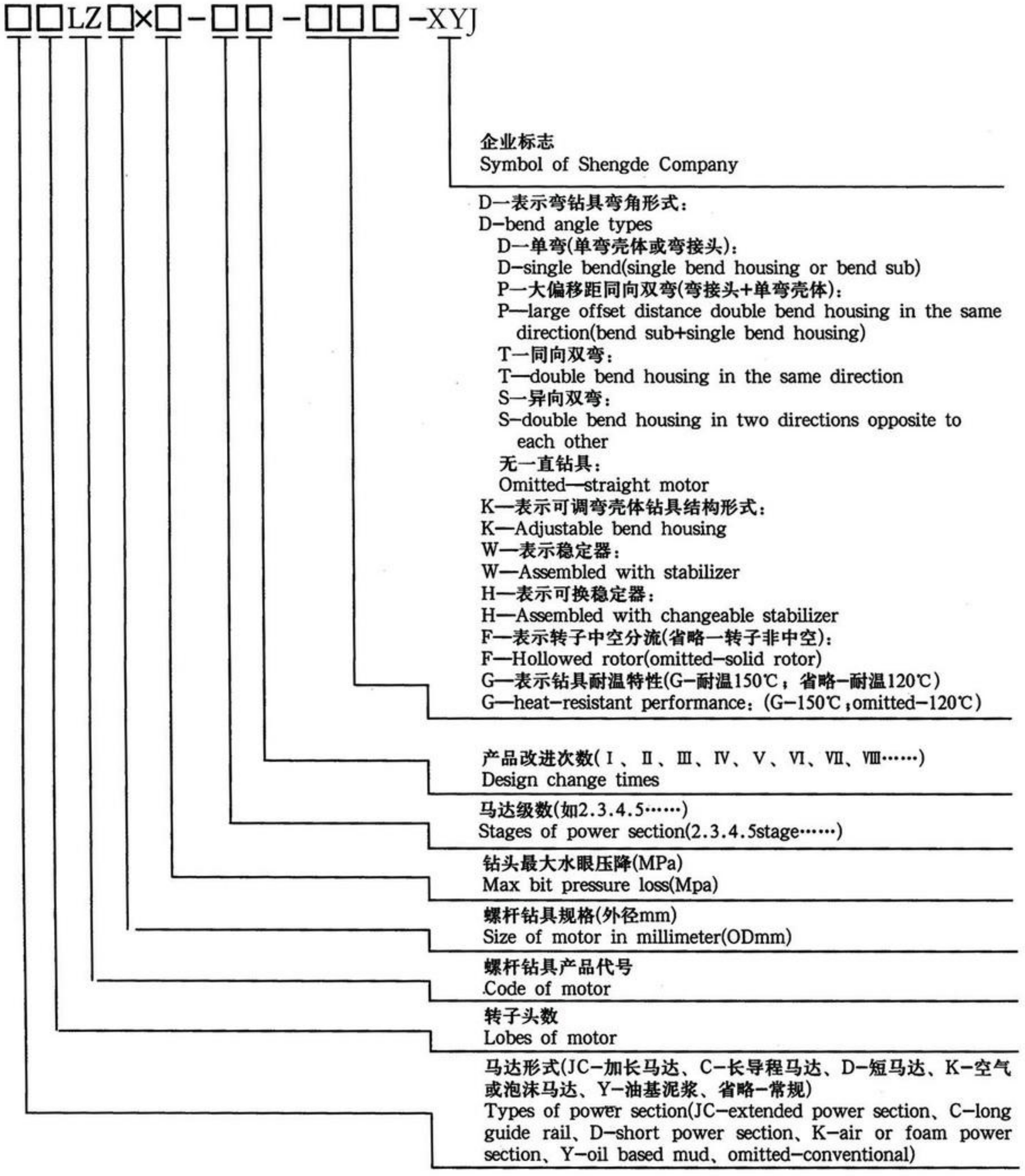
1)Bit nozzle pressure loss is 7.0Mpa, using hard alloy radial bearing and drive shaft assembly with thrust bearings (seeFig. 6):

2)Bit nozzle pressure loss is 14.0Mpa, using hard alloy radial bearing and PDC cutter flat thrust bearing. It has longer lasting life and higher bearing capacity.

图6(Fig.6)



4. 螺杆钻具型号说明　　4.Model of Downhole Motor



5. 使用须知

5.1井场钻井技术人员和司钻必须了解钻具的结构原理和使用参数。按使用手册的要求合理使用钻具。

5.2根据整个井眼的钻井作业计划，由钻井工程师根据任务结合地层结构、井眼孔径、深度、机械转速选定所用钻头与钻具型号，决定水眼直径和钻具组合。现场施工必须严格按制定的钻井作业计划执行。

5.3对钻井液的要求：螺杆钻具的马达为容积式，决定钻具性能的因素是马达的输入流量和作用于两端的压力降，而不是钻井液的类型。钻井液的物理化学性能除个别有损钻具寿命外，一般不影响钻具性能，应注意考虑钻井工艺的需要。但钻井液所含的各种硬颗粒必须予以限制，因为它会加速轴承、马达的磨损而降低钻具的使用寿命，建议固相含砂量不超过1%(事实证明：若含砂量达到5%，钻具寿命会降低50%)。同时注意钻井液中不要混有各种气体，因为混有气体的钻井液在钻具中压力的变化下容易产生“气蚀作用”，加速钻具的损坏，尤其是定子橡胶更容易被气蚀坏，必须予以足够的重视。

5.4使用钻头的选择：与螺杆钻具一起使用的钻头在选择上是十分重要的问题。因此螺杆钻具是否能成功的发挥作用的几个因素中，钻头与钻具的匹配是最重要的，希望能引起现场使用人员的重视。选择钻头与螺杆钻具配套使用的因素应是：

5. Application Notice

5.1 Site drilling technicians and drillers shall know well downhole motor structure principle and technical parameters, properly operate downhole motor in accordance with requirements specified in this manual.

5.2 Drilling engineer shall make operation program upon the whole hole, and select the model of downhole motor and bit to be used, determine nozzle size and downhole motor combination according to formation edge structure, hole size, depth and mechanical speed. The determined drilling program shall be strictly carried out accordingly on the location.

5.3 Drilling Fluid Requirement: Downhole motor shall be volumetric. The downhole motor property depends on motor inlet flow rate and the pressure loss functioning on both ends, rather than on the kind of drilling fluid. Physical and chemical property of drilling fluid, except the occasicoal damage to downhole motor running life, normally does not affect its property.

This shall be considered for the need of drilling process. However, the content of hard grains in mud stream must be limited since they can speed up wear of bearing and motor, may shorten downhole motor running life. It is suggested that solid sand content should not be over 1%(actually when sand content is 5%, running life will be reduced by 50%). Also, take care, not let drilling fluid mixed with any gas, because the fluid with gas may easily cause“Gas Erosion”, which may speed up tool damage with change of pressure. In particular, the rubber on stator is more easily damaged by gas erosion. Due attention shall be paid to this problem.

5.4 Bit Selection: For bit selection, it is important to combine and match downhole motor to be used. It relates to success of downhole motor application. It is advised site operators should take care of this matter. Application factors in combining bit with downhole motor are as follows:

(1)钻井方案及计划；

(2)针对地层需要的刃部结构；

(3)钻井液流通通道的结构；

(4)预先计划的机械钻速；

(5)使用该钻头，钻具运转的时间估算；

(6)钻头水眼压降的设计。

什么样的地层结构、地层软硬、使用哪类钻头、用什么样的刃部设计，请参考有关钻头的专业资料，这里仅就使用螺杆钻具完成各种钻井作业，对钻头的选择作些简要说明。

A：除了钻头水眼造成的压降外，要使钻井液流经钻头底部时别再形成其他较大的压力损失，尤其是钻头水眼压降已达到该型号钻具规定的压降值时更应注意。这对牙轮钻头不必担心，但是PDC钻头冠部液体通道的设计，就必须考虑通道过流面积是否可能造成额外过多的压力损失问题，同时并能保证岩屑及时排出及钻头冷却需要。

B：牙轮钻头：这类钻头在螺杆钻具配合使用时，更实用于钻井周期不长的作业，如定向造斜、侧钻等。

C：PDC钻头：PDC钻头不仅适用于定向造斜，更适用于钻井周期较长的作业，如打直井等。在较长周期的钻井作业中，最重要的因素就是钻头与钻具作为一个整体，不要由于其中的哪一部分出了问题，而造成不必要的起下钻。大家已熟知：复合片钻头较牙轮钻头寿命长，而且结构是整体的，具有很多优点。

D：提高钻具和钻头的使用寿命，也是一个重要因素。改善传动轴的稳定性，例如加稳定器，对提高钻具寿命发挥钻头性能是有帮助的。考虑钻头金刚石的几何尺寸、布置方位、钻压负荷与要求井下钻具转速高、钻压小的甚密关系。总之，

(1)Drilling Plan and Program;

(2)Formation Edge Structure;

(3)Structure of Mud Flowing Channels;

(4)Determined MechanicaI Drilling Speed;

(5)Estimation of Bit and Downhole Motor Running Life;

(6)Design of Bit Nozzle Pressure Loss.

Please refer to relevant professional information for details about bit selection based on formation structure. Hereby it briefly describes bit selection for performance of drilling operation with downhole motor.

A: Except bit nozzle pressure loss, in order to avoid producing higher pressure loss while drilling fluid flowing through bit bottom, attention shall be specially paid to this matter when the nozzle pressure loss has reached the specified loss value of this kind drilling tool. This does not affect rock bit. However, for the crown passage design of PDC bit, the problem of whether the passing fluid area may cause much extra loss should be considered. Meanwhile prompt discharge of cuttings and bit cooling should be ensured.

B: Rock Bit: When this kind of bit is used with downhole motor, it is more suitable for shorter drilling period, such as directional deflection and re-entry etc.

C: PDC Bit: It is not only used for directionaI deflection, and also more appropriate for longer drilling period, such as vertical well drilling. During longer period of drilling operation, the more important factor is to integrate bit with downhole motor, and to avoid unnecessary trip operation due to some problem. It is known that PDC bit can last longer than rock bit, and it is integral in structure, thus having more advantages.

D: To prolong running life of bit and tool is also an important fact. It is helpful to extend screw life and to develop bit property by improving stability of drive shaft, e.g. stabilizer. And the close relationship between diamond with geometric dimension, location, drilling weight load and the required high speed and lower drilling weight of downhole tool should be considered. 1n general, it is hard to obtain satisfactory effect without strictly matching bit and downhole motor, and it might also cause earlier damage of the tool.

5.5 Requirement for Hole Bottom Temperature: It is unfavorable to the motor property, and it may intensify all

使用螺杆钻具不对所匹配的钻头进行认真选择，要想取得满意的效果是困难的，还会造成钻具过早的损失。

5.5对井底环境温度的要求：温度过高对钻具马达性能十分不利，会使所有不利因素加剧。使用油基泥浆液，井底温度低于95℃，钻具工作状态最佳。当温度超过150℃时，即使使用最佳的油基钻井液，甚至使用水基钻井液，钻具定子寿命也会大幅度缩短。

为使钻具在较高的油基钻井液下正常工作，可以采用分段下钻，间歇循环，使用带分流孔的空心转子，以加速循环或改善钻井液的散热性能及其它性能的方法。保证实际定子工作温度低于极限值。

我公司生产两种定子。一种是普通定子，额定温度为95℃，最高温度120℃。一种是耐高温定子，额定温度105℃，最高温度150℃。

5.6 对钻井液流量的要求：螺杆钻具特点之一，输出转速与输入钻井液流值成正比。每种钻具都有一定的有效工作流量范围，建议按推荐参数进行选择，否则会降低钻具的工作效率和使用寿命。

5.7 钻井液压力与钻压的特点：钻具进行空运转时，若保持泥浆流量不变，钻具与钻头的压降为一个常数，该值随钻具型式和规格的不同而有所不同。钻具工作时，随着钻压逐步增加，钻井液循环压力逐渐上升，该压力的增量与钻压或钻进所需扭矩的增量成正比，当达到最大推荐值时，产生最佳扭矩。继续增加钻压，当循环钻井液在马达两端产生的压降超过最大设计值时，钻具将发生泄漏。正常工作时，表压随钻压的增减而升降。如果泵压表突然增加了几

disadvantageous factors if temperature goes too high. When using oil-based mud, the hole bottom temperature shall be lower than 95℃, then downhole motor shall be working in optimum condition. When temperature is over 150℃, stator life may be greatly shortened, even by using optimum oil-based mud or using water-based mud.

In order to keep downhole motor working normally at high temperature of oil-based mud, the way shall be adapted to conduct trip-in by sections and intermittent recycling. To ensure the actual temperature of stator below the ultimate value, hollow rotor with splitter hole can be used to speed up recycling or to improve heat radiation of the fluid and other property.

Our company produces two kinds of stators: one is conventional stator, with 95℃ as rated temperature and 120℃ as maximum temperature; the other is high-temperature stator, with 105℃ as rated temperature and 150℃ as maximum temperature.

5.6 Requirement for Flow Rate of Drilling Fluid: One of the downhole motor features is that the output speed is proportional to the input flow rate of drilling fluid. Each downhole motor has a certain effective range of working flow rate. It is advised to choose the range according to the recommended parameters, Otherwise, it may shorten the downhole motor's working efficiency and running life.

5.7 Features of Drilling Fluid and Drilling Weight: When downhole motor is in idle working condition, if keeping fluid flow rate unchanged, the pressure loss caused by both bit and downhole motor shall be a constant value. This value changes in response to the specific drill model and specification. As downhole motor is running, fluid recycling pressure will gradually increase with gradual rise of drilling weight. The increment of pressure is proportional to the torque increment needed by drilling weight and strpping in. When it reaches the maximum recommended value, optimum torque shall be produced. If drilling weight goes on rising, when the pressure loss of recycling fluid at both ends of motor is over maximum design value, leakage shall occur from the downhole motor. In normal operation, the gauge pressure rises or falls with the drilling weight. If the gauge shows sudden rise of several Mpa, the drilling weight goes on increasing,but pump pressure no longer increases, this indicates

兆帕，继续增加钻压，泵压不再增加，这说明钻具发生了泄漏，此时钻具定子与转子间密封破坏，钻井液通过破坏的马达密封腔从钻头水眼中流出。当因故障卡钻时，钻井液在钻具制动情况下，仍可以继续循环流过钻具。一旦钻具发生制动，应迅速将钻具提离井底降低钻压，因为钻井液长时间流过不转的马达会使钻具严重损坏。

另外，要使钻具获得最佳工作效率，应将钻具两端的压差控制在推荐参数范围内。

5.8 预先进行必要的水利计算：钻井作业时，由泥浆泵泵出的钻井液依次经立杆、水龙头、方钻杆而进入钻杆、钻链、无磁钻铤、钻具(马达)、钻头水眼及环空而返回地面。在钻井液不断循环过程中，由于钻井液本身的摩擦和钻井液与管壁、井壁的摩擦及各局部流动造成的损失，皆需消耗一定的能量。这一能量损失以压力损失表现出来。累加各部分的压力损失后可计算出总的压力损失，按预计钻井深度算出总压力损失后，就可以作为确定泵压的一个参数，这种大量的压力损失计算是很繁琐的。对于现场操作者来说可以采用一种简便的做法，只要将钻头稍稍提离井底，在额定排量下，主管压力表上的读数值就是上述总压力损失值。

6. 使用方法

在选择钻具及其组合方案时，应制定钻井作业计划，充分考虑井眼轨迹、钻头类型、规格、地层结构和水力计算等细节。

6.1钻具下井前的地面检查；

6.1.1 钻具除提升短节与旁通阀连接外，其他部分的壳体连接均涂以锁紧剂。

6.1.2 用钻头装卸器把钻头装上，只许用链钳转动钻具传动轴头，而且只能逆时针旋转(俯视旋

there occurs some leakage from downhole motor. The seal between stator and rotor may be damaged, and fluid going through the damaged seal cavity is flowing out from bit nozzle. When it is sticking due to this problem. fluid can be still recycling through downhole motor with downhole motor braking. Once downhole motor brakes, it shall be quickly lifted away from the hole bottom to reduce drilling weight, because downhole motor may be seriously damaged with fluid flowing through the idie motor for longer time.

Additionally, the pressure loss at the bottom ends of downhole motor shall be controlled within the recommended range, to ensure downhole motor in optimum working efficiency and running life.

5.8 Hydraulic Calculation in Aduance: In drilling operation, the pumped mud flows successively through riser, swivel, kelly into drill pipe, collar, non-magnetic collar, motor, bit nozzle and annular space, and upwards to the surface. During recycling, the loss caused from the friction of fluid itself and the friction of fluid onto the pipe wall, hole wall and/or partial flow will consume a certain energy.

The energy loss will be shown through the pressure loss. Total pressure loss can be calculated by accumulating pressure loss in each portion. The total pressure loss calculated according to the determined drilling depth can be a parameter to determine the pump pressure. It is complicated to calculate such large amount of pressure loss. Therefore, the site operator can adapt a simple method. Only by lifting the bit a little bit from the bottom, the reading on the pressure gauge of main pipe shall be the mentioned total pressure loss at the rated flow rate.

6.Application

when selecting the downhole motor and its combination, you should work out drilling program, fully consider hole size, hole trace, bit type, specification, formation structure and hydraulic calculation.

6.1 Surface Checking Before Tripping in

6.1.1 Except the connections between nipple and by-pass valve, other connections on shell of downhole motor shall be coated with locking agent.

6.1.2 Assemble bit on the handling device, counterclockwise rotate the drive shaft ends only with a chain wrench to protect the inside threads from loosening.

6.1.3 Hoist lifting-sub, and put downhole motor into turntable and by-pass valve into the center in easy watch position. And

向，下同)，以防止内部螺纹松扣。

6.1.3 吊起提升短节，把钻具放入转盘中，把旁通阀置于转盘中易于观察的位置。用卡瓦把钻具卡牢，卸去提升短节。

6.1.4 检查旁通阀：用锤柄或木棒向下压旁通阀芯，从上部向旁通阀注满水，此时旁通阀应不漏，水面无明显下降，然后挪走木棒，阀芯应被弹簧弹起复位，所注水应从侧面各孔均匀流出，即可认为正常。

6.1.5 接方钻杆并下放，使旁通阀位于钻杆下方便于观察的地方，开动钻井泵，逐渐提高排量直到旁通阀关闭，上提钻具，看钻头是否转动，此时旁通阀处于“关闭”位置。

不应有钻井液从旁通孔流出，检查的目的仅是看钻头是否旋转，不必持续很长时间，操作过程中应避免钻头与井口防喷器、井口管线接触、碰撞。停泵后注意观察旁通阀是否再次打开，使钻井液从旁通孔排出。泵未完全停止之前，不要把旁通阀提到转盘以上，防止污染井台。

6.1.6 卸下方钻杆，按设计的钻具组合，分别把弯接头、无磁钻铤、稳定器等接好。将弯接头拧入旁通阀之前，如果用斜口管鞋座造斜，应检查造斜键，保证斜口管鞋座处于正常的工作位置，并保证与接头的弯头刻线对准。

在所有钻具组合及钻杆连接过程中，注意防止粘扣错扣。为防止操作中移扣，建议装卸过程中应牢记：钻头接头相对于壳体的旋向为俯视反时针方向。违反此项规定，如反向转动转盘或用转盘旋紧马达以上的扣等，就会造成钻具内部零件的松扣或脱扣，请用户注意。

6.2 把钻具及其组合下到井眼里：尽管钻具本

then clamp tightly downhole motor with slips, and disassemble lifting sub.

6.1.4 Check By-pass Valve: Press downward the valve stem with hammer handle or wood stick. Fill water from the top into the valve. there should be no leakage from the valve and no great drop of water level, And then loosen the stick, the valve stem shall be sprung up to its original position. The filled water shall flow out evenly from the side holes. This is the normal state.

6.1.5 Connect and low down the kelly. Put by-pass valve under the kelly in an easy watch position. Start pump, and gradually increase flow rate till by-pass valve is closed. Lift the downhole motor to see whether the bit is rotating. Now by-pass valve is in“close”position.

There should be no fluid flowing out from by-pass hole. To do this is only for checking bit rotation. It needn′t last long. In the operation. the bit should be prevented from touching wellhead blowout preventer and flow line. After pump stops, check whether by-pass valve is in“open”position, and fluid flowing out of by-pass valve or not. Do not lift the valve over turntable until pump completely stops so as to protect the platform from being polluted.

6.1.6 Disassemble kelly and combine the downhole motor in accordance with the program. Connect bent sub non-magnetic collar and stabilizer etc. respectively. If you make deflection with muleshoe, before twisting bent sub into by-pass valve, you should examine deflecting key to ensure muleshoe sitting in normal working position, and align the scale line of connector and bent sub.

During the process of downhole motor combination and drill pipe connection, due attention should be paid to avoid thread gluing and alternation.

In order to prevent thread from moving in the operation. it is advised to keep in mind: Rotary direction of bit sub opposite the shell is counterclockwise. If you rotate turntable or clamp motor with turntable in wrong direction, thread loosening and thread off will occur on parts inside the downhole motor. This is caution for the users.

6.2 Trip in the Combined Downhole Motor into Borehole: Even though the outside of downhole motor looks simple and it has enough rigidity. trip-in speed still needs to be controlled, when drillers are strpping in downhole motor. Otherwise, the

身外形简单，且有足够的刚性，司钻下放钻具时，仍需控制下放速度，否则易被井眼中的沙桥、井眼台肩、套管鞋所损坏。遇有这样的井段，往往需开动钻井泵，慢慢地扩大井眼再通过。

如果用弯接头或弯壳体，钻头侧面就更容易碰上井壁的硬岩层和套管鞋等，因此要周期性的转动钻具组合，以消除侧钻的影响。

对于深井和高温井，下放钻具时建议周期性的进行中途循环；这样可以防止钻头堵塞，或因高温造成钻具定子损坏。

在井内，钻井液若不能迅速通过旁通阀阀口，进钻柱中，应减慢下井速度，或不时停下来充灌泥浆，下钻时，注意不可墩钻或将钻具直接放进井底。

6.3 开动钻具：如果钻具处于井底，必须提起0.3—0.6m，开动钻井泵此时记下立杆压力表读数，与计算的压力值对比一下，如果超过水力计算的压力数值也是正常的，这是钻头侧钻引起的。

清理井底，尤其是打斜井，井底必须足够“干净”，因为井底堆积或沉淀的岩屑影响转速或造斜。最好用正常的钻井液循环清理，清理时也可慢慢转动钻具或钻具分次转动(每次转动30°～40°)，依次地把堆在井底的物体清理干净。

清理干净后，再把钻具上提0.3—0.6m，校对压力值，记录下来。

重新下入井底并逐步加钻压，马达扭矩增加，立杆压力表压值升高，这个升高的压力值应符合各型号钻具规定的马达压降值，此压力表增大的数值反映了马达的负载是否正常，也反映钻压加的是否合适，因此保持马达转距基本稳定，钻压基本稳定，只要把立杆压力表读数限制在所选钻具推荐范围内就可以了。它能使司钻及时了解钻具工作情况。

钻头不在井底时，如果循环压力低于计算值，

downhole motor may be damaged by sand bridge, hole shoulder or casing shoe in the hole. When this happens. it is usually required to start pump, to extend the hole slowly for its passing.

If it is a bent sub or bent shell, it is easily for bit side to touch the hard rock strata and casing shoe etc. on the bore wall. Please periodically rotate downhole motor combination to eliminate the influence of lateral drilling.

As for deep and high-temperature well, it is advised periodically to conduct middle way recycling while stripping in the downhole motor. Thus, to protect the bit from plugging or protect the stator from damaging due to high temperature. In case the fluid can not rapidly flow through the holes of by-pass valve in the borehole, the stripping in speed should be slowed down or suspended regularly for mud filling. Again in stripping in, take care, so that no percussion or no direct strip-in will occur.

6.3 Start Downhole Motor: lf downhole motor is located at the hole bottom, you must lift it for 0.3-0.6m. Then start the pump and record the reading of the riser pressure. Compare it with the calculated pressure value, it is also normal if it is over the pressure of hydraulic calculation. This is caused from lateraI drilling.

Clear the hole bottom. 1n particular, for slant hole, the hole bottom must be very“clean”, because the cuttings packed and deposited in the bottom can affect the torque or deflection. It is best to clean it with normal recycling. While cleaning, slowly turn the downhole motor or turn it by times(turning 30°-40° each time, gradually clean up the bottom. Then lift downhole motor for 0.3-0.6m, calibrate and record the pressure value.

Gradually enhance drilling weight when tripping into the bottom again. Meanwhile, motor torque increases, riser pressure on gauge increases, too. The pressure value should conform to the motor pressure loss specified for giren type of downhole motor. The increased value on the gauge indicates motor load is normal or not, and also shows the added weight is appropriate or not. Therefore, motor torque and drilling weight can be kept stable by only limiting the riser gauge reading to the recommended range. This makes drillers know downhole motor operation timely.

When the bit is not in the bottom. if recycling pressure is

可能是旁通阀处与“开位”或钻杆损坏，井漏等造成的。

如果循环压力高于计算值，而且侧钻造成压力升高的因素已排除，循环压力仍高于计算值，则可能是钻头水眼被堵或传动轴被卡死，此时循环压力要比计算压力高得多。

6.4起钻：钻具起钻过程类似常规操作。起钻时，旁通阀处于开位，允许钻柱中的钻井液泻入环空。但是钻具本身不能排出钻井液，通常在起钻前在钻柱上部注入一段加重钻井液顺利排出。

6.4.1在钻具提出到旁通阀位置后，卸下旁通阀口上各部件，先用清水从旁通阀顶部进行冲洗，然后使用木棒或锤柄等将阀芯按下、松开使其移动无阻。清洗完毕，拧上提升短节，提出钻具。

6.4.2装好钻头装卸器，卡牢钻具外壳，反转钻头(俯视反旋)把马达中残存的泥浆从旁通阀排出，卸下钻头。

6.4.3卸下钻具，从传动轴孔中冲洗钻头，将传动轴水帽及轴承清洗干净，然后平放钻具，正常维护保养待用。若暂停使用或长时间搁置不用，建议向钻具内注入少量矿物油防锈(注：不允许加入柴油)。

6.5使用螺杆钻具井的故障分析：

如前所述，钻井液循环压力变化反映在立杆压力表上，它可以帮助现场人员辩别井底发生的情况和问题，事实证明：正确的判断可以节省大量起下钻所耗费的时间和成本。综合考虑钻具使用过程中的各种因素，归纳为(表3)。供用户参考。

lower than the calculated value, it is possible that by-pass valve locates in“open” position, or it is caused by drill pipe damage or well leakage etc.

If recycling pressure is higher than the calculated value, and the factor of pressure rise caused in re-entry is eliminated. but it is still over the calculated value, possibly the bit nozzle is plugged or drive shaft is sticked. In this case,the recycling pressure is much higher than the calculated value.

6.4 Trip Out: Downhole motor tripping out is similar to the conventional trip-out. By-pass valve is in “open” position in tripping out. The fluid in string is allowed to be drained into annular space. But downhole motor can not rapidly discharge the fluid by itself. Usually a section of heavy fluid is added into the top of string before tripping out, to press the fluid in the pipe to smoothly drain.

6.4.1 After downhole motor is tripped out to the location of by-pass valve, disassemble the parts on the top of the valve holes. Firstly wash it from the valve top with clean water, then press down the valve stem with hammer handle or wood stick, and loosen it for free movement. As soon as cleaning is completed, twist lifting nipple and trip out the downhole motor.

6.4.2 Install the bit assembly-and-disassembly-device to clamp the shell of downhole motor. Turn the bit in counter rotation to drain the residual mud from by-pass valve and then disassemble the bit.

6.4.3 Disassemble downhole motor. Wash it from the holes of the drive shaft, to clean the cap of drive shaft and bearing. Then handle the downhole motor onto a flat place. 1t is on stand-by after repair and maintenance. It is advised to inject small quantity of mineral oil (Note:No dissel is allowed in this case) into downhole motor against rusting, if it is not used temporally or if it is stored for longer time.

6.5 Troubleshooting

As mentioned above, the change of fluid recycling pressure is indicated through the pressure gauge of the riser. This may help site operators identify what is happening in the bottom. In fact, correct identification can save tripping time and cut down the costs. Complex troubleshooting is shown in Table3 for your reference.

表3：钻具故障分析表　(Table.3):Troubleshooting

异常现象 Problems	可能原因 Possible Causes	判断及处理方法 Troubleshooting
压力表压力突然升高 Gauge pressure loss sudden rise	马达失速 Motor speed loss	把钻具上升0.3－0.6m，核对循环压力，逐步加钻压，压力表随之逐步升高，均正常，可确认是失速。 Lift downhole motor for 0.3–0.6m,examine recycling pressure,slowly increase drilling weight. If gauge pressure rises accordingly in normal condition,the problem is motor speed loss.
	马达传动轴卡死，钻头水眼被堵 Motor drive shaft sticked tightly and/or bit nozzle plugged	把钻头提离井底，压力表读数仍很高，只能提出钻具检查或更换钻头。 Lift bit away from the bottom.lf gauge pressure is still too high,one has to lift out the drill for checking or to change the bit.
压力表慢慢地增高（不指随钻井深度增加而增大的正常压降） Gauge pressure slowly increasing (not means increase of the normal pressure loss with the increase of drilling depth)	钻头水眼被堵 Bit nozzle plugged	把钻头提离井底，再检查压力，如果压力仍然高于正常循环压力，可以试着改善循环流量或上下移动钻杆，如无效只得取出修理、更换。 Lift bit away from the bottom,again examine the pressure.If the pressure is still over recycling pressure,try to improve recycling flow rate or to move the drill pipe up and down.If the problem is not solved,one has to lift out the drill for repair or change
	钻头磨损 Bit wear out	继续工作，细心观察，如仍无进尺，只能取出更换。 Go on operating under careful observation.lf there is still no footage rate,lift out the drill for change.
	地层变化 Formation change	把钻头稍稍上提，如果压力与循环压力相同，则可继续工作。 Lift the drill a little bit.lf the pressure is the same with recycling pressure,it may go on working.
压力表压力缓慢降低 Gauge pressure slowly drops	循环压力损失变化 Fluctuation of recycling pressure loss	检查钻井液流量。 Examine fluid flow rate.
	钻杆损坏 Drill pipe damaged	稍提钻具，压力表读数仍低于循环压力，提出井眼检查。 Lift the drill a little bit.If the gauge pressure is still lower than recycling pressure,lift it out for examination.

异常现象 Problems	可能原因 Possible Causes	判断及处理方法 Troubleshooting
没进尺 No footage rate	地层变化 Formation change	适当改变钻压和循环流量（注意必须在允许范围内）。 Appropriately change drilling weight and recycling flow rate(Note:it must be within the allowable range).
	马达失速 Motor speed loss	压力表读数偏高，钻具提取离井底，检查循环压力，从小钻压开始，逐步增大钻压。 Gauge pressure is too high,lift the drill away from the bottom,examine recycling pressure,to increase drilling weight gradually.
	旁通阀处于“开位” By-pass valve in “open” position	压力表读数偏低，稍提起钻具，起停钻井泵两次仍无效，则需要提出井眼更换检查旁通阀。 Gauge pressure is too low,lift the drill a bit and start and stop the pump twice.If it is not solved, lift it out to check or change by-pass valve.
	万向轴损坏 Cardan shaft damaged	常伴有压力波动，稍提起钻具，压力波动范围小些，只能取出钻具，检查更换。 Often with pressure fluctuation,lift the drill a bit,fluctuation range becomes smaller.Only lift it out for examining and changing.
	钻探损坏 Bit wear out	更换新钻头。 Change new bit.

7. 定向井螺杆钻具的使用

定向钻井就是沿着预先设计的井眼轴线钻到目的层的钻井方法。要实现这个目标除螺杆钻具，还需要组成钻具组合的浮动接头、弯接头、钢钻铤、无磁钻铤、稳定器、钻头以及测量系统等配套工具和设备。我公司生产的螺杆钻具仅是完成这项工作的主要工具之一。

7.1我公司生产的螺杆钻具可以满足定向钻井的各项需要。

7.2弯接头是有弯曲角度的接头短节，其公扣拧入钻具上部。弯接头上部再接钻铤，这样在

7. Application of Steering Downhole Motor

Directional drilling is a way to drill the target stratum along with the designed axial line. To do this,except applying downhole motor, it is required to use a complete system, combined with float sub, bent sub, steel collar, non-magnetic collar, stabilizer, bit as well as MWD system. Our downhole motor is one of the drilling tools to perform this operation.

7.1 Our downhole motor can meet the various demands of directional drilling.

7.2 Bent sub is composed of bent nipples, with its male thread onto the top of the drill. The top of bent nipple is connected with collar. Thus, there forms an angle between collar and the drill. This angle plays a key role in determining

钻铤及钻具间形成一个角度，这个角度对决定定向斜角起主要作用。弯接头的角度为0°－3°，可以由用户自己决定。弯接头角度的选择应考虑井眼尺寸、井斜角变化的要求、所用钻具估计能完成的进尺等因素。弯接头的角度直接影响井眼尺寸、井斜角和井斜角的变化率。（见表4）

directional oblique angle. The bent sub angle ranges from 0° to 3° which is decided by the customers. The factors of change of hole size, hole deviation angle and footage rate shall be considered in selection of bent subs. The bent sub angle may directly affect the hole size, the hole deviation angle and inclination change (See Table-4).

表4：弯接头角度，井斜角变化率/30m
(Table.4)Bent Sub Angle and Inclination Angle Change/30m

弯接头角度 Bent Sub Angle	120(4 3/4″) Downhole Motor		165(6 1/2″) Downhole Motor		197(7 3/4″) Downhole Motor	
	井眼尺寸 Hole Size	变化率 Change	井眼尺寸 Hole Size	变化率 Change	井眼尺寸 Hole Size	变化率 Change
1°	152.4(6″)	3° 30′	222.3(8 3/4″)	2° 30′	250.8(9 7/8″)	2° 30′
1° 30′		4° 30′		3° 30′		3° 45′
2°		5° 30′		4° 30′		5° 00′
1°	171.5(6 3/4″)	3° 30′	250.8(9 7/8″)	1° 45′	269.9(10 5/8″)	2° 00′
1° 30′		4° 00′		3° 30′		2° 30′
2°		5° 00′		4° 45′		4° 15′
2° 30′		5° 45′		5° 00′		5° 30′
1°						
1°	200(7 7/8″)	2° 30′	269.9(10 5/8″)	1° 15′	311.2(12 1/4″)	1° 45′
1° 30′		3° 30′		2° 00′		2° 30′
2°		4° 30′		3° 00′		3° 30′
2° 30′		5° 30′		4° 00′		5° 00′

如果弯接头有斜口管鞋造斜键，应当检查一下这个键要对正弯接头上的刻线，这样可以保证定向方位的正确；如果使用，应当检查一下，并在运转前记录下来。

If the bent nipple has muleshoe key on it, theuser should examine the alignment between the key and the bent sub, to ensure correct directionaI azimuth. If using magnetic deflection, the user should examine the interaction between the alignment line and polarity of the magnet inserted in the collar, and record it before operation.

7．3反扭矩对定向钻井的影响：钻具组合，通过钻杆下到预定定向造斜深度，从预定深度到井台在反扭矩的作用下产生变形。施加钻压时，钻具输出一定的扭矩，那么大小相同方向相反的反扭矩就作用在整个钻具组合及钻杆上，造成它们的

7．3 Influence of Opposite Torque on Directional Drilling: The downhole motor combination will be stripped in with the drill pipe into the scheduled depth of directional deflection, deforming under the reaction of opposite torque from the scheduled depth to the platform. When increasing drilling

扭转变形，因此必然影响定向的方位。在定向钻井工作中，为了保持正确的方向，必须考虑扭矩。由反扭矩造成的反扭角的大小取决于：

- 钻压
- 钻杆的类型与长度
- 井斜角的大小
- 钻铤和重钻杆的类形和长度
- 装有扶正器时，扶正器的数量和长度钻柱的

反扭角可以粗略地参照(表5)的数值

如果在预定方位井斜角下继续造斜而造斜过程中出现偏离预定方位的情况，建议用(表6)，它可获得最有效的方位变化，而又很少影响井斜角的变化。

weight, the drill may output a certain torque. Thus, the opposite torque of same force and reverse direction will react on the cornbination, causing torsion deformation. This will, of course, affect the directional azimuth.

During the period of directional drilling, the opposite torque shall be considered to ensure correct direction. The degree of opposite torsion angle caused by the opposite torque depends upon:

- Drilling weight
- Type and length of drill pipe
- Size of deviation angle
- Type and length of collar and heavy drill pipe
- When completed with centralizer for the opposite torsion angle of drill string,the quantity and length of centralizer can refer to the data in Table-5

If deviation of scheduled direction occurs during on-going deflection with the planed deviation angle, it is advised to refer Table-6 to obtain effective azimuth change, which has less influence on affecting the deviation angle.

表5：钻柱反扭角估算

(Table.5)Estimation of Opposite Torsion Angle on String

开始造斜深度（m） Initial Deflection Depth(m)	估算反扭角 Estimated Opposite Torsion Angle
0-152	Left Turn20° 左旋20°
＞152－305	Left Turn25° 左旋25°
＞305－475	Left Turn35° 左旋35°
＞475－1524	Left Turn50° 左旋50°
＞1524－full well depth ＞1524-全井深	Left Turn10° /305m左旋10° /305m

表6：已有井斜角时（纠偏）反扭角的估算

(Table.6)Estimation of Opposite Torsion Angle with Deviation

井深 Well Depth	井斜角 Hole Deviation Angle	从井眼的高点调整钻具 Adjust the Drill from Top Hole	
		向左纠偏 Left Correction	向右纠偏 Right Correction
地面-305 Surface-305	2° -5°	Left Turn40° 左转	Right Turn140右转
	5° -10°	Left Turn40° 左转	Right Turn135右转

井深 Well Depth	井斜角 Hole Deviation Angle	从井眼的高点调整钻具 Adjust the Drill from Top Hole	
		向左纠偏 Left Correction	向右纠偏 Right Correction
地面-305 Surface-305	10° -15°	Left Turn40° 左转	Right Turn130° 右转
	15° -20°	Left Turn40° 左转	Right Turn125° 右转
	20° -25°	Left Turn40° 左转	Right Turn120° 右转
	25° -30°	Left Turn40° 左转	Right Turn115° 右转
	30° -35°	Left Turn40° 左转	Right Turn110° 右转
	0ver35°	Right Turn40° 右转	Right Turn105° 右转
305-710	2° -5°	Left Turn30° 左转	Right Turn155° 右转
	5° -10°	Left Turn20° 左转	Right Turn140° 右转
	10° -15°	Left Turn10° 左转	Right Turn135° 右转
	15° -20°	Left Turn15° 左转	Right Turn130° 右转
	20° -25°	Left Turn0° 左转	Right Turn125° 右转
	25° -30°	Left Turn5° 左转	Right Turn120° 右转
	30° -35°	Right Turn5° 右转	Right Turn115° 右转
	0ver35°	Right Turn10° 右转	Right Turn110° 右转
710-全部井深 710—Full depth	2° -5°	Left Turn25° 左转	Right Turn180° 右转
	5° -10°	Left Turn15° 左转	Right Turn170° 右转
	10° -15°	Left Turn5° 左转	Right Turn165° 右转
	15° -20°	Left Turn0° 左转	Right Turn145° 右转
	20° -25°	Right Turn5° 右转	Right Turn125° 右转
	25° -30°	Right Turn10° 右转	Left Turn115° 左转
	0ver35° 35° 以上	Left Turn10° 左转	Left Turn100° 左转

7．4注意事项

·调整弯接头指向时，转盘应按右旋定位，调整完毕，钻柱需慢慢地提升和下放数次(上提高度应超过9m)消除井眼中的钻杆应力，使其处于自由放松状态。

·所测得的井眼方位和井斜角不是钻头处的数据而是在钻头以上15米左右处，这是测斜装置距钻头的距离。

·连续造斜时，建议每钻一单根取一测量数据。为使造斜准确，所加钻压应稳定且不要过大。

7．5导向钻井螺杆钻具

7．4 Cautions

• When adjusting the guide point of bent sub, the turntable shall be orientated in right rotation．Then slowly trip in and out the drill string (1ifting by over 9m) to eliminate the pipe stress in the hole，keeping it in free position．

• The measured hole azimuth and deviation angle is not the data of the bit location，but the data on about 15m point above the bit location．This is the distance between measuring device and the bit．

• When going on deflecting, it is advised to measure the data while stripping in a drill pipe．The added drilling weight shall be kept stable but not too heavy to ensure correction of deflection．

·导向螺杆钻具是我公司为水平钻井设计和制造的新型井下动力钻具，通常是指配有弯壳体和稳定器的钻具。

·用途

配合PDC钻头或牙轮钻头组成不同的钻具组合，用于导向钻井系列，完成造斜和在不更换钻具组合而实现稳斜段(配合转盘低速旋转)及水平井段的钻井作业。

·传动轴外壳带有不同直径和不同形状的稳定器(见图6)，用户可根据钻井工艺的需要选择使用。

·弯万向轴壳体

弯万向轴壳体有单弯和双弯两种形式，并有不同角度的弯角供用户选择，双弯壳体还可选择同向双弯和反向双弯。(表7)为我公司常规钻具的弯角及造斜率供用户参考。

·为了解决水平钻井的携屑上返的困难问题，马达转子设计有中心分流孔入口处装有喷嘴，从而增加输入流量，可以进行高压喷射钻井。当需要排量较小时，可以封堵转子中孔。

可根据用户要求，制造转子头数与定子头数比为3：4，5：6，7：8，9：10的各种规格见(图7)，和不同规格的扶正器见(图8)，且可根据使用要求为用户提供钻头水眼压力降为14Mpa的产品。

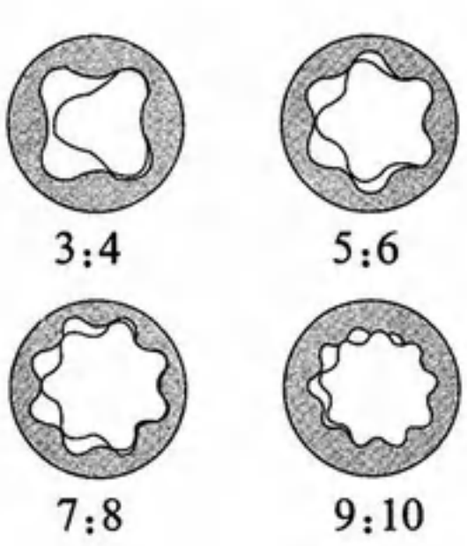


图7 (Fig.7)

7．5 Steering Downhole Motor

· Steering downhole motor is our newly designed and manufactured downhole dynamic tool. It is normally a kind of drilling tool completed with bent shell and stabilizer.

· Application

Completed with PDC bit or and rock bit, it composes various drill combination, being used for steering drilling. It may perform deflection without changing the combination to realize drilling operation in directional zone (with lower speed of turntable)and horizontal zone.

· The shell of the drive shaft is completed with a stabilizer of different diameter and shapes (See Fig.6). The users may choose them according to the drilling program.

· Bent cardan shaft shell

Bent cardan shaft shell is divided into single and double. Various angles are provided for your selection. For double bent shell, you may choose both homo direction and reverse direction.

Table-7 shows bent angle and deflection of our conventional downhole motor for your reference.

· In order to overcome the difficulty in carrying solid to flow upward in horizontal drilling, a nozzle is designed at the inlet of the center splitter on motor rotor, and it may increase the input flow rate and perform high-pressure jet drilling. When smaller flow rate is needed, the user may plug the splitter hole.

We can manufacture various types of downhole motor with the ratio of numbers of stator ends to rotor ends are: 3:4, 5:6, 7:8 and 9:10according to the user's specific demand, (seeFig.7)and various types of stabilizer.(seeFig.8)and provide the products of 14Mpa bit nozzle pressure loss based on the user's application.

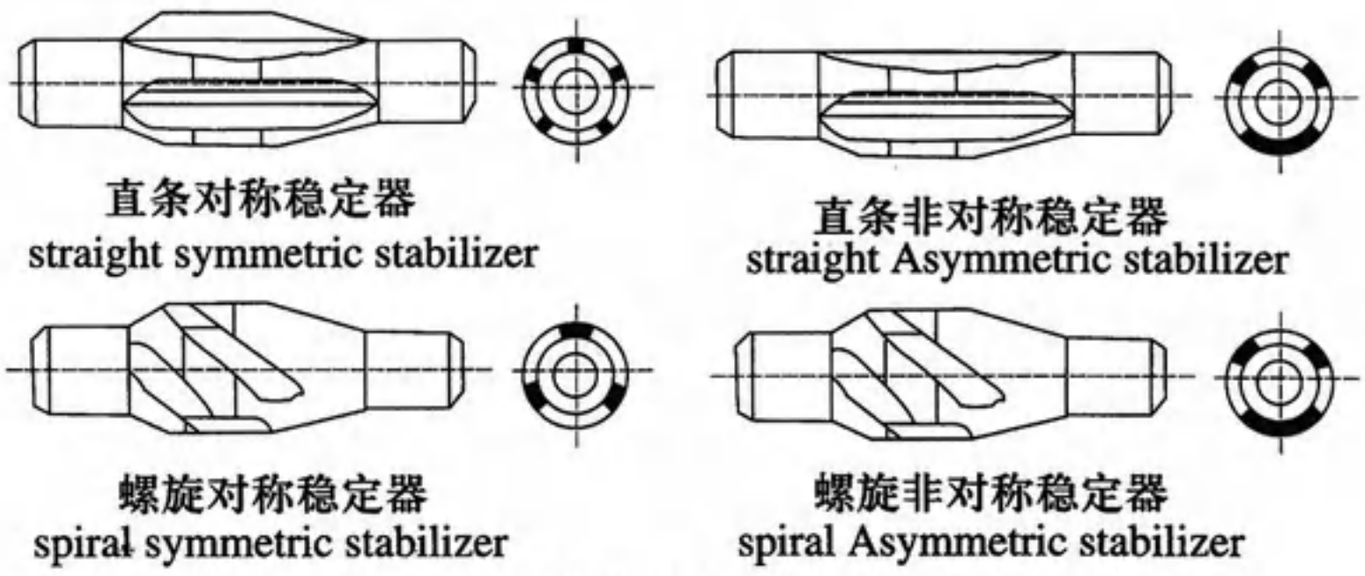


图8 (Fig.8)

8. 定货须知

如果您要使钻具取得良好的使用效果，不仅注重钻具本身质量状况，技术性能，还与您使用的目的、环境及介质条件、钻具组合等因素密切相关。因此您定货时正确选择钻具型号和结构形式尤为重要。

如果您在选型时存在疑问，请及时与我公司联系。

为了能正确、及时地向您提供所需产品，请您在定货时认真填写定货信息表，并且同时确定下面几个问题：

(1)是否需提供附件或附加结构：

·提升短节(井口或随钻)

·定向接头

(2)如果有可能，定货时提供以下信息以便跟踪服务：

·钻具使用单位

·钻具使用井位，使用目的及预计使用时间

·井身结构，使用钻具井段、泥浆条件等

8. Purchase Guide

lf you want to obtain good effectiveness by using downhole motor, you should take into account not only its quality, technical property, but also the application purpose, environmental conditions and its combination as well. So it is very important to make proper selection of the type and composition when purchasing the equipment. Please contact us if you have any questions during selection.

To ensure correct and rapid provision of our products, please fill in the form when you are planning to order the equipment, Meanuhile, the following information should be specified:

(1) Whether accessories are needed or not:

• Lifting nipple(wellhead or with drilling)

• Directional collar

(2) If possible, please provide the following information for feedback and post-sell service.

• Name of customers

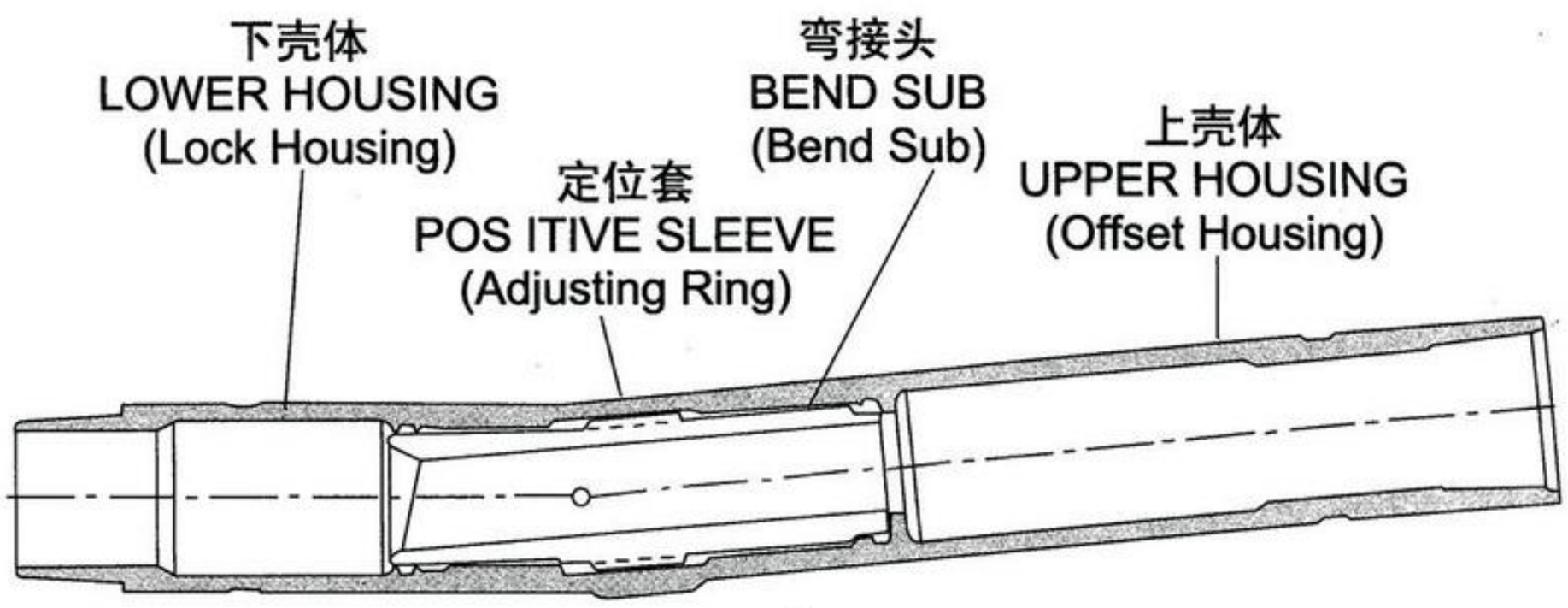
• Location, purpose and estimated duration

• Well bore structure, section to use screw drill and mud conditicn,etc.

表7 弯外壳螺杆钻具造斜率
(Table.7) Deflection of Bent Shell

参数 Parameter / 钻具型号 Model	井眼尺寸 (in) Hole Size	理论造斜率 Theoretical Deflection Angle K°30m								
		30′	45′	1° 00′	1° 15′	1° 30′	1° 45′	2° 0′	2° 15′	2° 30′
5LZ73x7.0	3 1/8	5.9	7.8	20.3	23.6	30.0	37.6	43.7	48.6	53.8
5LZ89x7.0	4 5/8	7.6	11.5	15.4	19.0	23.0	26.7	30.5	34.4	38.2
5LZ95x7.0	4 5/8	7.3	10.0	13.4	16.3	20.0	23.7	27.4	30.0	34.8
5LZ120x7.0	6	6.5	7.6	11.3	14.3	17.2	20.7	24.0		
5LZ165x7.0	8 1/2	4.4	6.5	8.9	12.0	13.9	15.4	17.5		
5LZ172x7.0	8 1/2	4.0	6.0	8.1	9.80	11.4	13.3	15.7		
5LZ185x7.0	8 1/2	4.0	6.0	8.1	9.80	11.4	13.3	15.7		
5LZ197x7.0	12 1/4	4.0	6.0	8.2	10.2	12.3	15.2	16.3		
5LZ244x7.0	12 1/4	3.6	5.4	7.3	9.1	10.9	12.7	14.5		

Ⅰ.可调弯壳体调节操作说明：图9
(Fig.9) Operation Description of Adjustable Bend Housing



可调弯壳体可轻松简便的调节角度0°—3°

以下为可调弯壳体调节设置程序步骤：

参见（图10）来设置第1步和第2步：

1.将钳牙放在如图所标的旋扣区域，松开连结。

2.当定位套的牙与上壳体的牙啮合时，顺时针旋开下壳体2—4圈（但不要完全卸开）。

The adjustable bend housing allows for quick and easy bend angle adjustment ranging from0° to3°.

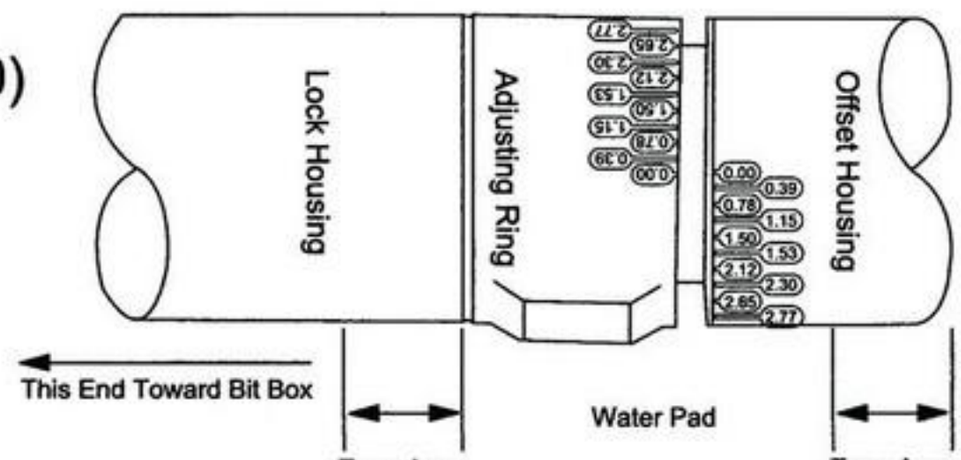
The following is the procedure for setting the adjustable bend housing:

Refer to Fig. 10 for step 1and 2:

1. Place the jaws of tongs in the tong areas shown in Figwe10 and break the tool joint.

2. While keeping the adjusting ring teeth engaged with the mated slots in the offset housing, unscrew the lock housing two to four complete turns in the clockwise direction (funthread).

图10
(Fig.10)



参见（图11）来设置第3步和第4步：

3.下滑动定位套至牙齿之间脱离。

4.调节弯壳体角度，顺时针旋转定位套，直到所需角度在上壳体上出现。

Refer to the above Fig. 11 for step 3 and 4:

3. Slide the adjusting ring downward to disengage the teeth in the ring and the offset housing.

4. To adjust the bend angle of the bent housing, rotate the adjusting ring clockwise until the desired bend—angle marking on the offset housing occurs.

图11
(Fig.11)

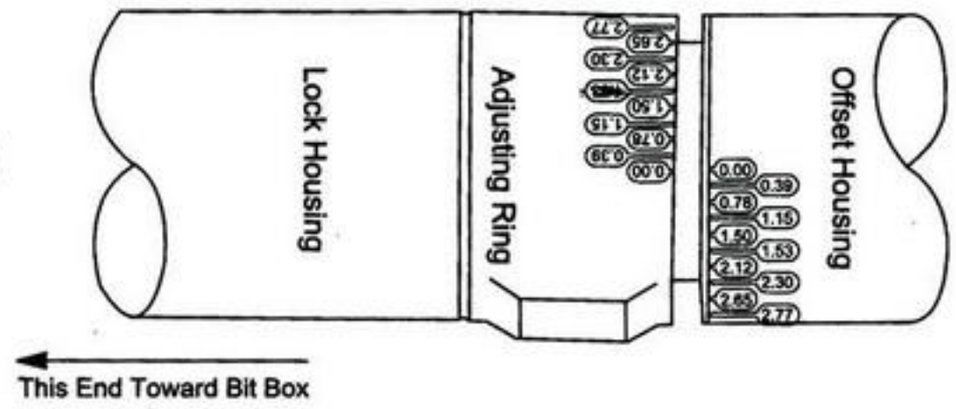
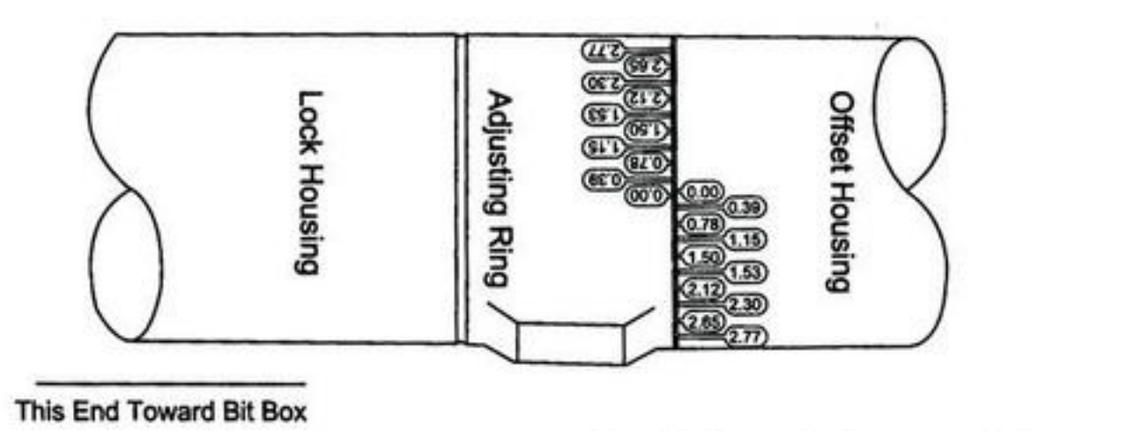


表8 钻具上下端螺纹安装扭矩
(Table.8) Top and Bottom Thread Torque

钻具规格 Size	上端螺纹 Top Thread	紧扣扭矩KNM Twist Torque	下端螺纹 Bottom Thread	紧扣扭矩KNM Twist Torque
43	NC12	2.0～2.6	NC12	2.0～2.6
60	1 1/2REG	2.8～3.5	1 1/2REG	2.8～3.5
54	1 1/2REG	2.8～3.5	1 1/2REG	2.8～3.5
73	2 3/8REG	3.4～4.8	2 3/8REG	4.8～6.3
89	2 3/8REG	3.4～4.8	2 3/8REG	4.8～6.3
95	2 7/8REG	6.8～11.6	2 7/8REG	6.8～11.6
120	3 1/2REG	14.3～17.2	3 1/2REG	9.4～12.2
165	4 1/2REG	32.4～35.6	4 1/2REG	16.3～21.8
172	4 1/2REG	32.4～35.6	4 1/2REG	16.3～21.8
185	4 1/2REG	32.4～35.6	4 1/2REG	16.3～21.8
197	5 1/2REG	54.4～68	6 5/8REG	68.0～79.3
203	5 1/2REG	54.4～68	6 5/8REG	68.0～79.3
216	6 5/8REG	68～79.6	6 5/8REG	38.1～43.5
244	6 5/8REG	74.8～88.4	7 5/8REG	46.2～54.4

图12
(Fig.12)



参见(图12)来设置第5步和第7部：

5．调节弯壳体角度，顺时针旋转定位套，调到所需角度。

6．应用丝扣液来涂下壳体和定位套之间的对接面。

7．一起调节下壳体和定位套，并且参考扭矩值表(Table 9)。匹配的上壳体外径和定位套显示数值。

Refer to Fig. 12 for step 5 and 7:

5. Engage the teeth of the adjusting ring and the offset housing at the desired bend angle.

6. Apply thread dope to the mated faces of the lock housing and the adjusting ring.

7. Screw the lock housing and the adjusting ring together and apply the torque value listed in Table 9. The matching markings on the OD of the offset housing and the adjusting ring indicated as well as the high side marks to identify the high side of the tool.

表9 可调部分下壳体上紧扭矩
(Table.9) Lock Housing Make-up Torque

LOCK HOUSING MAKE-UP TORQUE		
Motor Size	English	Metric
2-7/8	2.300 ft-lbs	3.200 N-m
3-1/8	2.700 ft-lbs	3.600 N-m
3-1/2	3.800 ft-lbs	5.100 N-m
3-3/4	4.600 ft-lbs	6.300 N-m
4-1/8	7.000 ft-lbs	9.500 N-m
4-3/4	9.500 ft-lbs	12.700 N-m
5-1/2	16.000 ft-lbs	21.500 N-m
6-1/4	20.000 ft-lbs	26.700 N-m
6-1/2	23.000 ft-lbs	31.000 N-m
6-3/4	27.000 ft-lbs	37.000 N-m
7-3/4	29.000 ft-lbs	39.000 N-m
8	30.000 ft-lbs	40.300 N-m
8-1/2	38.000 ft-lbs	51.000 N-m
9	40.000 ft-lbs	53.700 N-m
9-5/8	61.000 ft-lbs	83.000 N-m
11-1/4	100.000 ft-lbs	136.000 N-m

II. 可调弯壳体调节角度说明:
Description of Adjustable Bend Housing:

图13
(Fig.13)

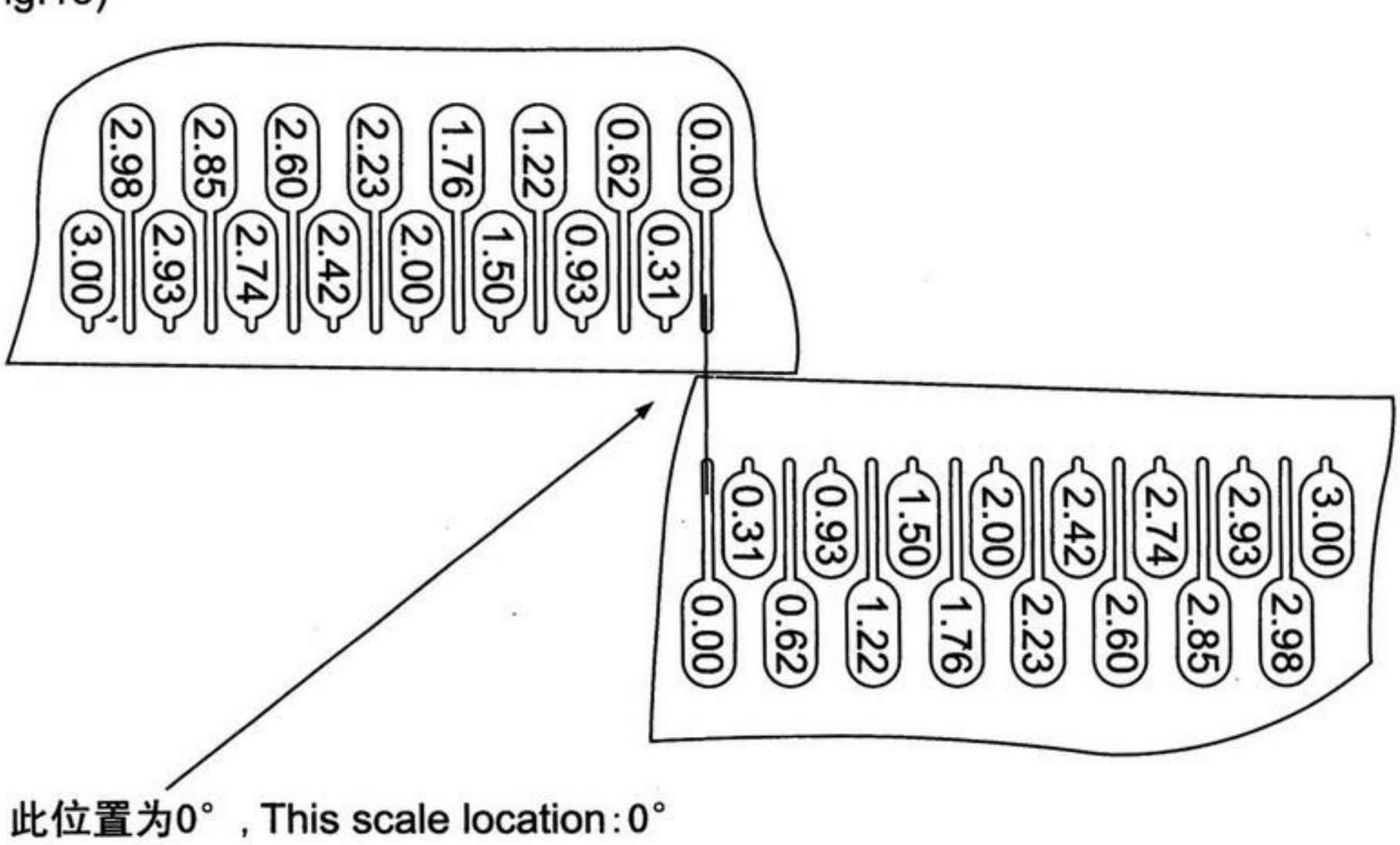
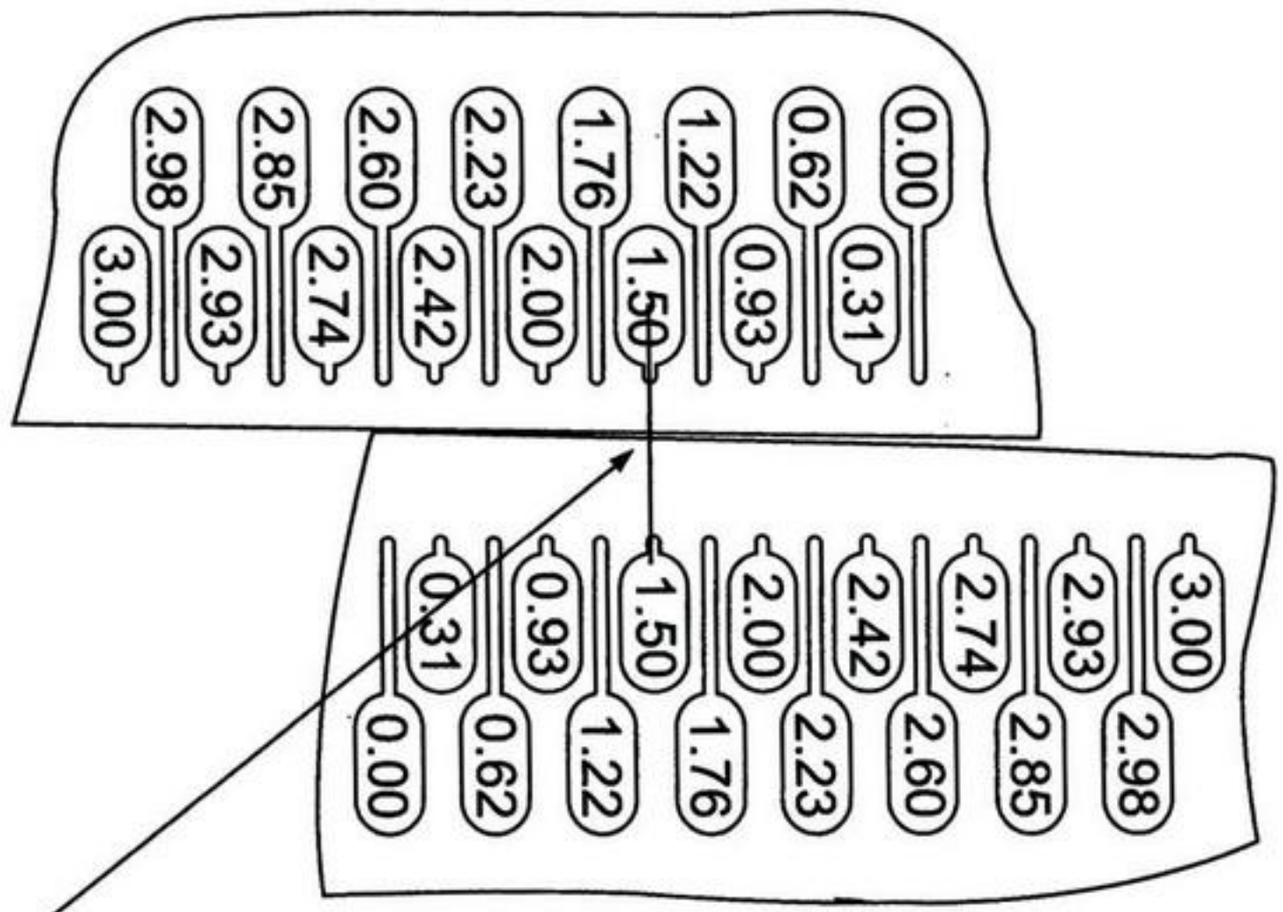


图14
(Fig.14)



III. 螺杆钻具弯壳体角度标示规定:图15
(Fig 15)Description of the Angle of Bend Housing:

为使用户在使用钻具时能清楚了解到该钻具弯壳体角度，特将标示规定如下：

1．以环形槽、尖槽标示所弯角度，每一空环槽表示1°，每一尖槽表示15′；

2．空环槽、尖槽位置及尺寸如图：

3．扎槽位置距内螺纹边缘200mm—250mm为宜；

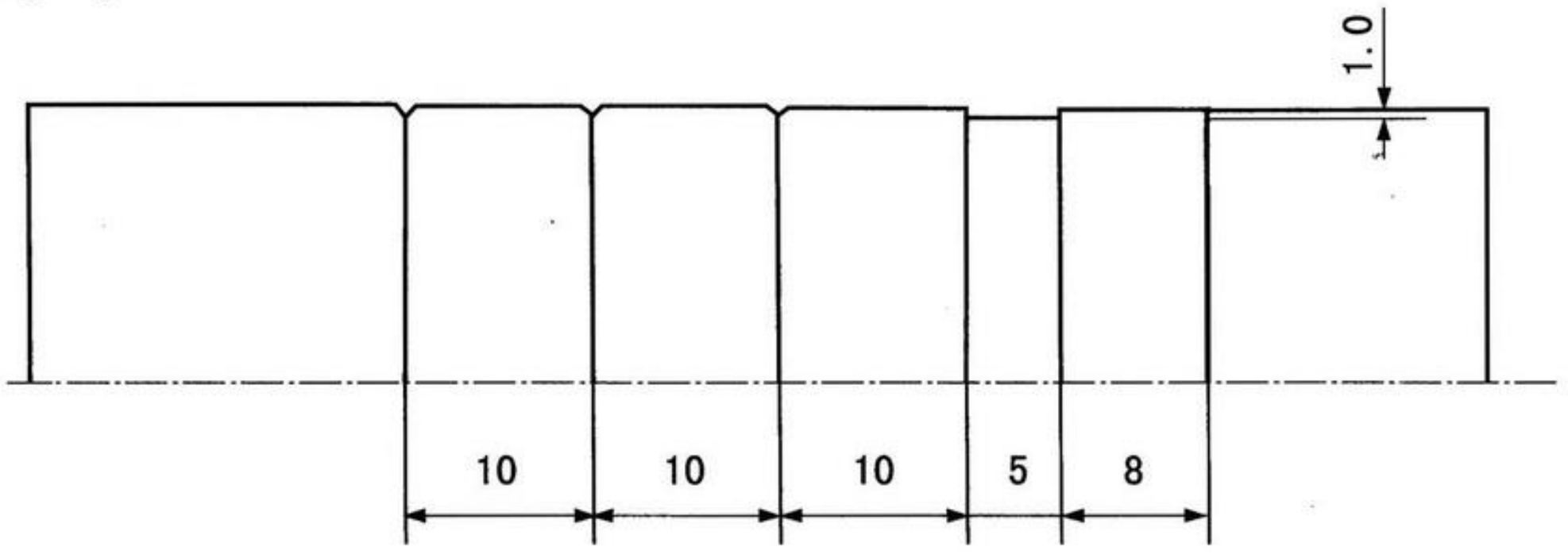
For users to know clearly angle of bend housing when operating this downhole motor, description is specifced as follows:

1. Angle is indicated by annular groove and acuminate groove: per empty annular groove is 1° while per acuminate groove is 15′;

2. Location and dimension of empty annular groove, acuminate groove(see Fig. 16):

3. It is appropriate that the distance between the location of fluting and the internal edge of thread is 200-250mm.

图16
(Fig 16)



Example Note:Above Angle is 1°45′

Ⅳ. 螺杆钻具在钻井中对应转盘速度：
Corresponding Speed of Turnplate in Drilling Well:

转盘以高于80rpm的速度使马达旋转会损伤定子的合成橡胶。高转盘速度可以使转子和传动机构产生的离心力增大，引起定子、传动机构、径向轴承和内连接螺纹磨损增大。

When turnplate speed is more than 80rpm, destroy of stator rubber will occur.Turnplate with high speed will lead to centrifugal force increasing at rotor and driving section,lead to abrasion increasing at stator,driving section,radial bearing and internal thread.

Ⅴ. 转盘速度与弯外壳角度的关系：(见表10)
(Table.10) The Relation Between Speed of Turnplate and Bend Housing:

弯外壳角度(0°-3°) Angle of Bend Housing(0°-3°)	转盘速度(rpm) Speed of Turnplate(rpm)
0.00°	80
0.25°	70
0.50°	70
0.75°	60
1.00°	50
1.25°	40
1.50°	40
1.75°	NR
2.00°	NR
2.25°	NR
2.50°	NR
3.00°	NR

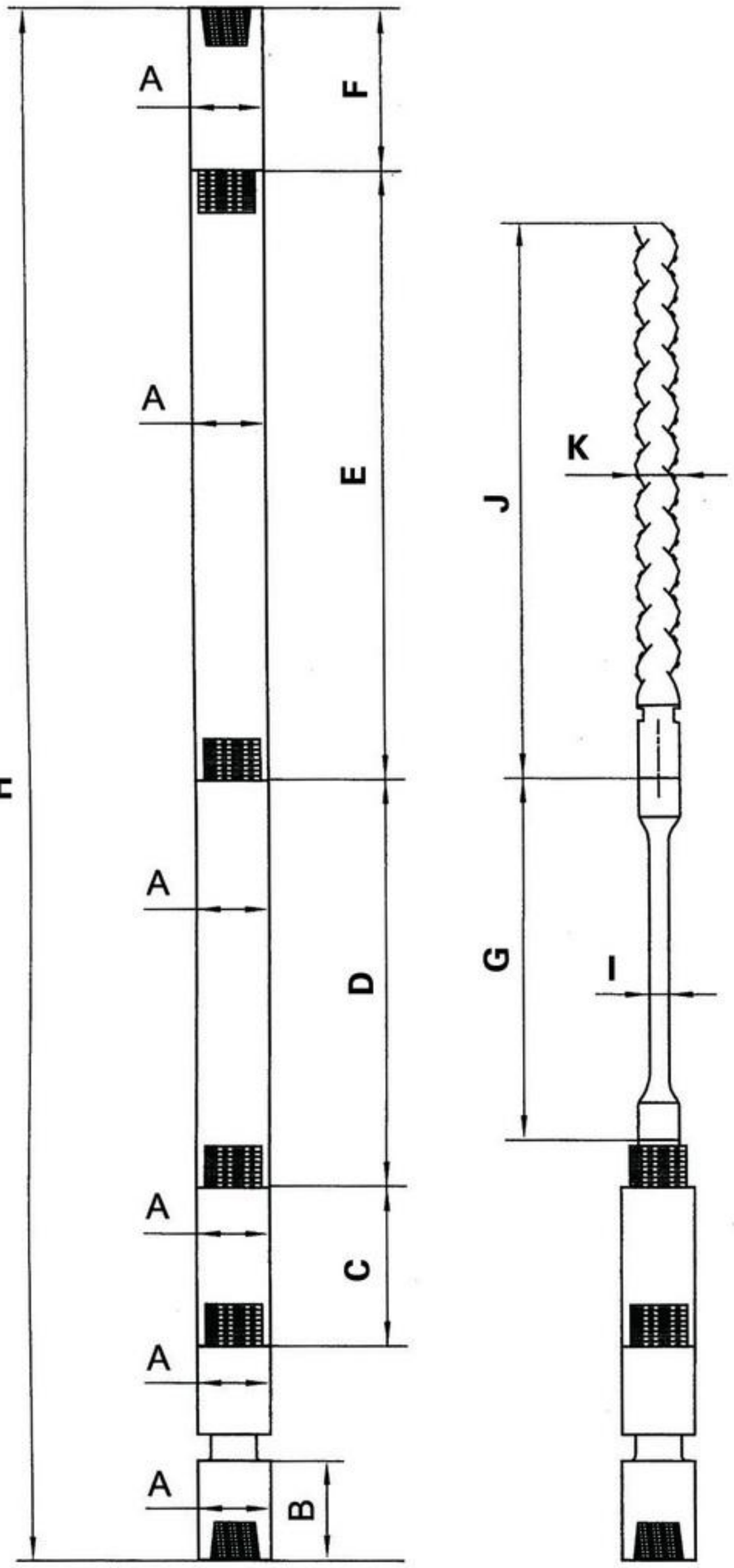
NR:为不推荐。
NR:Means not recommended。

注：弯外壳角度超过1.50°，禁止开动转盘导向钻进。
Note: If angle of bend housing exceeds 1.50°, turnplate is forbidden to steer drilling.

Ⅵ. 螺杆钻具允许承受最大拉力：(见表11)
(Table.11) Allowable Max Pull of Downhole Motor:

钻具规格 Size	作用在钻头上 Working on drilling bit		作用在壳体上 Working on housing	
	KN	LBS	KN	LBS
43	170	38200	245	55050
54	230	51680	330	56100
60	260	58400	380	58420
65	260	58400	380	58420
73	290	65170	420	94380
89	295	66300	640	143820
95	380	84900	870	195505
120	520	116850	1150	258425
165	1250	280900	1900	426965
172	1370	307860	1935	434830
185	1370	307860	1935	434830
197	1540	346070	2600	584270
203	1585	356180	3220	723595
216	2395	538200	3700	831460
244	2590	582020	4530	1017980

小规格螺杆钻具打捞尺寸图
The Fishing Size Drawing of small Size Downhole Motor



小规格螺杆钻具打捞尺寸表:

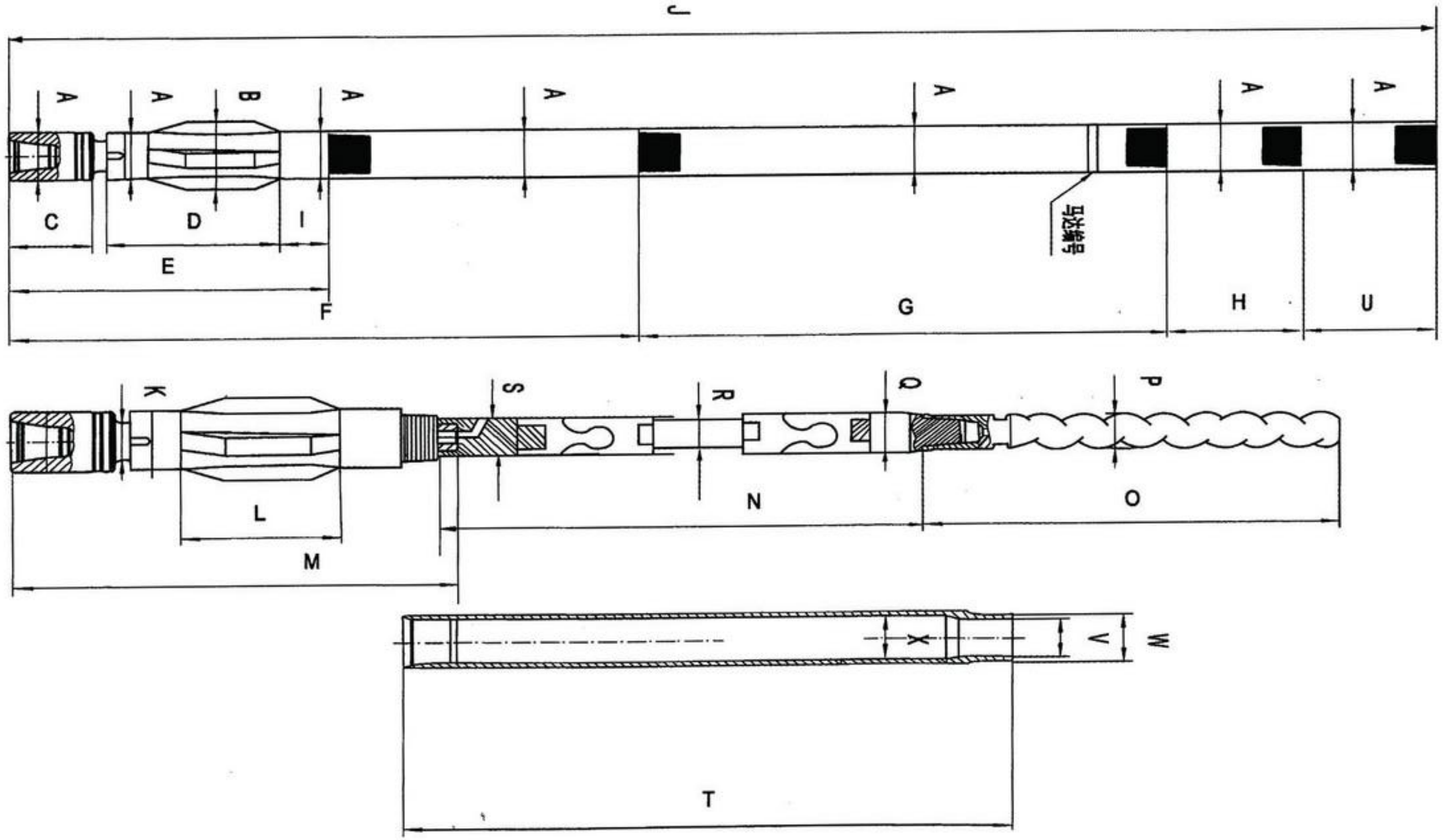
The Fishing Size Table of Small Size Downhole Motor

钻具型号 Size / 尺寸型号 Code	5LZ54X3.5	5LZ65X3.5	5LZ73X3.5	5LZ90X3.5
A	Φ 56	Φ66	Φ73	Φ90
B	110	110	110	180
C	---	---	---	---
D	536	335	605	590
E	1130	1382	1380	1940
F	165	175	180	225
G	374	455	570	430
H	NR	NR	NR	3440
I	Φ32	Φ36	Φ47	Φ49
J	1177	1350	1280	1900
K	Φ32.6	Φ38	Φ45	Φ56

注:
表中提供的尺寸仅供参考，如需要具体尺寸请与公司联系。

The size mentioned here is just for user's reference.If specific dimension is needed, please contact us.

常规螺杆钻具打捞尺寸图
The Fishing Size of Drawing Downhole of Motor(Stright or Bend Housing)



注：
此打捞尺寸图对应下页打捞尺寸表格
Note:Please refer to the next page to see the fishing, dimensions table about this fishing dimensions drawing

常规螺杆钻具打捞尺寸表：

The Fishing Size Table of Small Size Downhole Motor (Stright or Bend Hiusing)

钻具型号 Model of Motor / 尺寸代号 Code of Motor	5LZ43	5LZ54	5LZ60	5LZ65	5LZ73	9LZ90	9LZ95	9LZ100
A	Φ43	Φ54	Φ61	Φ66	Φ75	Φ90	Φ95	Φ102
B	----	----	----	----	----	----	Φ116	Φ122
C	76	157	125	110	145	195	222	226
D	----	----	----	----	----	----	180	180
E	277	455	490	385	518	618	654	649
F	1014	1035	970	885	1070	1348	1382	1379
G	1245	2235	1880	2200	2200	2500	2500	2500
H	----	190	190	190	205	240	240	240
I	----	----	----	----	----	----	215	215
J	2380	3520	3230	3630	3640	4455	4340	4365
K	Φ30	Φ35	Φ47	Φ50	Φ52	Φ61.5	Φ64	Φ64
L	----	----	----	----	----	----	140	140
M	365	493	520	540	568	780	825	834
N	760	550	455	475	520	530	535	535
O	1120	2110	1860	2150	2150	2450	2450	2450
P	Φ24.3	Φ30.5	Φ33.6	Φ38.2	Φ42.5	Φ61	Φ67	Φ67
Q	Φ24	Φ29	Φ38.5	Φ42.5	Φ47	Φ60	Φ65	Φ65
R	Φ15	Φ22.5	Φ38.5	Φ42.5	Φ47	Φ60	Φ60	Φ60
S	Φ24	Φ37	Φ38.5	Φ42.5	Φ47	Φ60	Φ65	Φ65
T	775	625	530	550	610	800	810	810
U	120	190	190	185	185	250	245	245
V	Φ26	Φ38.5	Φ39	Φ44	Φ48	Φ62	Φ70	Φ70
W	Φ36	Φ46.5	Φ50	Φ56	Φ63	Φ75	Φ81	Φ81
X	Φ26	Φ38.5	Φ47	Φ52	Φ60	Φ70	Φ76	Φ76

注

1、图中所示钻具为新型（V型）结构,万向轴为花瓣型。

2、表中提供的尺寸仅供参考，如需要具体尺寸请与公司联系。

3、扶正器的外径尺寸根据用户需求而定，表中不提供。

1.Downhole motors shown in the above table are with new structare(V shope), flat shaft.

2.The dimensions/sizes shown above are just for your reference.If the user need detailed and specific dimension,please contact us.

3.OD dimension of the stabilizer is determined by user's demand,so no such data are shown in above chart/table.

常规螺杆钻具打捞尺寸表：

The Fishing Size Table of Small Size Downhole Motor (Stright or Bend Hiusing)

钻具型号 Model of Motor / 尺寸代号 Code of Motor	7LZ120	7LZ146	5LZ165	7LZ172	7LZ185	5LZ197	5LZ203
A	Φ122	Φ146	Φ165	Φ172	Φ185	Φ197	Φ203
B	Φ146	----	Φ212	Φ212	Φ226	Φ238	Φ238
C	245	260	290	290	290	325	325
D	375	----	510	510	520	495	495
E	734	900	1040	1040	1110	1195	1195
F	1575	2060	2380	2555	2520	2565	2565
G	3300	3800	4400	4400	4400	4950	4950
H	280	330	----	----	----	----	----
I	119	----	270	270	275	345	345
J	5465	6740	7170	7345	7335	8315	8315
K	Φ86	Φ99	Φ123	Φ130	Φ138	Φ145	Φ145
L	240	----	280	280	280	280	280
M	874	1130	1200	1220	1375	1525	1525
N	673	850	920	1090	1060	1123	1123
O	3270	3750	4090	4100	4100	4800	4800
P	Φ84	Φ94	Φ104	Φ108	Φ108	Φ125.5	Φ125.5
Q	Φ75	Φ90	Φ116	Φ120	Φ125	Φ134	Φ134
R	Φ82	Φ96	Φ93	Φ95	Φ118	Φ128	Φ128
S	Φ82	Φ96	Φ114	Φ120	Φ125	Φ134	Φ134
T	930	1250	1440	1625	1520	1520	1520
U	311	360	390	390	350	410	410
V	Φ86	Φ100	Φ115	Φ125	Φ127	Φ150	Φ150
W	Φ103	Φ119.5	Φ139.3	Φ147.6	Φ155.7	Φ171	Φ171
X	Φ100	Φ112	Φ130	Φ136	Φ144	Φ163	Φ163

注

1、图中所示钻具为新型（V型）结构,万向轴为花瓣型。

2、表中提供的尺寸仅供参考，如需要具体尺寸请与公司联系。

3、扶正器的外径尺寸根据用户需求而定，表中不提供。

1.Downhole motors shown in the above table are with new structare(V shope), flat shaft.

2.The dimensions/sizes shown above are just for your reference.If the user need detailed and specific dimension,please contact us.

3.OD dimension of the stabilizer is determined by user's demand,so no such data are shown in above chart/table.

螺杆钻具技术参数表

钻具型号	外径尺寸 Tool OD Mm	in	钻头尺寸 Bit Size Mm	In	两端连接螺纹 Connected Thread 上端 up	下端 down	头数 Lobe	级数 Stage	排量 Flow Rate (L/S)	转速 Rotory Speed (r/min)	工作压力降 Working Pressure Loss (MPa)	最大压力降 Max Pressure Loss (MPa)	输出扭矩 Output Torque (N.m)	最大扭矩 Max Torque (N.m)	工作钻压 Working Pressure (KN)	最大钻压 Max Pressure (KN)	输出功率 Output Power (Kw)
5LZ43×7.0-4	43	11/16	48-76	17/8-3	NC12	NC12	5:6	4	0.8-1.6	335-670	3.2	4.52	73	103	3	6	2.52-5.12
5LZ54×7.0-4	54	21/8	60-89	23/8-31/2	11/2REG	11/2REG	5:6	4	1.8-3.6	285-570	3.2	4.52	145	205	4	8	4.33-8.66
5LZ60×7.0-4	60	23/8	79-111	31/8-43/8	11/2REG	11/2REG	5:6	4	2.33--4.66	280-560	3.2	4.52	191	270	5	10	5.6-11.2
5LZ73×7.0-4	73	27/8	95-121	33/4-43/4	23/8REG	23/8REG	5:6	4	3.67-7.34	140-280	3.2	4.52	584	825	12	25	8.56-17.12
5LZ79×7.0-4	79	31/8	95-121	33/4-43/4	23/8REG	23/8REG	5:6	4	3.67-7.34	140-280	3.2	4.52	584	825	12	25	8.56-17.12
5LZ89×7.0-4	90	31/2	114-149	41/2-57/8	23/8REG	23/8REG	5:6	4	4.25-8.5	110-220	3.2	4.52	1187	1677	22	35	13.6-27.2
7LZ89×7.0-4	90	31/2	114-149	41/2-57/8	23/8REG	23/8REG	7:8	4	5.4-9.2	90-200	3.0	4.52	1625	2275	22	35	15.8-30.5
5LZ95×7.0-4	95	33/4	118-149	45/8-57/8	27/8REG	27/8REG	5:6	4	5.3-13.3	160-300	3.2	4.52	1320	1876	30	55	20.4-39.5
9LZ95×7.0-4	95	33/4	118-149	45/8-57/8	27/8REG	27/8REG	9:10	4	7.6-15.2	140-280	3.2	4.52	1661	2346	30	55	24.3-48.6
5LZ100×7.0-4	100	315/16	118-149	45/8-57/8	27/8REG	27/8REG	5:6	4	5.3-13.3	160-300	3.2	4.52	1320	1876	30	55	20.4-39.5
9LZ100×7.0-4	100	315/16	118-149	45/8-57/8	27/8REG	27/8REG	9:10	4	7.6-15.2	140-280	3.2	4.52	1661	2346	30	55	24.3-48.6
5LZ102×7.0-4	102	315/16	118-149	45/8-57/8	27/8REG	27/8REG	5:6	4	5.3-13.3	160-300	3.2	4.52	1320	1876	30	55	20.4-39.5
9LZ102×7.0-4	102	315/16	118-149	45/8-57/8	27/8REG	27/8REG	9:10	4	7.6-15.2	140-280	3.2	4.52	1661	2346	30	55	24.3-48.6
5LZ105×7.0-4	105	41/8	121-152	43/4-6	27/8REG	27/8REG	5:6	4	7.5-15.3	146-292	3.2	4.52	1536	2170	30	55	21.2-42.4
9LZ105×7.0-4	105	41/8	121-152	43/4-6	27/8REG	27/8REG	9:10	4	8.3-16.6	132-265	3.2	4.52	1921	2713	35	70	26.5-53
5LZ120×7.0-4	120	43/4	149-200	57/8-77/8	31/2REG	31/2REG	5:6	4	11.5-23.1	140-278	3.2	4.52	2160	2869	50	100	35.8-71.5
7LZ120×7.0-4	120	43/4	149-200	57/8-77/8	31/2REG	31/2REG	7:8	4	12.4-24.8	120-240	3.2	4.52	3159	4462	50	100	39.7-79.4
5LZ127×7.0-4	127	5	149-200	57/8-77/8	31/2REG	31/2REG	5:6	4	11.5-23.1	140-278	3.2	4.52	2160	2869	50	100	35.8-71.5
7LZ127×7.0-4	127	5	149-200	57/8-77/8	31/2REG	31/2REG	7:8	4	12.4-24.8	120-240	3.2	4.52	3159	4462	50	100	39.7-79.4
7LZ135×7.0-4	135	53/8	149-200	57/8-77/8	31/2REG	31/2REG	7:8	4	13.5-27	105-210	3.2	4.52	3923	5542	50	100	43-86

注：此说明书最终解释权归盐城市新永佳石油机械制造有限公司所有，如有变动以实物为准。

螺杆钻具技术参数表

钻具型号	外径尺寸 Tool OD Mm	in	钻头尺寸 Bit Size Mm	In	两端连接螺纹 Connected Thread 上端 up	下端 down	头数 Lobe	级数 Stage	排量 Flow Rate (L/S)	转速 Rotory Speed (r/min)	工作压力降 Working Pressure Loss (MPa)	最大压力降 Max Pressure Loss (MPa)	输出扭矩 Output Torque (N.m)	最大扭矩 Max Torque (N.m)	工作钻压 Working Pressure (KN)	最大钻压 Max Pressure (KN)	输出功率 Output Power (Kw)
7LZ146×7.0-4	146	5 3/4	171-222	6 3/4-8 3/4	4 1/2REG	4 1/2REG	7:8	4	14.5-29	101-202	3.2	4.52	4382	6189	55	110	46.3-92.6
5LZ165×7.0-4	165	6 1/2	213-251	8 3/8-9 7/8	4 1/2REG	4 1/2REG	5:6	4	14.3-28.7	96-190	3.2	4.52	3673	4878	80	160	47.5-46.3
7LZ165×7.0-4	165	6 1/2	213-251	8 3/8-9 7/8	4 1/2REG	4 1/2REG	7:8	4	16.5-33	87-174	3.2	4.52	5799	8191	80	160	52.8-105.6
5LZ172×7.0-4	172	6 3/4	213-251	8 3/8-9 7/8	4 1/2REG	4 1/2REG	5:6	4	15.7-31.5	90-180	3.2	4.52	4160	5525	100	170	52.5-105
7LZ172×7.0-4	172	6 3/4	213-251	8 3/8-9 7/8	4 1/2REG	4 1/2REG	7:8	4	18.3-36.6	82-164	3.2	4.52	6803	9609	100	170	58.4-116.8
5LZ172×7.0-5	172	6 3/4	213-251	8 3/8-9 7/8	4 1/2REG	4 1/2REG	5:6	5	15.7-31.5	90-180	4	5.65	5200	7345	100	170	63-115.5
7LZ172×7.0-5	172	6 3/4	213-251	8 3/8-9 7/8	4 1/2REG	4 1/2REG	7:8	5	18.3-36.6	82-164	4	5.65	7480	10569	100	170	64.2-128.4
5LZ185×7.0-5	185	7 1/4	222-251	8 3/4-9 7/8	4 1/2REG	6 5/8REG	5:6	5	18.5-37	76-152	4	5.65	9274	13100	100	170	73.8-147.6
5LZ197×7.0-5	197	7 3/4	251-311	9 7/8-12 1/4	6 5/8REG	6 5/8REG	5:6	5	18.55-37	80-158	4	5.65	6277	8866	150	200	74-148
7LZ197×7.0-5	197	7 3/4	251-311	9 7/8-12 1/4	6 5/8REG	6 5/8REG	7:8	5	20.5-41	74-148	4	5.65	7220	10197	150	200	82.3-164.6
5LZ203×7.0-5	203	8	251-311	9 7/8-12 1/4	6 5/8REG	6 5/8REG	5:6	5	18.55-37	80-158	4	5.65	6277	8866	150	200	74-148
7LZ203×7.0-5	203	8	251-311	9 7/8-12 1/4	6 5/8REG	6 5/8REG	7:8	5	20.5-41	74-148	4	5.65	7220	10197	150	200	82.3-164.6
5LZ216×7.0-5	216	8 1/2	251-375	9 7/8-14 3/4	6 5/8REG	6 5/8REG	5:6	5	22.1-44.2	70-140	4	5.65	8185	12448	220	330	79.4-158.8
7LZ216×7.0-5	216	8 1/2	251-375	9 7/8-14 3/4	6 5/8REG	6 5/8REG	7:8	5	25.5-48.5	75-150	4	5.65	9795	13832	220	330	87.3-173.8
5LZ244×7.0-5	244	9 5/8	251-375	9 7/8-14 3/4	6 5/8REG	6 5/8REG	5:6	5	34-68	75-145	4	5.65	10763	15215	220	400	108.3-216.6
7LZ244×7.0-5	244	9 5/8	251-375	9 7/8-14 3/4	6 5/8REG	6 5/8REG	7:8	5	37-72	80-156	4	5.65	11839	16600	220	400	118-237

注：此说明书最终解释权归盐城市新永佳石油机械制造有限公司所有，如有变动以实物为准。

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