盛德石油机械

科技求盛 创新争优 诚信为德 品质精良

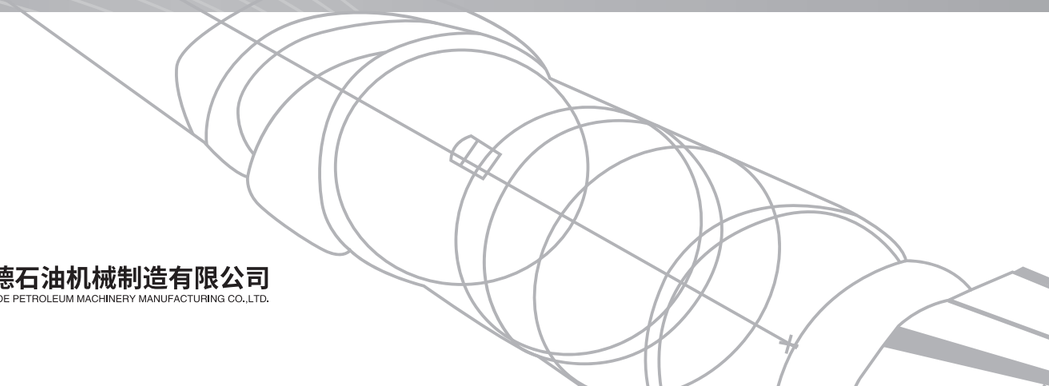
螺杆钻具说明书
DOWNHOLE MOTOR MANUAL

潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO.,LTD.

公司地址/Add：山东省潍坊市奎文区机场路2088号
No.2088,Airport Rd.,Kuiwen District,Weifang,Shandong Province
公司邮编/Zip：261041
销售电话/Tel：0536-8820186
公司传真/Fax：0536-8820688
售后服务/Tel：0536-8820189
http：//www.sdshengde.com
//www.sindpec.com

请关注企业微信公众平台

潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO.,LTD.



目录

Content

ONE

TWO

THREE

1.前言

本手册系统的介绍了本公司设计制造螺杆钻具的结构特点和性能参数，并对其使用的工作条件及影响因素给出建议，便于用户在充分地了解螺杆钻具性能特点的基础上，根据钻井工程的实际工况，选择性能符合实际需求的螺杆钻具产品；本手册还系统的介绍了本公司设计制造螺杆钻具产品使用维护要求，供用户合理使用维护螺杆钻具，并通过优化钻具组合及采用最优的钻井参数，充分发挥其应有的技术性能，从而获得更好的钻井经济效益。

本公司螺杆钻具产品的设计、制造和验收依据石油天然气行业标准SY/T 5383—2010 螺杆钻具，并持续关注该标准的更改或更新，满足最新版本的要求。

2.螺杆钻具的工作原理及分类

螺杆钻具是以钻井液为动力的容积式井下动力马达。其利用钻井泵泵出的钻井液流经马达进出口时形成的压差推动马达的转子旋转，并通过其内部的万向轴和传动轴带动钻头旋转，将由钻井液压差和流量构成的液力功率转换为驱动钻头旋转的扭矩和转速构成的机械功率，从而成为仅驱动钻头旋转的井下动力钻井工具。

螺杆钻具可以分别驱动牙轮钻头、PDC钻头、金刚石钻头或其他特殊类型的钻头，与各种不同的钻具组合及不同的钻井参数相配合，完成直井、定向井和水平井等各种类型石油天然气井的常规或非常规钻井作业。

螺杆钻具按使用场合不同而大致分为：钻井用螺杆钻具；采油、修井用螺杆钻具；地表穿越用螺杆钻具以及煤气层井下用螺杆钻具等，其工作原理完全相同，但结构和强度存在较大差异。

本手册着重于介绍钻井用螺杆钻具。

3.螺杆钻具的组成

构成螺杆钻具最基本的部件是旁通阀、防掉短节、马达、万向轴和传动轴五大部件(如图1)。为满足定向井或其他钻井工程的需求，也可增加或更换为如定向接头、弯接头、万向轴固定弯壳体（0～3°间的固定角度）、万向轴地面可调弯壳体、传动轴稳定器、可拆换式稳定器等其他部件，构成各种形式的螺杆钻具产品。

1. Introduction

This manual systematically introduces the structural characteristics and performance parameters of the downhole motor designed and manufactured by our company, and gives Suggestions on the working conditions and influencing factors of the downhole motor, so as to facilitate users to choose the downhole motor products whose performance meets the actual requirements based on the full understanding of the downhole motor performance characteristics and the actual working conditions of drilling engineering. This manual also systematically introduces the maintenance requirements of downhole motor products designed and manufactured by our company，for the user to use the maintenance downhole motor reasonably, and gives full play to its due technical performance by optimizing the combination of drilling tools and adopting the optimal drilling parameters, so as to obtain better drilling economic benefits.

The design, manufacture and acceptance of the company's downhole motor products are based on the oil and gas industry standard SY/T 5383-2010 downhole motor, and continue to pay attention to the changes or updates of the standard to meet the requirements of the latest version.

2. Principle and application

Downhole motor is a volumetric downhole dynamic power section driven by drilling fluid. It uses the pressure difference formed by the drilling fluid pumped by the drilling pump to flow through the power section inlet and outlet to push the rotor of the power section to rotate, and drives the bit to rotate through its internal universal shaft and drive shaft, convert the hydraulic power generated by the pressure loss and flow rate of the drilling fluid into the mechanical power generated by the torque and rotation speed of the driving bit. Thus it becomes a downhole power drilling tool that only drives the bit to rotate.

Downhole motor can drive cone bits, PDC bits, diamond bits or other special types of bits, respectively, in combination with various drilling tool and matches different drilling parameters to complete conventional or unconventional drilling operations of various types of oil and gas wells such as vertical wells, directional wells and horizontal wells.

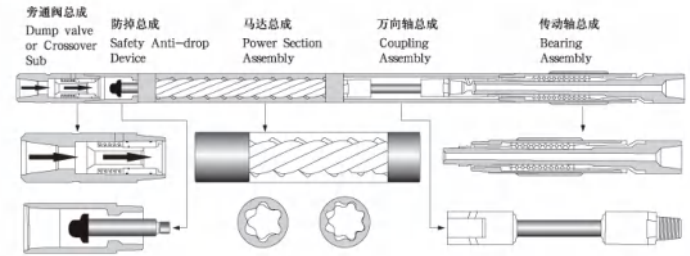


图1(Fig.1)

3.1旁通阀

该部件的功用是起下钻时建立钻柱内部与井眼环空钻井液的通道，以便高于井口的钻柱中存留的钻井液顺利流向井眼环空，或使井眼环空的钻井液顺利流进液柱高度下降的钻柱内部；正常钻进中，关闭钻柱内部与井眼环空钻井液通道，使钻井液全部通过马达和钻头。

因为起钻过程中，由于马达不工作钻柱中留存的钻井液无法由钻柱底部的钻头水眼流向井眼环空，卸开钻柱时，高于井口的钻柱中存留的钻井液会喷到钻台上，影响井口作业的操作和安全环保。下钻过程中，中空的钻柱下入井内，使得井眼环空的钻井液液柱高度大于钻柱内部，若井眼环空的钻井液不能顺利流入钻柱内，会使得钻柱受到的浮力加大，必须不停的向钻柱中灌注钻井液，增加了工作量。为此，需要增加旁通阀。

该部件的结构是一个常开的旁通阀门。在起下钻作业过程中，由弹簧把阀芯顶起，阀门处于开启状态，可使钻柱中钻井液绕过不工作马达与井眼环空联通；正常钻进时，由钻井泵驱动的钻井液流过该部件的阀芯时，由于阀芯两端存在的压力差克服弹簧力的作用，使阀门处于关闭状态，从而关闭钻柱内部与井眼环空钻井液通道，使钻井液全部流向马达和钻头(如图2)。

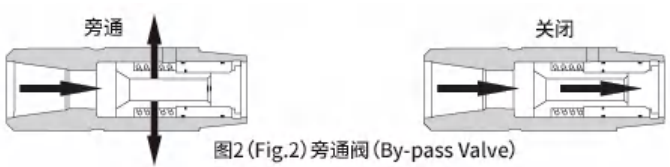


图2(Fig.2)旁通阀(By-pass Valve)

Downhole motor can be roughly divided into downhole motor for drilling,oil recovery workover,surface crossing and underground gas wells according to the occasion of use. Their working principle is exactly the same, but there are big differences in structure and strength.

This manual focuses on downhole motor for drilling.

3. Constitution

The basic components of downhole motor are bypass valve, anti-drop nipple, power section, universal shaft and drive shaft (Fig. 1). In order to meet the needs of directional wells or other drilling projects, other components such as directional sub, bent sub, fixed bent housing of universal shaft (fixed angle between 0～3°), ground adjustable bent housing of universal shaft, transmission shaft stabilizer and removable stabilizer can also be added or replaced to form various downhole drilling products.

3.1 By-pass valve assembly

The function of this part is to establish the channel between the interior of the drill string and the annulus space drilling fluid during trip operation, so that the retained drilling fluid in the drill string higher than the wellhead can flow smoothly to the annulus space, or the drilling fluid in annulus space can flow smoothly into the interior of the drill string that with the decreased height of the fluid column. In normal drilling, the drilling fluid channel can be closed between the annulus space and the interior of the drill string, so that all the drilling fluid can be passed through the power section and the drill bit.

During the drilling process, since the power section is not working, the retained drilling fluid in the drill string cannot flow from the bit nozzle at the bottom of the drill string to the annulus space, and when the drill string is unloaded, the retained drilling fluid in the drill string higher than the wellhead will be sprayed onto the drilling platform, affecting the operation, safety and environmental protection of the wellhead operation. In the drilling process, the hollow drilling string goes down into the well, making the height of the drilling fluid column in the annulus space greater than that inside the drilling string. If the drilling

防掉短节

该部件的功用是防止因在钻进中螺杆钻具防掉短节以下的螺纹意外开扣或壳体意外断裂而造成螺杆钻具转子以下的转动部分落井。

该部件结构为在转子上部接一个接头，接头的上部伸入外壳接头的内部，在接头上部安装直径大于外壳接头的内部台阶的零件，起到防掉作用。

3.2马达

该部件的功用是将由钻井液压差和流量形成的液力功率转换为驱动钻头旋转的扭矩和转速形成的机械功率。

该部件由具有一定几何参数的螺旋形状的转子和由钢管及在钢管内壁上压注的具有一定几何参数的螺旋形状橡胶衬套定子两个零部件构成。马达部件转子结构形式分为：常规螺杆钻具和转子中空分流式螺杆钻具两种形式；按定子橡胶衬套结构型式分为：常规螺杆钻具和等壁厚螺杆钻具两种马达形式。

螺杆钻具作为容积式马达具有下列特性：

① 工作扭矩与螺杆马达的结构和工作压降有关，而与钻井液流量或钻头转速无关；

② 输出转速与螺杆马达的结构和钻井液流量有关，提高钻井液流量可以加大螺杆钻具的输出功率和制动扭矩；

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)，图3是几种典型马达配合的截面廓形(如图3)。除了马达头数外，影响马达性能的独立参数还有转子直径、偏心距和导程。马达转子的一个导程组成一个密封腔，马达定子的一个导程称为一级。

马达的性能由其头数、直径、偏心距及导程共同决定。不能简单的认为“马达的头数越多，转速越低，扭矩越大”。在输入相同的流量与压降条件下，输出的转速与扭矩相同的马达，无论其头数、直径、偏心距或导程有多大差别，其使用性能是相同的。

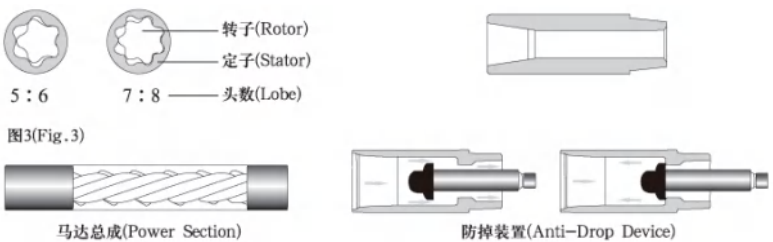


图3(Fig.3)

fluid in annulus space fails to flow smoothly into the drilling string, the buoyancy force on the drill string will increase, so that the drilling fluid must be continuously poured into drilling string to increase workload. To do this, additional bypass valves are required.

The structure of the component is a normally open bypass valve. During the trip operation, the spool is lifted by the spring and the valve is open, allowing the drilling fluid in the drill string to bypass the inoperative power section to communicate with the annulus space; during normal drilling, when the drilling fluid driven by the drilling pump passes the valve core of the part the pressure difference between the two ends of the valve core overcomes the spring force, so that the valve is closed, thereby closing the drilling fluid passage between internal drill string and the annulus space , so that the drilling fluid flows all the way to the power section and the drill bit (Fig.2).

Anti-drop nipple

The function of this part is to prevent the rolling part below the downhole motor rotor from falling into the well because of the accidental opening of thread below the nipple or unexpected fracture of the housing during drilling.

The structure of this part is to connect a joint on the upper part of the rotor, the upper part of the joint extends into the inner part of the housing joint, and the parts whose diameter is larger than the inner step of the housing joint are installed on the upper part of the joint to prevent it from falling off.

3.2 Power section assembly

The function of the unit is to convert the hydraulic power generated by the pressure loss and flow rate of the drilling fluid into the mechanical power generated by the torque and rotation speed of the driving bit.

This part is composed of a spiral shaped rotor with certain geometric parameters and a spiral-shaped rubber bushing stator with certain geometric parameters that made of steel tube and injected on the inner wall of steel tube.The rotor structure of power section parts can be divided into two forms: conventional downhole motor and hollowed rotor shunt downhole motor.

3.2.1转子中空分流马达

当依据钻井工程需要的钻井液环空返速或钻头水功率确定的钻井液流量远远大于所采用螺杆钻具的额定流量时，会使得钻头转速远远大于其额定工作转速，也会使螺杆钻具转速超过其承受极限。为降低螺杆钻具（或钻头）的转速，可以将转子加工成为具有通孔的管状，将钻井液流量分流为流经马达密封腔产生旋转输出功率和由转子中空流出不产生旋转输出功率两个部分。钻井液流量分流的比例关系由中空的管中加装喷嘴的尺寸大小决定。在确定转子喷嘴尺寸时，应确保通过马达密封腔的分流流量不低于马达的额定流量值，这样才能使马达输出的旋转功率满足钻井要求。(如图4)

图4(Fig.4)

中空转子(Hollw Rotor)

当钻井液密度和流量恒定时，流经转子固定尺寸喷嘴的流量和流经马达密封腔的流量随负载变化而变化。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，马达压降不断增加时，使流经转子喷嘴流量增加，而流经马达密封腔流量减少。因此，喷嘴尺寸的确定，需要考虑马达最佳工作压降时所需的流经马达密封腔的流量。下面提供的喷嘴尺寸的计算方法，未能解决这个问题，需要用户根据经验调整。

当然，当依据钻井工程需要的钻井液环空返速或钻头水功率确定的钻井液流量较大时，也可专门设计符合其输出转速和钻头所需转速的螺杆钻具。当钻井液流量超过马达额定流量不多时，用户可联系本公司，采用调整马达配合间隙的方式，控制马达（钻头）转速。

计算喷嘴尺寸的方法（仅供参考）

According to stator rubber bushing structure types, there are two types of power sections: conventional downhole motor and equi-wall thickness downhole motor.

As a volume power section, downhole motor has the following characteristics:

①The working torque is related to the structure and working pressure drop of downhole motor, but not to the flow rate of drilling fluid or the bit speed;

②The output speed is related to the structure and drilling fluid flow of downhole motor. Increasing the drilling fluid flow can increase the output power and braking torque of downhole motor.

The spiral lines of power section rotor can be divided into single head and multiple head (the number of spiral lines of stator is 1 more than that of rotor). Fig. 3 is the section profile of several typical power sections (Fig. 3). In addition to the number of power section heads, the rotor diameter, eccentricity and lead are the independent parameters that affect the power section performance. One lead of the power section rotor constitutes a sealed cavity, and one lead of the power section stator is called a stage.

The performance of the power section is determined by its number of heads, diameter, eccentricity and lead. You can't simply say, "the more heads of the power section, the lower the speed, the greater the torque." Under the same flow rate and pressure loss conditions, the power section with the same output speed and torque will have the same performance regardless of the number of heads, diameter, eccentricity or lead.

3.2.1 Hollow rotor power section

When the drilling fluid flow determined according to the annulus return rate or the bit water power required by drilling engineering is much larger than the rated flow rate of the downhole motor adopted, the bit speed will be much larger than its rated operating speed, and the downhole motor speed will also exceed its bearing limit.In order to reduce the speed of downhole motor (or drill bit), the rotor can be processed into a tubular shape with through-hole and divided the drilling fluid flow

流经马达密封腔的流量为Q_m，通过马达喷嘴的流量Q_z。即：总流量$Q=Q_m+Q_z$

设定马达转速n值计算Q_m值　$Q_m=\frac{nq}{\eta_v x60}$(L/S)

容积效率η_v取0.90 ∴$Q_z=Q-Q_m$(L/S)

喷嘴直径　$d=4\sqrt{\frac{898\rho Q_z^2}{\triangle P}}$（mm）

Q_m-马达密封腔流量(L/S)
Q_z-转子喷嘴的流量(L/S)
Q-中空转子马达的总流量(L/S)
η_v-容积效率
马达压降$\triangle P=\triangle P_{st}+\triangle P_{op}$
$\triangle P_{st}$-马达启动压降(MPa)
$\triangle P_{op}$-马达工作压降(MPa)
△ρ-钻井液比重(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)。

into two parts: flow through the sealing cavity of the power section to generate rotating output power and flow out of the hollow rotor to generate no rotating output power. The proportionality of the flow split is determined by the size of the nozzles in the hollow tube.When determining the size of rotor nozzle, it should be ensured that the shunt flow through the sealing chamber of the power section is not lower than the rated flow value of the power section, so that the rotary power output of the power section can meet the requirements of drilling. (Fig.4)

When the density and flow rate of the drilling fluid are constant, the flow rate through the fixed sized nozzle of the rotor and through the sealed cavity of the power section varies with the load. When the drill bit leaves the hole bottom and the power section load is approximately zero, the flow rate through the rotor nozzle is the minimum, while the flow rate through the power section sealing cavity is the maximum. When the pressure loss of the power section increases, the flow through the nozzle of the rotor increases, while the flow rate through the seal chamber of the power section decreases. Therefore, to determine the nozzle size, it is necessary to consider the required flow rate through the sealing cavity of the power section when the power section has the optimal working pressure loss. The calculation method of nozzle size provided below fails to solve this problem, which requires the user to adjust according to experience.

Of course, downhole motor can also be specially designed to meet the output speed and required speed of the drill bit when the flow rate that determined based on the annulus return rate of the drilling fluid required by the drilling engineering or the water power of the bit is large. When the drilling fluid flow exceeds the rated flow rate of the power section by a small amount, the user can contact the company and control the power section (drill bit) speed by adjusting the power section clearance.

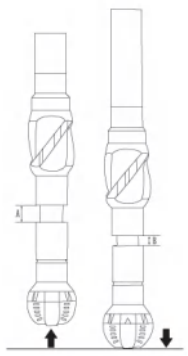
表一　中空转子马达每转排量估算：

(Table.1) Estimation of Flow Rate of Hollow Rotor Motor

LZ286X7.0L		q=20.3
LZ244X7.0L		q=20.3
LZ216X7.0L		q=17.1
LZ203X7.0L		q=14.0
LZ197X7.0L	5LZ197X14.0L	q=14.0
LZ185X7.0L		q=13.0
LZ178X7.0L		q=10.2
LZ172X7.0L		q=10.2
LZ165X7.0L	5LZ165X14.0L	q=8.5
LZ159X7.0L		q=8.0
LZ135X7.0L		q=5.0
LZ127X7.0L		q=5.0
LZ120X7.0L	5LZ120X14.0L	q=5.0
LZ102X7.0L		q=5.0
LZ95X7.0L		q=3.3
LZ89X7.0L		q=2.4
LZ73X7.0L		q=1.3
LZ54X7.0L		q=1.3

最大允许止推轴承间隙说明：见图表二

Allowed Maximal Clearance of Axial Bearing：(Table.2)



钻具型号 Size	间隙 Clearance
LZ54	3mm
LZ73	3mm
LZ89	4mm
LZ95	4mm
LZ102	4mm
LZ120	5mm
LZ127	5mm
LZ135	5mm
LZ159	5mm
LZ165	6mm
LZ172	6mm
LZ178	6mm
LZ185	6mm
LZ197	7mm
LZ203	7mm
LZ216	7mm
LZ244	8mm
LZ286	8mm

3.3万向轴部件

该部件的功用是将转子的行星运动转变为传动轴转动，以便将马达产生的扭矩及转速传递给钻头，驱动钻头旋转。

该部件由内部的万向轴组件和外部的万向轴壳体构成。万向轴组件按结构型式可分为：花瓣式（可配弯壳体组合型式）、球铰式（可配弯壳体或可调弯壳体组合型式）以及挠轴式钛合金万向轴（可配可调弯壳体组合型式）。(如图5)

Method for calculating nozzle size (for reference only)

The flow through the sealing cavity of the power section is Q_m, and the flow through the nozzle of the power section is Q_z.

Namely: total flow $Q=Q_m+Q_z$

Set n value of power section speed to calculate Q_m value $Q_m=\frac{nq}{\eta_v x60}$(L/S)

Volumetric efficiency η_v take 0.90 $\therefore Q_z=Q-Q_m$(L/S)

Nozzle diameter $d=\sqrt[4]{\frac{898\rho Q_z^2}{\triangle P}}$ (mm)

Q_m-Flow rate of power section seal cavity(L/S)

Q_z-Flow rate of rotor nozzle(L/S)

Q-Total flow rate of power section with hollow rotor(L/S)

η_v-Volumetric efficiency

Power section pressure loss $\triangle P=\triangle P_{st}+\triangle P_{op}$

$\triangle P_{st}$-Power section start pressure loss(MPa)

$\triangle P_{op}$-Power section operating pressure loss(MPa)

$\triangle\rho$-Specific gravity of drilling fluid(kg/L)

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

For the parameters, (see table-1)

图5(Fig.5)

球形万向轴(Ball Drive Universal Shaft)

挠轴式钛合金万向轴(Flexible shaft type titanium alloy cardan shaft)

图5(Fig.5)

花瓣式万向轴(Flat Universal Shaft)

3.4传动轴部件

该部件的功用是支撑并保持马达定转子的相对位置,使马达能够持续工作;并与万向轴配合将转子的行星运动转变定轴转动,以便将马达产生的扭矩及转速传递给钻头,驱动钻头自转。同时承受由于钻井液在马达工作时产生的向下的推力、正常钻进中由于施加钻压而产生的向上的力以及钻进中作用在钻头上的侧向力。

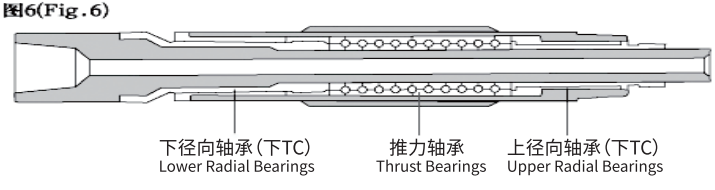
该部件的主要结构是一组四点接触式多列推力轴承(俗称串轴承)和上下各一组硬质合金镶块的径向轴承组成。

本公司提供的该部件有以下两种结构形式供选择:

(1)钻头水眼压降≤7.0MPa时,采用上下各一组硬质合金镶块的径向轴承和中间一组四点接触式多列推力轴承(俗称串轴承)组成的传动轴部件(如图6);

(2)钻头水眼压降为≥7.0MPa而≤14.0MPa时,采用上下各一组硬质合金镶块的径向轴承和金刚石复合片(PDC)的平面止推轴承组成的传动轴部件,其寿命更长、承载能力更高。

图6(Fig.6)



3.3 Driveshaft assembly

The unit's function is to convert the planetary motion of the rotor to fixed-axis rotation, so that the torque and rotational speed generated by the power section are transmitted to the drill bit, which drives its rotation.

The part is composed of internal universal joint assembly and external universal joint housing. According to the structure type, the universal shaft assembly can be divided into：flower petal type (can be combined with curved shell type),the knuckle ball (can be combined with curved shell or adjustable curved shell type) and flexible shaft type cardan shaft titanium alloy(can be combined with adjustable curved shell type).(Fig. 5).

3.4 Bearing assembly

The function of the component is to support and maintain the relative position of the power section rotor, so that the power section can continue to work; And with the universal axis, the planetary motion of the rotor is transformed into the fixed axis rotation, so as to transfer the torque and rotation speed generated by the power section to the drill bit and drive the drill bit to rotate. At the same time, it can bear the downward thrust caused by drilling fluid when the power section works, the upward force caused by the bit weight applied in normal drilling, and the lateral force on the bit during drilling.

The main structure of this part is a group of four-point contact thrust bearings (commonly known as series bearings) and a group of cemented carbide inserts at the top and bottom.

The part provided by our company has the following two structural forms for selection:

(1) When bit nozzle pressure loss is ⩽ 7.0 MPa, the drive shaft components consisting of a set of radial bearings with carbide inserts at the top and bottom and a set of four-point contact multi-row thrust bearings (commonly known as tandem bearings) at the middle are used (Fig. 6).

(2) When bit nozzle pressure loss is between 7.0 MPa and14.0 MPa, the drive shaft components consisting of radial bearings with carbide inserts and planar thrust bearings with PDC, it have longer service life and higher load-carrying capacity.

3.5万向轴固定弯壳体

该部件功用是使万向轴壳体上下螺纹接头的轴线之间形成一定的夹角，与下部的稳定器配合，钻进中在钻压作用下给钻头施加一个侧向力，以便控制钻头走向。

该部件分为单弯、同向双弯、异向双弯(DTU)以及大偏移距同向双弯等形式。

单弯：万向轴壳体为单弯壳体，弯点的位置按用户要求可以设置在弯壳体的上部，也可以设置在弯壳体下部。对于同样的角度，弯点设置在弯壳体下部因偏移距小，造斜率较高。

同向双弯：万向轴壳体上具有两个方向相同的共面弯角。

异向双弯(DTU)：万向轴壳体具有方向相反的两个共面角度，通常下部弯角的度数是上部弯角度数的两倍。这种结构具有弯角大而偏移距小的特点，造斜率较高。

大偏移距同向双弯：螺杆钻具上部为弯接头，万向轴壳体为单弯壳体，两角度同向共面。

本公司弯螺杆钻具在弯点处有标记槽和刻线，标记槽内标示出弯点的角度数值，刻线表示弯角方向（高边），供用户现场识别。（如图7）

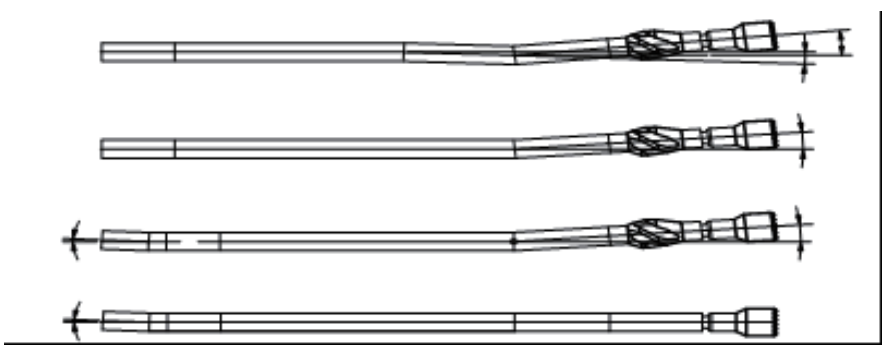


图7（Fig.7）

3.5Fixed curved housing of universal axis

The function of this part is to form a certain angle between the upper and lower thread sub axis of the universal shaft housing, cooperate with the stabilizer of the lower part, and exert a lateral force on the bit under the action of drill pressure during drilling, so as to control the direction of the bit.

This part is divided into single bend, double bend in the same direction, double bend in different direction (DTU) and double bend in the same direction with large offset.

Single bend: The universal shaft housing is a single bent housing. The position of the bending point can be set on the upper part of the bent housing or the lower part of the bent housing according to the user's requirements. For the same angle, the bending point set at the lower part of the bent housing will have larger deflection rate due to the small offset.

Co-directional double bending: The universal shaft housing has two coplanar bending angles in the same direction.

Unidirectional double bend (DTU): The universal shaft housing has two coplanar angles in opposite directions, usually the degree of the lower bending angle is twice that of the upper bending angle. This structure has the characteristics of large bend angle and small offset, and has a high deflection rate.

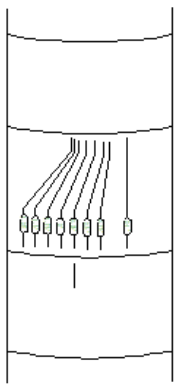
Large offset co-directional double bending: the upper part of the downhole motor is a bending sub, and the universal shaft housing is a single bent housing with two angles in the same direction and in the same plane.

Our company's bent downhole motor have marking grooves and engraved lines at the bending point. The angle values of the bending point are marked in the marking groove, and the marking lines indicate the direction of the bending angle (high edge), which can be recognized by users on the spot. (Fig.7)

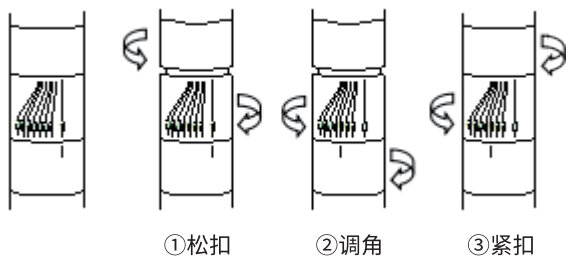
3.6万向轴地面可调弯壳体

该部件功用同样是使万向轴壳体上下螺纹接头的轴线之间形成一定的夹角，与下部的稳定器配合，钻进中在钻压作用下给钻头施加一个侧向力，以便控制钻头走向。

该部件的弯曲角度在地面上可在一定范围内进行调节，方便用户根据钻井需要在螺杆钻具下井前改变弯壳体角度，具有较大的灵活性。可调弯壳体的角度调整范围为0～3°，分级调整，壳体上的刻线同时指示角度和高边。（如图8）



可调弯壳体结构示意图
Structure schematic diagram of adjustable bent housing



可调弯壳体角度调整步骤
Angle adjustment steps of adjustable bent housing

图8（Fig.8）

3.6 Universal axis ground adjustable bent housing

On the ground, the bending angle of the component can be adjusted within a certain range, which is convenient for users to change the bending angle of the housing according to the drilling needs before downhole motor goes down the well. The angle adjustment range of the adjustable bent housing is 0 ~ 3°, which is adjusted be levels. The cutting line on the housing indicates (Fig.8)

3.6.1.Operation Description of Adjustable Bend Housing (Fig.9)

the angle and high edge at the same time.

Adjustment of downhole motor adjustable bent housing

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

Refer to (Fig. 10) for step land 2:

1. Place the jaws of tongs in the tong areas shown in picture 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 2-4 complete turns in the clockwise direction(but do not remove it completely).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.

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.

3.6.1.可调弯壳体调节操作说明:图9

螺杆钻具可调弯壳体的调节

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.当定位套的牙与下壳体的牙啮合时,顺时针旋开上壳体2-4圈(但不要完

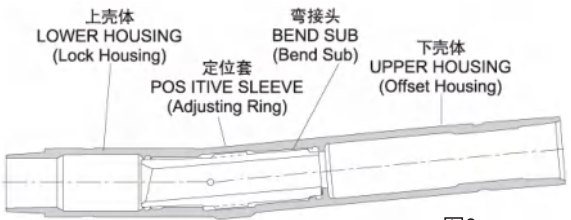


图9
(Fig.9)

参见(图11)来设置第3步和第4步:

3.向上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,直到所需角度在下壳体上出现。

参见(图12)来设置第5步和第7部:

5.旋转定位套使所要调节的度数与下壳体上的度数线对齐后,下滑定位套,使其与下壳体齿牙啮合。

6.应用丝扣油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(表9 Table.9)。匹配的上壳体外径和定位套显示数值。

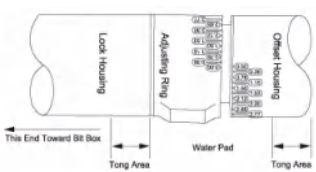


图10
(Fig.10)

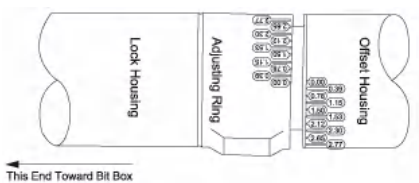


图11
(Fig.11)

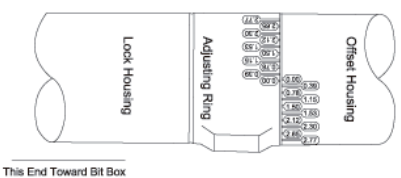


图12
(Fig.12)

Apply Thread Dope to this Face
before Retorquing

3.6.2.Description of Adjustable Bent Housing

3.6.3.(Fig.15)Description of the Angle of Bend Housing

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(Fig. 16)：

3.It is appropriate that the distance between the location of fluting and the internal edge of thread is 100-150mm.

3.7 Drive Shaft Stabilizer

The function of this part is to cooperate with the bent sub or bent housing of the upper part in the drilling process, and exert a lateral force on the bit under the action of drill press in order to control the direction of the bit.

The structure of this part is downhole motor with different forms of stabilizers on the drive shaft housing.

Common forms of stabilizers include(Fig.17):

① Spiral stabilizer (three-wing, five-wing, etc.);

② Symmetrical straight strip stabilizer (uniform distribution of five-wing);

③ Asymmetric straight strip stabilizer;

④ patch stabilizer;

The form and size of stabilizer have great influence on deflection or angle holding. Users should pay attention to this when choosing downhole motor.

3.8 removable stabilizer

The function of this part is also to cooperate with the bent sub or bent housing of the upper part in the drilling process, and exert a lateral force on the bit under the action of drill press in order to control the direction of the bit.

The structure of this part is different forms of stabilizer on the drive shaft housing of downhole motor. It is assembled with the drive shaft housing. Users can change the suitable stabilizer at any time according to the need of drilling in the well site.(Fig.18)

表三 钻具上下端螺纹紧扣扭矩
(Table.3)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
LZ54	11/2REG	2.8～3.5	11/2REG	2.8～3.5
LZ73	23/8REG	3.4～4.8	23/8REG	4.8～6.3
LZ89	23/8REG	3.4～4.8	23/8REG	4.8～6.3
LZ95	27/8REG	6.8～11.6	27/8REG	6.8～11.6
LZ102	27/8REG	6.8～11.6	27/8REG	6.8～11.6
LZ120	31/2REG	14.3～17.2	31/2REG	9.4～12.2
LZ127	31/2REG	14.3～17.2	31/2REG	9.4～12.2
LZ135	31/2REG	14.3～17.2	31/2REG	9.4～12.2
LZ159	41/2REG	32.4～35.6	41/2REG	16.3～21.8
LZ165	41/2REG	32.4～35.6	41/2REG	16.3～21.8
LZ172	41/2REG	32.4～35.6	41/2REG	16.3～21.8
LZ178	41/2REG	32.4～35.6	41/2REG	16.3～21.8
LZ185	41/2REG	32.4～35.6	41/2REG	16.3～21.8
LZ197	51/2REG	54.4～68	65/8REG	68.0～79.3
LZ203	51/2REG	54.4～68	65/8REG	68.0～79.3
LZ216	65/8REG	68～79.6	65/8REG	38.1～43.5
LZ244	65/8REG	74.8～88.4	75/8REG	46.2～54.4
LZ286	65/8REG	74.8～88.4	75/8REG	46.2～54.4

表四 可调部分上壳体上紧扭矩
(Table.4)Lock Housing Make-up Torque

LOCKHOUSINGMAKE-UPTORQUE		
Power sectionSize	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

4.Model of downhole motor

□□LZ□·□x□□-□□□-SD
①②③④ ⑤ ⑥⑦ ⑧ ⑨

Types of power section(JC-extended power section、C-long guide rail、D-short power section、K-air on foam power section)
Lobes of power section
Code of power section
Size of power section in millimeter(ODmm)
Stages of power section(2.3.4.5stage·····)
Max drilling pressure loss(Mpa)
Design change numbers
Downhole motor types
D-single bend(single bend housing or bend sub)
P-large offset distance double bend housing in the same direction(bend sub+single bend housing)
T-double bend housing in the same direction
S-double bend housing in two directions opposite to each other
Omitted-straight power section
K-Adjustable bent housing
W-Assembled with stabilize
H-Assembled with changeable stabilizer
F-Hollowed rotor(omitted-solid rotor)
G-heat-resistant performance:(G-1 50°C;omitted-120°C)

3.6.2.可调弯壳体调节角度说明

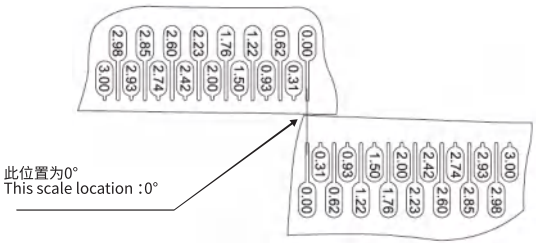


图13 (Fig.13)

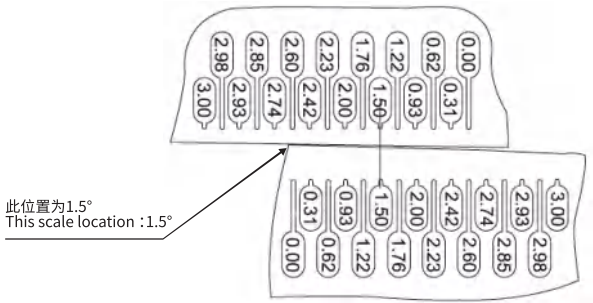


图14 (Fig.14)

3.6.3.螺杆钻具弯壳体角度标示规定:图15

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16:

3.扎槽位置距外螺纹边缘100mm-150mm为宜;

图15 (Fig.15)

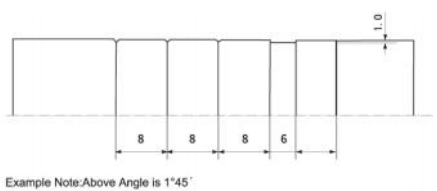


图16 (Fig.16)

Y-oil based mud、omitted-conventional

Symbol of Shengde Company

5. Influencing factors

Downhole motor is a kind of downhole power drilling tool with strong adaptability. It can work under various complicated downhole conditions. However, the use environment and drilling parameters will still affect its performance, and even seriously affect its service life. In this paper, the influence of environment and drilling parameters on downhole drilling performance is pointed out, so that users can better control the influence of environmental factors in use, adopt the best drilling parameters, make full use of the advantages of products, try to avoid its shortcomings, and achieve the best drilling effect.

5.1 Drilling Fluid Performance

Downhole motor is mainly suitable for oil well drilling (repairing) operations with water - or oil-based drilling fluids as the working medium. The influence of drilling fluid performance on drilling fluid is indicated as follows:

5.1.1 Density and solid content of drilling fluid

The density of drilling fluid, especially the solid content, has a great influence on drill's service life. Generally, the density of drilling fluid should be no more than 1.25, and the sand content of drilling fluid should be no more than 0.5%. In order to improve MTBF, the drilling fluid should be effectively separated and purified, so lower its solid content.

5.1.2 Viscosity and shear of drilling fluid

If the drilling fluid viscosity is too high, the braking torque of downhole motor will increase. If the drill bit is braked frequently in use, it may cause excessive wear or damage to the rotating part of downhole motor.

xcessive shear force of drilling fluid will result in poor start-up performance of downhole motor, increase the start-up pump pressure and even cause pump holding. When downhole drilling is started when the drilling fluid shear is too large or the drilling fluid is stationary for a long time, the pump should be turned on smoothly and keep the drill work at a greater extent.

3.7传动轴稳定器

该部件的功用是钻进中与上部的弯接头或弯壳体配合，钻进中在钻压作用下给钻头施加一个侧向力，以便控制钻头走向。

该部件结构为螺杆钻具的传动轴壳体上带有不同形式的稳定器。

常用的稳定器形式包括（图17）：

①螺旋稳定器（三翼片、五翼片等）；

②对称直条稳定器（五翼片均布）；

③非对称直条稳定器；

④贴片稳定器；

稳定器的形式和外径尺寸对造斜或稳斜的效果影响较大，用户在选用导向螺杆钻具时，应对此予以重视。

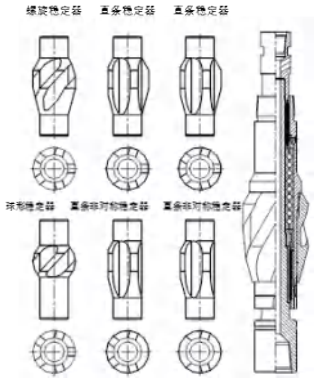


图17（Fig.17）

3.8可拆换式稳定器

该部件的功用同样是钻进中与上部的弯接头或弯壳体配合，钻进中在钻压作用下给钻头施加一个侧向力，以便控制钻头走向。

该部件结构为螺杆钻具的传动轴壳体上带有的不同形式稳定器与传动轴壳体是组装在一起的，用户在井场根据可以钻井需要随时更换适宜的稳定器。（图18）

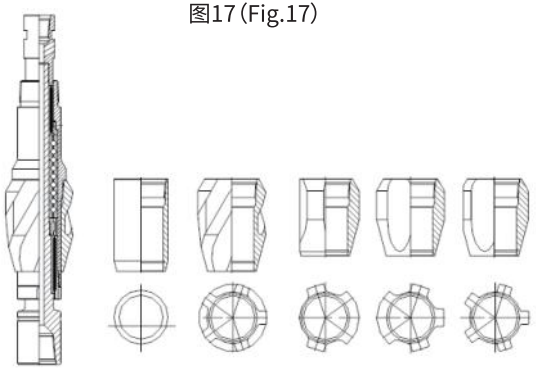


图18（Fig.18）

The PH value of drilling fluid should be between 8 and 10.5. If the PH value is too low, the parts of downhole motor will be damaged and the service life of downhole motor will be shortened.

Excessive shear force of drilling fluid will result in poor start-up performance of downhole motor, increase the start-up pump pressure and even cause pump holding. When downhole drilling is started when the drilling fluid shear is too large or the drilling fluid is stationary for a long time, the pump should be turned on smoothly and keep the drill work at a greater extent.

The PH value of drilling fluid should be between 8 and 10.5. If the PH value is too low, the parts of downhole motor will be damaged and the service life of downhole motor will be shortened.

Diesel oil or lubricant in oil-based drilling fluid will corrode the stator of downhole motor power section, which will cause r "softening" or dropping of rubber. At present, there is no data to prove which lubricant corrodes more seriously. If necessary, please consider to replace the drilling fluid lubricant.

5.2 Downhole temperature

Downhole motor power section stator bushing is formed by extrusion and consolidation of rubber. Rubber material will expand and contract with temperature rise and fall. The thickness of stator bushing of regular downhole motor power section varies greatly. Excessive temperature rise will not only cause excessive expansion of stator rubber, worsen power section wear and shorten the service life of drill tools, but also change the surface shape of power section stator and rotor due to different expansion of different rubber thickness, which affects the matching between the power section and the rotor, resulting in a decrease in downhole motor output performance. The rubber thickness of stator of equal wall thickness downhole motor is the same, so when the temperature changes, the rubber thickness can change uniformly without changing its surface shape, which is more suitable for use in the environment with higher temperature downhole.

4.螺杆钻具型号说明

□□LZ□·□x□□-□□□-SD
①②③④ ⑤ ⑥⑦ ⑧ ⑨

①马达形式(JC-加长马达、C-长导程马达、D-短马达、K-空气或泡沫马达、H-等壁厚马达)

②转子头数

③螺杆钻具产品代号

④螺杆钻具规格(外径mm)

⑤马达级数(如2.3.4.5……)

⑥钻头最大水眼压降(MPa)

⑦产品改进序列号(Ⅰ、Ⅱ、Ⅲ、Ⅳ、Ⅴ、Ⅵ、Ⅶ、Ⅷ……)

⑧螺杆钻具形式

D-单弯(单弯壳体或弯接头)钻具

P-大偏移距同向双弯(弯接头+单弯壳体)钻具

T-同向双弯钻具

S-异向双弯钻具

无-直钻具:

K-可调弯壳体钻具

W-带稳定器钻具

H-带可更换稳定器钻具

F-转子中空分流(省略一转子非中空)钻具

G-钻具定子的耐温特性(G-耐温150℃;省略-耐温120℃)

Y-钻具使用环境为油基钻井液(省略-常规钻井液)

⑨企业标志

In order to minimize the downhole temperature variation and performance deterioration, our downhole motor products can be divided into three types according to their applicable working temperature: regular downhole motor, high temperature downhole motor and ultra-high temperature downhole motor. In addition of the difference between the formula of stator rubber, there are also difference on the control of stator and rotor of power section. The company adjusts the stator and rotor matching status to the best according to the downhole temperature of the block and well depth which are widely used by users. Regular downhole motor has rated temperature ⩽95°C and maximum temperature of 120°C, it is not suitable for long-term use when downhole temperature exceeds 120°C. High temperature downhole motor has the rated temperature 120°C, and maximum temperature 150°C, it is not suitable for long-term use when downhole temperature is lower than 120°C or more than 150°C; Ultra high temperature downhole motor, has the rated temperature of150°C and maximum temperature of 180°C, it is also not suitable for long-term use when downhole temperature is below 150°C. Therefore, it is suggested that before choosing downhole motor products, users should know the downhole temperature of where it will be used for a long time, so as to determine to choose regular downhole motor, high temperature downhole motor or ultra-high temperature downhole motor. When downhole motor is required to be used for a long time with downhole temperature (non-cyclic temperature) above 150°C, the company can provide high performance ultra-high temperature downhole motor to meet the drilling needs of deep and high-temperature wells.

In addition, the company can customize the production of oil-resistant or salt-resistant downhole motor according to the special needs of users.

5.影响因素提示

螺杆钻具是适应性非常强的一种井下动力钻具，在各种复杂的井下工况下均能工作。但使用环境和钻井参数还是会影响到其性能的发挥，甚至会严重影响其使用寿命。在此，就使用环境和钻井参数对螺杆钻具使用性能的影响加以提示，以便用户使用中更好地控制环境因素的影响，采用最佳的钻井工艺参数，充分利用产品的优势，尽量避免其不足，达到最优的钻进效果。

5.1钻井液性能

螺杆钻具主要适用于以水基钻井液或油基钻井液为工作介质的石油钻（修）井作业。钻井液的性能对其影响提示如下：

5.1.1钻井液的密度和固相含量

钻井液的密度，特别是固相含量对其使用寿命有较大影响。一般要求钻井液密度不大于1.25，钻井液含砂量不大于0.5%。为了提高一次下井连续工作时间（MTBF），应当对钻井液进行有效的分离净化，使其具有尽可能低的固相含量。

5.1.2钻井液粘度和切力

钻井液粘度过大，会增加螺杆钻具的制动扭矩，使用中如果钻头频繁制动，可能会造成螺杆钻具转动部分过度磨损或损坏。

钻井液切力过大会造成螺杆钻具启动性能变差，启动泵压升高甚至憋泵。钻井液切力过大或钻井液静置时间较长情况下启动螺杆钻具时，应平稳开泵并较大程度的活动钻具。

钻井液的PH值最好在8~10.5之间，PH值过低会对螺杆钻具的零件产生破坏作用，缩短螺杆钻具的使用寿命。

油基钻井液中的柴油或润滑剂会腐蚀螺杆钻具马达定子，严重时会造成橡胶“软化”或掉块。目前尚没有数据证明哪种润滑剂腐蚀更严重。必要时，可考虑更换钻井液润滑剂。

5.2井下温度

螺杆钻具产品的马达定子衬套是用橡胶挤压固结形成的，橡胶材料会随温度升降而热胀冷缩。常规螺杆钻具马达定子衬套的厚度变化很大，温度升高过大不仅会造成其定子橡胶的过量膨胀，加剧马达磨损，缩短钻具使用寿命；还会因为橡胶厚度不同造成的膨胀量不同而改变了其曲面形状，影响的马达定、转子的配合，造成螺杆钻具输出性能下降。等壁厚螺杆钻具其定子橡胶的厚度是相同的，所以温度变化时橡胶厚度能够均匀变化而不改变其曲面形状，更适合井下温度较高的环境使用。

5.3 Bit nozzle pressure loss

The bits used in conjunction with downhole motor are usually equipped with nozzles. The nozzle pressure loss of the bit nozzles can cause pressure difference at both ends of the downhole motor drive shaft bearing. At present, downhole motor's drive shaft bearing group relies on drilling fluid for lubrication and cooling. Bit nozzle pressure loss diverts some drilling fluid from the clearance of the bearing group to lubricate and cool the bearing. If bit nozzle pressure loss is insufficient, the partial flow will be insufficient, which is unfavorable for the bearing work. If the bit nozzle pressure loss is too high, the flow rate will be too large, which will also cause the bearing to be eroded. The conventional downhole motor products provided by our company are all marked with pressure loss of 7.0 MPa, and the bit nozzle pressure loss should be maintained at 1.8 to 7.0 MPa during use.

In jet drilling, the bit nozzle pressure loss currently used is always greater than 7.0 MPa, so the main countermeasure now is to appropriately reduce the gap of the TC bearing. If necessary, provide bit nozzle pressure loss that less than 14.0MPa. The drive shaft components consisting of radial bearings with carbide inserts and planar thrust bearings with PDC, it have longer service life and higher load-carrying capacity.

5.4 Drilling Fluid Flow (Power section Flow)

Drilling fluid flow rate is an important parameter in drilling operation. It is usually has the minimum limit to ensure the smooth return of rock debris, and it is also limited by the power of the drilling pump configured.

When downhole motor works, the output speed (bit speed) is proportional to the flow rate of drilling fluid. The drill speed directly affects the machanical drilling speed of drilling.

Excessive drilling fluid flow will lead to high power section speed, which will reduce the continuous use time of downhole motor. When the flow rate of drilling fluid is small, the rotational speed decreases and the output power of power section will be insufficient, which will reduce the machanical drilling speed of drilling fluid.

为了尽量减少产品应井下温度变化过大而性能变差，本公司螺杆钻具产品按其适用的工作温度分为常规螺杆钻具、高温螺杆钻具和超高温螺杆钻具三种类型，其区别除定子橡胶配方有所不同外，在马达定、转子过盈量的控制上也有区别。本公司根据用户大量使用的区块和井深的井下温度，将供应产品的定转子配合调整到最佳的状态。

常规螺杆钻具的额定温度为≤95°C，最高温度为120°C，不适合在井下温度超过120°C下长期使用；高温螺杆钻具，额定温度为120°C，最高温度为150°C，不适合在井下温度低于120°C而超过150°C下长期使用；超高温螺杆钻具，额定温度为150°C，最高温度为180°C；超高温螺杆钻具也不适合在井下温度低于150°C以下长期使用。所以建议用户在选择螺杆钻具产品之前应了解其将要长时间使用时的井下温度，以此决定选用常规螺杆钻具、高温螺杆钻具或者超高温螺杆钻具。当需要在井下温度（非循环温度）高于150°C的条件下长期使用时，本公司可以提供高性能的超高温螺杆钻具，以满足深井、高温井中使用螺杆钻具钻井的需求。

此外，本公司可按照用户的特殊需求，定制生产耐油基或耐盐基的螺杆钻具。

5.3钻头水眼压降

与螺杆钻具配合使用的钻头通常装有喷嘴，钻头喷嘴的水眼压降会在螺杆钻具传动轴轴承的两端造成压力差。目前螺杆钻具的传动轴轴承组是依靠钻井液进行润滑和冷却的，钻头水眼压降使一部分钻井液从轴承组的间隙分流，润滑和冷却轴承。如果钻头水眼压降不够，则分流量不足，对轴承工作不利。而钻头水眼压降过高，分流量太大，也会使轴承受到冲蚀。本公司提供的常规螺杆钻具产品均标有压降为7.0MPa，使用中应保持钻头水眼压降在1.8~7.0MPa。

喷射钻井中，现在采用的钻头水眼压降往往大于7.0MPa，所以目前主要的应对措施是适当减小TC轴承的间隙。必要时也可提供钻头水眼压降为≤14.0MPa的，采用上下各一组硬质合金镶块的径向轴承和金刚石复合片(PDC)的平面止推轴承组成的传动轴部件，其寿命更长、承载能力更高。

5.4钻井液流量（马达流量）

钻井液流量是钻进作业的重要参数，通常以保证岩屑能够顺利上返为最低限制，也会受到所配置钻井泵的功率限制。

螺杆钻具工作时，输出转速（钻头转速）与钻井液流量成正比。钻头转速直接影响钻井的机械钻速。

钻井液流量过大，将导致马达转速过高，必将减少螺杆钻具连续使用的时间。钻井液流量较小时，转速随之下降，马达输出功率不足，会降低钻井的机械钻速；

Users should select downhole drilling products with corresponding performance according to the determined drilling fluid flow rate that meets the requirements of drilling operation and the bit speed required for the corresponding mechanical drilling speed.

The performance parameters of downhole motor products provided by our company are designed according to the given power section flow, working speed, power section pressure loss and working torque. Users can convert the real performance parameters of downhole motor in use according to the relationship between the four parameters. If you divide the actual drilling fluid flow rate by the power section's drilling fluid flow rate, and multiplie the obtained coefficient by the rated output speed of the power section, the actual rotational speed of the power section can be obtained. In practical work, the power section speed should be controlled at 150~200r/min, preferably no less than 100r/min, and no more than 250r/min. Power sections below 100r/min do not have sufficient output power may not work or fail prematurely. When the power section speed is higher than 300r/min, the rubber surface cannot form effective liquid film, especially when the power section speed is higher than 300r/min, the rubber surface cannot form liquid film at all, the rubber will wear rapidly. If the on-site conditions permit, the drilling fluid flow can be adjusted by adjusting the parameters of the drilling pump (cylinder diameter, stroke number, etc.) to obtain a more ideal bit speed and thus a higher mechanical drilling speed.

When users find that the flow rate of drilling fluid used in the field is far different from the rated flow rate of downhole motor, they should contact the company's business personnel to determine whether it can be used normally. If the actual flow rate of drilling fluid is much larger than the rated flow rate of downhole motor, a hollow rotor downhole motor can be used to allow a portion of the drilling fluid to be diverted through the through hole of the rotor, thereby enabling the power section speed to meet the requirements.It should be noted that if the hollow rotor downhole motor is used, the actual drilling fluid flow must be guaranteed to conform to the predicted flow rate and to match the nozzle installed in the hollow rotor. If the flow rate of drilling fluid is low, the output speed of downhole motor will decrease seriously, and it may cause its premature failure.

用户应当根据确定的满足钻井作业要求的钻井液流量和获得相应机械钻速所需的钻头转速，来选择相应性能的螺杆钻具产品。

本公司所提供的螺杆钻具产品的性能参数是依据给定的马达流量、工作转速、马达压降和工作扭矩设计的，用户可根据这4个参数的相互关系，换算出使用中螺杆钻具的真实性能参数。如将实际的钻井液流量除以马达的钻井液流量，得到的系数再乘以马达的额定输出转速，即可以得出马达的实际转速。实际工作中马达转速应控制在150~200r/min为好，最好不要低于100r/min，也不要高于250r/min。低于100r/min马达没有足够的输出功率，很可能无法工作或过早失效。高于250r/min时，橡胶表面不能形成有效的液体薄膜，特别是当马达转速高于300r/min时，橡胶表面完全不能形成液体薄膜，橡胶将迅速磨损。如果现场条件允许也可以通过调整钻井泵的参数（缸径、冲数等）调整钻井液流量，获得更为理想的钻头转速，从而获得较高的钻井机械钻速。

用户发现现场使用的钻井液流量远离所使用螺杆钻具的额定流量时，应与公司业务人员联系，确定是否可以正常使用。如果实际的钻井液流量远大于螺杆钻具的额定流量时，可以使用中空转子螺杆钻具，使一部分钻井液通过转子的通孔分流，从而使马达转速满足要求。需要注意的是，如果使用了中空转子螺杆钻具，必须保证实际的钻井液流量与预定的相符合，并与中空转子所装水眼相匹配。如果钻井液流量偏低，将导致螺杆钻具输出转速严重下降，并可能会使其过早失效。

如果实际的钻井液流量大于螺杆钻具的额定流量不多时，本公司可以提供专门的产品，通过调整马达定转子间隙，控制钻头转速，使螺杆钻具正常工作。

5.5泵压（马达压降）

钻井现场能够提供的最高泵压受到钻井泵功率和循环管线压力等级的限制，同时泵压是钻井液流动压降、钻头水眼压降和马达工作压降之和，钻进中要留有足够的泵压空间用作马达压降。

螺杆钻具的马达压降与其输出扭矩成线形正比关系，随马达压降的增大输出扭矩线形增加，表明螺杆钻具具有良好的过载能力。当钻压增大时，导致钻头阻力矩增加，此时马达压降增大使螺杆马达输出扭矩增大，以克服摩阻扭矩。如果预留的泵压空间不够，增大钻压会导致憋泵，螺杆钻具不能在正常压降范围内工作。

If the actual flow rate of drilling fluid is a bot larger than the rated flow rate of downhole motor, our company can provide special products to make downhole motor work normally by adjusting the rotor clearance of the power section and controlling the bit speed.

5.5 Pump pressure (power section pressure loss)

The maximum pump pressure provided by drilling site is limited by the power of drilling pump and the pressure level of circulating pipeline. At the same time, pump pressure is the sum of drilling fluid flow pressure loss , bit nozzle pressure loss and power section working pressure loss. In drilling, sufficient pump pressure space should be left for power section pressure loss. The power section pressure loss of downhole motor has a linear proportional relationship with its output torque, and the output torque linearity increases with the increase of power section pressure loss, which indicates that downhole motor has a good overload capacity. When the drilling pressure increases, the resistance moment of the bit increases, and the output torque of the screw power section increases with the increase of the pressure loss of the power section to overcome the friction torque. If the reserved pump pressure space is not enough, increasing drilling press will lead to pump holding, and downhole motor can not work within the normal pressure loss range.

5.6 Drilling pressure

During the downhole drilling, the drilling pressure is the only parameter which can be actively adjusted at any time. With the changes of drilling pressure, the pump pressure or riser pressure will also change. Because when drilling pressure increases, the bit resistance moment increases, and the pressure loss of the power section increases so that the output torque of the screw power section increases to overcome the frictional torque.

Sufficient drilling pressure should be applied to provide sufficient torque for the bit to break rock. How much to apply drilling pressure can be determined by observing the change in the suspension weight on the weight gauge. The torque output from the downhole motor can be determined by the pressure change on the riser pressure gauge. The relationship between the power section pressure loss and its output torque can be used to calculate the torque endured by the drill bit.

5.6钻压

螺杆钻具在井下工作时，钻压是唯一可以随时主动调整的参数。随着钻压的变化，泵压或立管压力也随之变化。因为，当钻压增大时，导致钻头阻力矩增加，此时马达压降增大使螺杆马达输出扭矩增大，以克服摩阻扭矩。

应当施加足够的钻压，才能为钻头破岩提供足够的扭矩。所施加钻压的大小，可以通过观察指重表上悬重的变化来确定。螺杆钻具输出的扭矩大小可以通过立管压力表上压力的变化来确定马达压降，由马达压降与其输出扭矩之间的关系，最终可以计算出钻头承受的扭矩。

如果预留的泵压空间足够时，马达压降随着所施加的钻压加大而升高。当钻压进一步加大时，马达压降也急剧增加。由于马达本身结构的限制，当马达压降达到一定程度后，破坏了定转子间密封腔的密封能力而钻井液流量全部泄露，钻头转速急剧下降甚至停车，即为螺杆钻具在井下工作经常出现的马达制动状态。地面可以观察到立管压力升高，但钻头进尺很小甚至没有进尺。马达制动状态在螺杆钻具使用过程中是不允许发生的。遇有这种情况必须及时提起钻具以减小钻压，如果地面压力表读数恢复正常，则可确认是钻压过大引起制动。处理后如无异常，可以继续钻进。马达制动的本质是钻头所承受的扭矩已经超过了螺杆钻具的制动扭矩，螺杆钻具已出现制动现象，或已完全制动。当然降低钻头承受的扭矩使之小于螺杆钻具制动扭矩，螺杆钻具即可继续工作。因为螺杆钻具的制动扭矩与钻井液流量有关，有时钻头扭矩并未增加，但钻井液流量下降（如活塞或凡尔刺漏等），也可能出现马达制动，但此时立管压力升高的幅度会大大降低。

可以通过钻头提离井底时的立管压力与施加钻压后的立管压力的差值，作为马达的工作压降，并可计算出输出扭矩。立管压力的变化直接反应马达的输出扭矩和马达在井下的工作情况，立管压力大幅度的突然升高或突然降低也反映了螺杆钻具工作的不正常。

应当通过逐渐增加钻压使马达压降逐渐达到螺杆钻具性能参数表给出的工作压降，此时输出扭矩为螺杆钻具马达的工作扭矩。从而使获得最高的输出效率。同时，应当控制钻压不能超过规定的最大钻压值，以免导致传动轴轴承的损坏；或者马达压降过高而马达滞动，导致马达定子过度磨损而失效。建议螺杆钻具在马达工作压降的2/3至1倍范围内平稳钻进，必将获得最优的机械钻速和最长的使用寿命。

现场操作应通过同时观察指重表和泵压表，在允许的范围内逐渐增加钻压，同时观察立管压力表，监视马达工作压降以及其产生的钻头扭矩。发现异常及时调整钻压，以控制钻进过程。

If the reserved pump pressure space is sufficient, the pressure loss of the power section will increase as the drilling pressure is increased. When drilling pressure is further increased, pressure loss of the power section will also increases sharply. Due to the limitation of the power section structure, when the pressure loss of the power section reaches a certain degree, the sealing capacity of the sealing cavity between fixed rotors will be damaged, and the drilling fluid flow leaked, and the bit speed drops sharply or even stops, which is the braking state of the power section that often occurs in downhole motor. The riser pressure can be observed on the ground, but the bit footage is very small or even no footage. Power section braking is not allowed to occur during downhole motor operation. In this case, the drilling pressure must be reduced by lifting the drilling tool in time. If the ground pressure gauge reading returns to normal, it can be confirmed that excessive drilling press causes braking. If there is no abnormality after treatment, drilling can be continued. The essence of power section braking is that the torque of the drill bit exceeds that of the downhole motor., cause the downhole motor braked phenomenon or downhole motor completely braked. Of course, the downhole motor can continue to work by reducing the bit's braking torque, make it less than the downhole motor's braking torque. The braking torque of downhole motor is related to the flow rate of drilling fluid. Sometimes the bit torque does not increase, but the flow rate of drilling fluid decreases (such as piston or Verne spill), power section braking may also occur, but at this time the rise of riser pressure will be greatly reduced.

The difference between the riser pressure when the drill bit lifting from the well bottom and the riser pressure after adding drilling pressure can be used as working pressure loss of the power section and output torque can be calculated. The pressure change of the riser directly reflects the output torque of the power section and the working condition of the power section downhole. The sudden increase or decrease of the riser pressure is also reflecting the abnormal working condition of downhole motor.

6.使用维护要求

用户应按照钻井工程设计的要求，选择性能参数符合现场实际需要的螺杆钻具产品，并选配合适的结构形式（如：单弯、稳定器类型、弯点位置等）。

螺杆钻具下井使用之前，应当进行细致的检查，确保下井后能正常工作，避免不必要的起下钻和由此造成的损失。下井前应确认其为新螺杆钻具或使用后经过正常维修的螺杆钻具。使用过的螺杆钻具，如果未经拆检和维护保养，可能蕴藏极大的事故隐患，给钻井作业带来不必要的损失。如果确实需要旧的螺杆钻具再次下井，应仔细检查螺纹部位是否有松动的迹象，以及壳体是否有影响安全的腐蚀或划伤。

6.1 下井前的地面检查；

6.1.1 新螺杆钻具壳体螺纹在出厂时均已旋紧并涂以锁紧剂，在钻台上不得擅自旋动任何螺纹部位。

6.1.2 用钻头装卸器把钻头装上，仅允许使用链钳转动钻具传动轴轴头，并且只能顺时针旋转(俯视旋向，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。用卡瓦把钻具卡牢，卸去提升短节。

6.1.4 检查旁通阀：用锤柄或木棒压下旁通阀阀芯到压不动为止，从上部向旁通阀内注满水，此时观察旁通阀侧面的各孔应不漏水，旁通阀中水面应无明显下降，然后松开下压的旁通阀阀芯，阀芯应被弹簧弹起复位，阀内所注满的水应从侧面各孔均匀流出。若旁通阀阀芯下压到下死点时，注水旁通阀侧面的孔有明显泄露或松开下压的旁通阀阀芯，阀芯无法弹起复位，则应判定旁通阀失效，钻具不能下井。

6.1.5 接方钻杆并下放，使旁通阀位于钻台下方便于观察的地方，平稳启动钻井泵，逐渐提高排量到钻井泵稳定运行状态，记录此时的立管压力值即为井口立管压力。然后观察是否有钻井液从旁通孔流出；再上提钻具，看钻头是否转动。然后停止钻井泵，注意观察停泵后旁通阀是否顺利打开，使钻井液从旁通孔排出。旁通阀关闭不严或无法正常打开，钻头转动不正常，钻具均不能下井。

使用全新或搁置时间相对较长的螺杆钻具时，由于部分转子已嵌入定子橡胶中，可能首次启动压力相对较高甚至出现“憋泵”；可用管钳或“猫头”顺时针(俯视时旋向)旋转传动轴轴头1~3周后，再重新开泵。

操作过程中应避免钻头与井口防喷器、井口管线接触、碰撞。泵未完全停止之前，不要把旁通阀提到转盘以上，防止污染钻台。

6.1.6 卸下方钻杆，按设计的钻具组合接好钻柱。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顺时针方向。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，均可能会造成钻具内部零件的松扣或脱扣，请用户注意。

The drilling pressure should be gradually increased so that the pressure loss of the power section can gradually reaches the working pressure loss given in the downhole motor performance parameter table. At this time, the output torque is the working torque of the downhole motor power section, so as to obtain the highest output efficiency. Meanwhile, the drilling pressure shall not exceed the maximum drilling pressure value as stipulated, so as to avoid the damage of drive shaft bearing, or power section stagnation due to excessively high pressure loss, resulting in excessive wear and failure of power section stator. It is recommended that downhole motor drilling smoothly within 2/3 to 1 times of working pressure loss of the power section, which will surely achieve the optimum mechanical drilling speed and the longest service life.

In field operation, drilling pressure should be gradually increased within the allowable range by simultaneously observing weight indicator and the pump pressure gauge, while observing the riser pressure gauge, monitoring the pressure loss of the power section and the bit torque generated by it. Timely adjust drilling pressure to control drilling process if any abnormal conditions are found.

6. Use and maintenance requirements

According to the requirements of drilling engineering design, users should choose downhole motor products with performance parameters in line with the actual needs of the site, and choose appropriate structural forms (such as single bend, stabilizer type, bending point position, etc.).

Before downhole motor, careful inspection should be carried out to ensure normal operation after downhole, so as to avoid unnecessary up-and-down and resulting losses. Before entering the well, it should be confirmed as it is the new downhole motor or had been normally maintained after last time use. The used downhole motor, if not inspected and maintained, may contain great potential accidents and bring unnecessary losses to drilling operations. If you do need the old downhole motor to work again, carefully check for signs of loosening of the threads and for corrosion or scratches on the casing that affect safety.

6.2 下钻

尽管钻具本身外形简单，且有足够的刚性，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，或因高温造成螺杆钻具定子损坏。

下钻中，若钻井液不能迅速通过旁通阀侧孔进入钻柱内，甚至出现环空溢出钻井液时，应减慢下钻速度，或不时停下来充灌钻井液。注意不可将钻具直接放进井底并防止顿钻。

6.3 启动钻具

如果钻具处于井底，必须提起0.3~0.6m，开动钻井泵循环钻井液，反复多次上提下放钻柱，当立管压力相对稳定后记下立管的压力表读数，即为钻头离开井底的立管压力。

重新轻着井底，并慢慢加钻压，立管压力表示值随即升高，此时的立管压力即钻进立管压力，它与钻头离开井底的立管压力的差值即马达的工作压降。应控制马达工作压降不要超过各型号螺杆钻具额定工作压降。换句话说，立管压力表增大的数值（即马达压降）反映了马达的负荷是否正常，也反映了钻压的大小是否合适。

6.4 正常钻进

钻进过程中，要维持扭矩基本稳定，钻压应尽量平稳。可控制钻压并观察立管压力，只要立管压力稳定控制在一定范围内，则输出给钻头的扭矩就基本稳定。立管压力能使司钻及时了解螺杆钻具在井底的工作情况。

特别提示：新的螺杆钻具首次下井工作，其定转子与传动轴均需磨合一段时间才能达到最佳状态。所以，应先适当减小钻压，平稳运行30min之后再正常钻进。

6.1 Ground inspection before downhole;

6.1.1 The new downhole motor housing threads have been screwed and coated with locking agent when leaving the factory. No unauthorized rotation of any thread parts on the drilling platform is allowed.

6.1.2 To mount the drill bit with a bit loader. Only chain pliers are allowed to rotate the shaft of the drill drive shaft, and only clockwise rotation (downward rotation, the same below) is allowed to prevent the internal thread from loosening.

6.1.3 Lift the nipple and put the drill tool into the rotary table. Clamp the drill string with a slip and remove the lifting nipple.

6.1.4 Check bypass valve: Press down bypass valve core with hammer handle or wooden stick until it can be pressed down anymore, fill water from the top to the bypass valve, and observe the hole on the side of bypass valve should not leak, the water surface in the bypass valve should has no significant drop, then loosen the downward pressed bypass valve spool, the spool should be bounced back by spring, and filled in the valve and water should flow evenly from the side holes. If the by-pass valve spool is depressed to the bottom dead point, the hole on the side of the water injection by-pass valve has obvious leakage or the valve core can not be rebounded and reset after loosen the depressed by-pass valve spool, then it should be judged that the by-pass valve fails and the drill can not go down the well.

6.1.5 Connect the kelly pipe and lower it so that the bypass valve is located under the drilling floor for easy observation. Start the drilling pump steadily and gradually increase the displacement to the stable operation state of the drilling pump. Record the riser pressure value at this time, which is the wellhead riser pressure. Then observe if any drilling fluid flows out of the bypass hole. Then lift the drill tool and see if the drill bit turns. Then stop the drilling pump and observe whether the bypass valve opens smoothly after stopping the pump, so as to discharge drilling fluid from the bypass hole. If bypass valve is not closed properly or cannot be opened normally, or the drill bit rotates abnormally, the drill tool can not go down the well.

When using a new downhole motor or a relatively long shelf time downhole motor, please note that part of the rotor has been embedded in the stator rubber, the first time start-up pressure may be relatively high or even occurs "pump holding". The pump can be restarted after 1 to 3 circle of rotation of the drive shaft head clockwise with pipe pliers or "cat head".

6.5起钻

螺杆钻具提出井口后，卡牢钻具外壳，旋转传动轴轴头(俯视为顺时针)，把马达密封型腔中存留的钻井液从钻头排出。

将螺杆钻具下放到旁通阀露出转盘，把螺杆钻具卡牢在转盘上，先用清水从旁通阀顶部进行冲洗。然后使用木棒或锤把等将阀芯反复按下、松开多次，使其能自由地移动为止。最后拧上提升短节，提出钻具。

将螺杆钻具提出转盘，装好钻头装卸器，并卸下钻头。

螺杆钻具卸下后，应平稳地送下钻台，妥善保管或及时送管具公司、维修站检修。

6.6维护与保养

螺杆钻具下井使用后，应立即进行拆检和维护保养。未经拆检的螺杆钻具不应再次下井使用，除非上次使用时间很短，工况较好，并能确认没有影响再次下井安全的腐蚀、划伤、磨损等缺陷。

凡是在钻具组合中螺杆钻具与震击器（随钻或打捞震击器）一起使用，只要有过震击，因为无法量化对螺杆钻具的损伤程度，再次使用可能造成钻具断裂等事故。所以起钻后螺杆钻具必须及时告知厂家进行维修检测。

使用过的旧螺杆钻具如果未经正常的维修和更换易损件，很可能在反复使用中引起事故，造成不必要的起下钻，甚至因得不到及时维修，而造成整个钻具的报废。

螺杆钻具的拆检和维护保养，应当在有条件的维修车间内进行。拆装人员应对螺杆钻具产品的原理、结构和使用比较了解。

维修时，应检查壳体的划伤、裂纹等缺陷，必要时应予探伤。壳体表面严重划伤或产生裂纹，应予更换，不得再次使用。

维修时，应按有关规定检查螺纹表面状况，并在组装时注意紧密距变化情况。螺纹损伤或紧密距变化较大时，应予更换。

拆卸螺杆钻具时，应当用氧乙炔火焰烘烤螺纹部位（不得超过250℃），使螺纹粘结剂失效。过度烘烤会降低螺纹连接强度，务须予以注意。

During the operation, the drill bit should be avoided from contact with the wellhead blowout preventer and the wellhead pipeline. Do not lift the bypass valve above the rotary table before the pump is completely stopped to prevent contamination of the drill floor.

6.1.6 remove the kelly bar and connect the drill string according to the designed drill assembly. It is suggested that in the process of loading and unloading, the rotation direction of the bit sub relative to the housing is clockwise from the top down. Any violation of this rule, such as reversing the rotary table or tightening the buckle above the power section, may cause loosening or release of the internal parts of the drilling tool, please note.

6.2 Drilling

Although the drill is simple in shape and rigid enough, it is still necessary to control the lowering speed when the drilling tool is lowered, otherwise it can be easily damaged by the sand bridge,wellbore shoulder and the casing shoe in the wellbore. In the case of such well section, it is always necessary to start the drilling pump to slowly expand the wellbore for passing through.

If bent sub or bent housing is used, the side of the drill bit is more likely to hit the hard rock and casing shoes, etc., so the drill assembly should be rotated periodically to eliminate the effect of side drill.

For deep and high temperature wells, it is recommended to carry out the periodically midway cycle when releasing the drill, so as to prevent bit clogging or stator damage caused by high temperature.

During drilling, if the drilling fluid can not enter the drill string quickly through the side hole of bypass valve or even overflow in annulus, the drilling speed should be slowed down or the drilling should be stopped from time to time for fluid filling. Be careful not to put the drilling tool directly into the hole bottom and prevent percussion drilling.

6.3 Start-up Drilling Tool

If the drilling tool is at the bottom of the well, it must be lifted by 0.3-0.6m, and start the drilling pump to circulate drilling fluid, and repeatedly raise and lower the drill string. When the riser pressure is relatively stable, record the pressure gauge reading of

6.7吊运和保管

螺杆钻具出厂及运输过程中的吊装，应使用尼龙绳悬挂螺杆钻具的中部，使螺杆钻具水平平稳起吊。使用钢丝绳起吊时，钢丝绳应带有橡胶护套，避免划伤螺杆钻具的壳体。

不得使用破损的钢丝绳起吊。

螺杆钻具应平放于坚硬的地面，或者平放于适宜的支架上。不得长期存放在软土或泥泞的地面。存放期间，应保持两端的护丝完好，防止污物进入。存放场地应遮阳、防雨，通风良好，环境温度不高于45℃。

螺杆钻具的有效储存期为自定子生产之日起一年半。超期储存的螺杆钻具仍可以使用，其连续工作时间可能会有不同程度的减少。

6.8.常见故障分析及其应对措施建议

螺杆钻具在井下工作过程中，可能遇到各种异常情况。以下就机械钻速变慢和泵压异常两种故障进行分析并提出应对措施，仅供参考：

6.8.1机械钻速变慢故障分析（表五）

使用螺杆钻具钻进中，出现的机械钻速逐渐变慢的现象，而不是突然变慢或者是没有进尺。

遇到机械钻速变慢，操作步骤：上提钻柱校对循环泵压（与计算泵压相比或之前的循环泵压相比）。

观察循环泵压变化情况，可能观察到：循环泵压偏高、循环泵压不变或循环泵压偏低三种情况，分别进行分析：

the riser, that is, the riser pressure when the bit leaving the bottom of the well.

Gently drop the downhole motor to the bottom of the well, and gradually increase the drilling pressure. The riser pressure is then increased. At this time, the riser pressureis the riser pressure, its difference with the riser pressure when bit leaves the bottom of the well is the working pressure loss of the power section. Should control the power section work pressure loss never exceed the rated working pressure loss of each model of downhole motor. In other words, the increased value of the riser gauge (ie, the power section pressure loss) reflects whether the load on the power section is normal or not, and whether the volume of the drilling pressure is appropriate.

6.4 Normal Drilling

In the process of drilling, to maintain the basic stability of the torque, drilling press should be as smooth as possible. You can control the drilling pressure and observe the riser pressure at the same time. As long as the riser pressure is controlled within a certain range, the output torque to the drill bit will be basically stable. The riser pressure can make the driller know the downhole motor's working condition at the bottom of the well in time.

Special tips: when the new downhole motor works for the first time, its stator and rotor and drive shaft need to run in for a period of time to reach the best state. Therefore, drilling pressure should be reduced appropriately and run smoothly for 30 minutes before drilling normally.

6.5 Lifting Drills

After the downhole motor is put into the wellhead, the drilling tool casing should be fastened, and the drive shaft head (clockwise in plan view) should be rotated to discharge the drilling fluid remaining in the power section sealing cavity from the drill bit.

Lower the downhole motor to the bypass valve and expose the turntable, fasten the downhole motor on the turntable, and flush with water from the top of the bypass valve first. Then use a wooden stick or hammer to repeatedly press and release the

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	判断方法 Judgment method	可能原因 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压偏高 High circulating pump pressure	钻头泥包 Bit mud pack	在钻进过程中泵压会上升（水眼被堵），而且转盘（顶驱）扭矩会下降。 During the drilling process, the pump pressure will rise (bit nozzle is blocked), and the turntable (top drive) torque will decrease.	流量偏低、地层粘黏度高、钻井液性能不良。 Low flow rate, high formation viscosity and poor drilling fluid performance.	持续循环钻井液，仍不见效果，可建议起钻检查钻头。 Continuous circulating drilling fluid, if it still has no effect, it is recommended to pull out drill and inspect the bit.	
	井下落物 Downhole falling objects	逐渐加大钻压，有转盘（顶驱）扭矩过大、扭矩波动幅度大、有时还会伴有憋跳现象。 Increase the drilling pressure gradually, resulting in too large torque of rotary table (top drive), large fluctuation range of torque, or sometimes accompanied by the phenomenon of jumping or holding back drilling.	井底落物、井壁掉块、PDC钻头断刀翼、牙轮钻头轴承卡死等。 Dropping hole objects, sidewall falling, PDC bit broken blade, cone bit bearing stuck, etc.	起钻检查。 Drilling inspection.	

spool till it can move freely. Finally, screw on the lifting nipple and lift out the drill.

Remove the downhole motor from the turntable, install the bit unloader and remove the bit.

After the downhole motor is unloaded, it should be sent down to the drilling platform smoothly and kept properly, or timely sent to the pipe company or repair station for maintenance.

6.6 Maintenance

After downhole motor is used, it should be disassembled, inspected and maintained immediately. The downhole motor without disassembly and inspection shall not be used again unless the last time of use is very short, the working condition is good, and it can be confirmed that there is no corrosion, scratch, wear and other defects that will affect the safety of the second well operation.

Generally, when downhole motor is used together with drilling jar (with the drill or salvage jar) in the drill assembly, as long as there is a shock, it is impossible to quantify the damage degree to the downhole motor, re-use it may cause drilling tool fracture and other accidents. Therefore, after lifting the downhole motor, must inform the manufacturer for maintenance and inspection in time.

If the old downhole motor is not well maintained or without replacement of wearing parts, it is likely to cause accidents during repeated use, causing unnecessary drilling up-and-down, or even the scrap of the whole drill because it haven't get repaired in time.

The disassembly, inspection and maintenance of downhole motor shall be carried out in a conditional maintenance workshop. Disassembly and assembly personnel should have a better understanding of the principle, structure and use of downhole motor products.

During maintenance, the housing should be inspected for defects such as scratches and cracks, and flaws shall be inspected if necessary. If found serious scratches or cracks on the surface of the housing, the housing shall be replaced and shall not be

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	判断方法 Judgment method	可能原因 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压不变 Short or long pull out.	水平段、造斜段摩阻过大 Excessive friction in horizontal section and inclined section	转盘（顶驱）复合钻进时，扭矩过大。 Torque will be too high when rotary disk (top drive) drilling is combined.	钻压大部分无法施加到钻头上导致。 Caused by most of the drilling pressure cannot be applied to the bit.	短起或者长起。 Short or long pull out.	
	马达输入动力不足 Insufficient power section input	加钻压（工作钻压范围内）钻进，会出现泵压不变或泵压上升不明显的情况。 Add drilling pressure (within the range of work drilling pressure), the pump pressure will remain unchanged or with no obvious rise.	a)钻井液流量不足 A) insufficient drilling fluid flow	检查流量应在推荐范围之内。在推荐最大流量的70%~ 90%时机械钻速会比较理想。如果流量在推荐值的下线附近，应适当的减少钻压。 Check whether the flow is within the recommended range. When the recommended maximum flow rate is 70%-90%, the penetration rate will be ideal. If the flow rate is close to the recommended lower limit, the drilling pressure should be reduced appropriately.	
			b)钻具到了使用后期 B) The drilling tool has reached its late stage of use.	如果想继续使用一段时间，提高排量可以加快钻速。 If you want to continue to use for a period of time, increasing the displacement can speed up the drilling rate.	
			c)润滑剂或油基钻井液中柴油腐蚀马达定子 C) Diesel oil in lubricants or oil-based drilling fluids corrodes the power section stators	换润滑剂 Change lubricant	润滑剂腐蚀会使胶块“软化”。用手捏返出胶块感觉变软。 Lubricant corrosion can lead to "softening" of rubber blocks. It feels soft when you squeeze the returned rubber with your hand.
			d)井底温度过高，导致的橡胶掉块。 D) Rubber block falling due to high hole bottom temperature.	换高温螺杆钻具 Use high temperature downhole motor	用手捏返出胶块，会感觉到胶块很硬。 If you squeeze the returned rubber with your hand, you will feel that the rubber is very hard.

used again.

During maintenance, check the surface condition of thread according to relevant regulations, and pay attention to the change of tightness during assembly. If the thread is damaged or the tightness changes greatly, it should be replaced.

When dismantling downhole motor, the thread should be baked with oxyacetylene flame (no more than 250°C), so that the thread binder fails. Attention must be paid that excessive baking will reduce the strength of the threaded connection

6.7 Lifting and Storage

When leaving factory and during transportation, the nylon rope should be used to suspend the middle part of downhole motor in order to make the downhole motor hoist horizontally and smoothly. When lifting with a wire rope, the wire rope should be provided with a rubber sheath to avoid scratching the casing of the downhole motor.

No damaged wire rope is allowed to be used in lifting

The downhole motor should be laid flat on hard ground or on suitable supports. It shall not be stored in soft soil or muddy ground for a long time. During storage, the wire at both ends should be kept intact to prevent dirt from entering. The storage site should be shaded, rainproof, well ventilated, and the ambient temperature should not exceed 45 °C.

The effective storage period of downhole motor is one and a half years from the date of stator production. Overdue downhole motors are still available, but their continuous working hours may be reduced by varying degrees.

6.8. Analysis of Common Faults and Suggestions for Responding Measures

During the drill working downhole, various abnormal conditions may be encountered. The following two faults, slow mechanical drilling speed and abnormal pump pressure, are analyzed, and countermeasures are proposed, for reference only:

6.8.1 Mechanical Drilling Speed Slowing Fault Analysis (Table.5)

During downhole drilling, the mechanical drilling speed gradually slows down, instead of suddenly slowing down or no footage. When the mechanical drilling speed slows down, the operation steps are as follows: lifting the drill string to check the circulat-

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	判断方法 Judgment method	可能原因 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压偏低 Low circulating pump pressure	钻具刺漏 Drill leakage	泵压下降过多，大于螺杆的启动压降（1~2MPa）加钻头水眼压降，可以判断是钻柱刺漏。泵压下降不多的时，可以下放钻铤以下钻柱的重量，如果是钻具钻铤刺漏，泵压就会回升到正常值。 The excessive drop of pump pressure is larger than the screw start-up pressure drop (1~2MPa) and bit nozzle pressure drop, which can be judged as drill string piercing. When the pump pressure drops little, the weight of the drill string below the drill collar can be lowered. If the drill collar leaks, the pump pressure will rise back to normal value.	由于钻柱刺漏，钻井液分流，导致输入螺杆钻具的水功率不足。 Due to drill string leakage, drilling fluid diversed, making the water power input to downhole motor is insufficient.	起钻检查钻柱是否刺漏。 Stop to check whether the drill string is leaking.	
	螺杆旁通阀未关闭 Screw bypass valve is not closed	在确定循环泵压确实下降时，把钻压稍微加大（在钻压最大范围内），会出现立管压力增加值偏低或不明显的情况。 When it is determined that the circulating pump pressure does decrease, slightly increase the drilling pressure (within the maximum range of drilling pressure), will result in a low or insignificant increase in the riser pressure.	由于部分钻井液从旁通阀口流入环空，未进入马达导致输入螺杆钻具的水功率不足。 As part of the drilling fluid flows into annulus from the bypass valve port, it does not enter the power section, resulting in insufficient water power input to the downhole motor.	起钻检查 Drilling inspection	

需要特别注意，螺杆钻具使用参数中的推荐钻压和最大钻压是在一定条件下给出的而不是一成不变的。钻进过程中，维系正常马达压降的钻压才是真正允许的最优推荐钻压。

It should be noted that the recommended and maximum drilling pressure in the operating parameters of downhole drilling are given under certain conditions, it is not invariable. During the drilling process, the best and recommended drilling pressure is to maintain the normal power section pressure loss.

ing pump pressure (compared with the calculated pump pressure or the previous circulating pump pressure).

Observing the change of circulating pump pressure, it is possible to observe three situations: high circulating pump pressure, unchanged circulating pump pressure or low circulating pump pressure, which shall be analyzed respectively:

6.8.2 Fault Analysis of Abnormal Pump Pressure (Table.6)

When drilling or composite drilling with downhole drilling, abnormal pump pressure failure may lead to pump pressure rise, pump pressure drop, or pump pressure unchanged after increasing drill pressure, etc. It should be analyzed separately:

7. Influencing factors of directional drilling

Downhole motor is frequently used in directional drilling. It has special structures such as curved housing and stabilizer. Therefore, the following problems should be paid attention to when using.

7.1 Deflection

Downhole motor can have various structural forms. It is difficult to determine the deflection of downhole motor because there are different drilling tool combinations, and the influence of formation structure and rock drillability. The structure of downhole motor and its influence on deflection are analyzed:

1. The nearer the bending point is to the drill bit, the higher the deflection is. Therefore, the use of universal bent housing has a higher deflection than the use of bending joint, and the bending angle of the housing also has a greater impact on deflection.
2. Stabilizer is also a key factor affecting downhole motor deflection. The form, size and distance from the drill bit of the stabilizer have an impact on deflection.
3. The bigger the bend corner, the higher the deflection.
4. When the angle of different parts of downhole motor and its coplanar error with asymmetric stabilizer are large, it has a great influence on deflection, or makes borehole difficult to control.

6.8.2泵压异常的故障分析（表六）

螺杆钻具钻进或复合钻进中，泵压异常故障可能有泵压升高、泵压下降，或加钻压泵压不变等，分别进行分析：

6.8.2 Fault Analysis of Abnormal Pump Pressure

When drilling or composite drilling with downhole drilling, abnormal pump pressure failure may lead to pump pressure rise, pump pressure drop, or pump pressure unchanged after increasing drill pressure, etc. It should be analyzed separately:

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	可能原因 Judgment method	判断方法 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压升高 Circulating Pump Pressure Increase	地面设备 Ground equipment	地面管线的堵塞 Blockage of Ground Pipeline	人头表与立管泵压值差值加大 Increased pressure difference between head gauge and riser pump	排除故障 Troubleshooting	
	井下故障 Downhole fault	地层原因：地层比较软，钻头吃进地层较多，扭距增大 Formation reason: the formation is relatively soft, the bit eats more formation, and the torque increases.	泵压是突然升高，随着进尺的增加，泵压会恢复到正常值 Pump pressure is suddenly increased, with the increase of drilling depth, pump pressure will return to normal value.	平稳钻进 Smooth drilling	
		井壁坍塌 Sidewall collapse	泵压升高突然，震动筛上可见较多岩屑掉块 Pump pressure is suddenly increased, and can see a lot debris falls on the shaker.	持续循环钻井液，等待泵压恢复正常 Continuous circulation of drilling fluid, waiting for pump pressure back to normal	

7.2 MechanicaI Drilling Speed

Downhole motor deflection and mechanicaI drilling speed are a pair of contradictory combinations, which restrict each other. In order to obtain a higher deflection, the combination of downhole motor's bend angle, stabilizer and drill string must not be conducive to improv the mechanicaI drilling speed. Moreover, in directional drilling, drilling parameters such as drilling pressure and rotational speed need to be controlled to ensure that azimuth and curvature meet the design requirements, which limits the possibility of higher mechanicaI drilling speed. Therefore, deflection and mechanicaI drilling speed should be considered comprehensively in directional drilling, consider and optimize both is the best scheme.

In the process of drilling, with the increase of deviation angle, normally the mechanicaI drilling speed will decrease. If the decline is too large or other faults, please refer to this manual for fault analysis and suggestions for countermeasures.

It should be pointed out in particular that the recommended and maximum drilling pressures given in the downhole motor parameter table in this manual are given under design assumptions, it is not invariable. In the process of directional drilling, the drilling pressure which can maintain the working pressure loss of the power section corresponding to the torque determined by opposite torsion angle is the best and recommended drilling pressure."

7.3 Pump Pressure

During directional drilling, the pump pressure or riser pressure will increase with the increase of drilling depth. Normally, please refer to section 5.5 of this manual. If the increase rate is abnormal or even caused pump holding, please refer to 6. Failure analysis and suggestions on countermeasures of this manual.

7.4 Compound Drilling

Compound drilling refers to a type of drilling where the top drive or rotary table drives the string while the downhole motor drives the bit.

During compound drilling, downhole motor usually includes bent sub, bent housing and stabilizer. The hole size is usually larger

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	可能原因 Judgment method	判断方法 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压升高 Circulating Pump Pressure Increase	井下故障 Down-hole fault	钻井液原因：地层有害体的侵入，或在钻井液处理过程中导致的钻井液密度、切力的增加 Drilling Fluid Reasons: invasion of hazardous bodies of the formation or Increase of drilling fluid density and shear force caused during drilling fluid treatment	在处理钻井液的过程中泵压升高，可以计算出增加的泵压值，上提钻柱观察循环泵压，泵压会有所下降； In the process of treating drilling fluid, the pump pressure increases and the added pump pressure value can be calculated. Lifted up the drill string to observe the circulating pump pressure, the pump pressure will decrease.	上提钻柱，持续循环钻井液，等待泵压恢复正常值。 Rise drill string and continuously circulate the drilling fluid, waiting for pump pressure back to normal value.	
		钻头故障：钻头水眼堵塞 Bit failure: bit nozzle blockage	泵压是突然升高，有时泵压短时又恢复正常；上提钻柱泵压维持较高值；使用马达钻进时，速度基本不降低，马达工作压降正常； Pump pressure is suddenly increased, sometimes the pump pressure returns to normal in a short time; the pump pressure maintains a high value when lifting the drill string; when using power section to drill, the speed is basically not reduced, and the working pressure loss of the power section is normal;	持续循环钻井液泵压恢复正常可正常钻进，否则应起钻 Continuously circulate the drilling fluid, if pump pressure can be back to normal, then carry out normal drilling, otherwise, pull out and inspect.	
		钻头故障：牙轮钻头泥包钻头 Bit failure: Roller bit is wrapped in mud	牙轮钻头泥包或牙轮卡死后，增大钻压泵压升高的不多，有进尺但较慢，马达钻进或复合钻进机械钻速都很慢，泵压有变化但不明显。 After the cone is wrapped with mud or being stuck, the increase of the pump pressure is not much when drilling pressure is added. There is increase of drilling depth but very slow, power section drilling or compound drilling machine drilling speed is very slow, the pump pressure changes but not obvious.		

than the bit diameter due to the large offset of the bit and the possibility of revolution while the bit rotates. Compound drilling will result in greater lateral forces at downhole motor and other tools. Based on theoretical calculation, the ultimate stress of downhole motor during compound drilling is 4 times that during normal drilling. Therefore, it should be more stable to implement compound drilling. For assembly to obtain larger deflection, should try to reduce the top drive or rotary speed."
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. (Table.7)

7.5 Opposite torsion angle

While downhole motor outputs torque to the bit, it also produces opposite torque to the drill string, which is usually borne by the rotary table or top drive. The opposite torque will cause torsional deformation of the drill string, and the angle of torsional deformation at the bit is called opposite torsion angle.When drilling vertically or compound drilling, opposite torsion angle has no effect and need not be considered. But in directional drilling, the plane where the bending angle of bent sub, bent housing and other tools is located is the future direction of wellbore. In order to ensure that the borehole direction extends along the predetermined direction, it is necessary to ensure that the plane of the tool bent angle is consistent with the predetermined borehole direction. Before downhole drilling, the angle between the plane where the tool bends and the north direction is called the installation angle. If the installation angle is consistent with the predicted borehole direction, the plane of tool bending angle will not be consistent with the predicted borehole direction due to the existence of opposite torsion angle during downhole drilling operation, so that the drilled hole is not consistent with the borehole direction. Therefore, in actual drilling, the installation angle of the tool should be different from the predetermined borehole direction, and the difference is just opposite torsion angle of the drill string. In this way, when downhole motor outputs torque, the plane of tool bending angle is consistent with the predicted borehole direction, thus ensuring that the borehole direction extends along the predicted direction.

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	可能原因 Judgment method	判断方法 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压升高 Circulating Pump Pressure Increase	井下故障 Down-hole fault	螺杆钻具故障：螺杆钻具传动轴或者转子等卡死 Downhole motor failure: stuck of downhole motor drive shaft or rotor etc.	通过立管压力和MWD（如果在用）的电压值进行观测，泵压升高是突然的。传动轴或者转子卡死，泵压升高值恒定，提起钻柱后泵压不下降，复合钻进有进尺但不快，井下动力钻进没进尺。 By observing the riser pressure and MWD (if in use) voltage, the pump pressure rise is abrupt. When the drive shaft or rotor jammed, pump pressure rise value is constant, does not drop even after lifting the drill string, compound drilling has footage but not fast, and the downhole power drilling has footage.	起钻检查，更换螺杆钻具 pull out for inspection and replace downhole motor	
		螺杆钻具故障：钻压过大造成螺杆钻具制动 Downhole motor failure: excessive drill pressure causes downhole motor braking	泵压突然升高，上提钻柱，泵压下降到正常值，再加钻压钻进正常。 The pump pressure suddenly rises, lifted up the drill string , the pump pressure drops to the normal value, and the drilling is normal after adding the drilling pressure.	可正常钻进 carry out normal drilling,	
		螺杆钻具故障:螺杆钻具外壳断裂 Downhole motor failure: broken of downhole motor housing	泵压突然升高，上提可能形成憋泵，下放钻柱泵压下降较多，无进尺。 The pump pressure suddenly rises, the upward lifting may form a holding pump, when downward the drill string, the pump pressure drops a lot, but there is footage.	立即起钻检查，更换螺杆钻具 Immediately pull out for inspection and replace downhole motor	

The size of opposite torsion angle depends on the output torque of downhole motor and the torsion section modulus of drill string. The influencing factors are as follows:

· Drilling pressure and the working pressure loss of downhole motor

· Drill string and its assembly

· Borehole size and deviation angle

8.Purchase guide

The use effect of downhole motor products is closely related to its working conditions, medium conditions, drill assembly and other factors. Therefore, it is very important to select drill model and structure correctly when ordering. If you have any questions about the selection, please contact us in time.

In order to provide the downhole motor needed in time and correctly, please confirm the following when choosing the downhole motor:

1. Requirements for connection threads

(Provide standard threaded connections when not required)

☐No requirements;

☐Special requirements: _____

2. Bend Form

(Provide direct downhole motor if not required)

☐Bend sub, angle:_____degrees, installation position: ☐upper part of bypass valve ☐lower part of bypass valve

☐Single-bent housing, angle is:_____degree, bending point position is: ☐upper part of the housing, ☐lower part of the housing.

☐Reverse Double Bend (DTU): Angle: _____×_____

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	可能原因 Judgment method	判断方法 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压下降 Circulating Pump Pressure Decrease	地面设备 Ground equip-ment	地面管线 Ground Pipeline	管线渗漏或钻井泵的上水不好造成流量不足。 Leakage of pipeline or poor water supply of drilling pump will result in insufficient flow.	详细检查排除故障 Detailed inspection and troubleshooting	
	井下故障 Down-hole fault	地层原因： Formation cause:	地层水的侵入，造成钻井液密度的降低而使立管压力下降，在渗透性强或溶洞的地层也可能造成突然的泵压下降。 Invasion of formation water results in the decrease of drilling fluid density and riser pressure. Sudden drop of pump pressure may also occur in strata with strong permeability or karst cave.	持续循环钻井液泵压恢复正常可正常钻进，否则应起钻 Continuously circulate the drilling fluid, if pump pressure can be back to normal, then carry out normal drilling, otherwise, pull out and inspect.	
		钻井液原因：地层中的有害体的侵入或处理钻井液导致的钻井液密度、粘度的降低 Drill string failure: drill string leaks or broken resulting in a drop in pump pressure	泵压下降是逐渐的，密度、粘度值恢复后，泵压也会恢复到正常值 Pump pressure drop is gradual. After density and viscosity recover, pump pressure will return to normal value.		
		钻柱故障：钻柱刺漏或断落造成泵压下降	泵压是逐渐下降的，下降度速率逐渐增大，泵压下降到稳定值后，无进尺。 The pump pressure decreases gradually, and the rate of descent increases gradually. When the pump pressure drops to a stable value, there is no footage.	立即起钻检查，更换损坏的钻具 Immediately pull out for inspection and replace the broken drill	

☐Double-curved (bend sub + bent housing), bent sub angle is_____degrees, bent housing angle is_____degrees

☐Double-curved (double-curved housing) :_____×_____

☐Other forms _____

Ground adjustable bent housing

3. Stabilizer Form

(No stabilizer is provided without requirement)

☐Spiral stabilizer, number of pieces:_____

☐Straight strip symmetric stabilizer, number of strips:_____

☐Straight strip asymmetric stabilizer, number of strips: _____

☐Other forms: _____

Adjustable stabilizer

4. Whether the rotor hollow shunt is required

(Hollow rotor will not be provided when not required)

☐ Non-hollow shunt ☐ hollow shunt

5. Temperature stator

(Provide room temperature drilling tools when not required)

☐ Regular temperature (⩽120℃) ☐ High temperature (⩽150℃) ☐ Ultra-high temperature (⩽180℃)

6. Are there any additional structural requirements as follows?

(The following additional structures are not provided when not required)

☐Lifting nipple ☐Directional sub ☐Rotor Anti-dropping Device

7. If possible, the following information should be provided when ordering

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	可能原因 Judgment method	判断方法 Judgment method	解决办法 Solutions	备注 Remarks
加钻压泵压无变化 Pump pressure unchanged after increasing drill pressure	钻柱故障 Drill string failure	钻柱断落 Drill string breakdown	无进尺，钻具断落后，循环泵压固定，悬重降低，可通过计算得到降低的悬重和泵压。 Without footage, the drilling tool is broken and dropped, the circulating pump pressure is fixed, and the suspension weight is reduced. The suspension weight and pump pressure reduced can be calculated.	起钻检查更换损坏钻具 Pull out for inspection and replace downhole motor	
	螺杆钻具故障 Downhole motor failure	螺杆钻具转动部分断裂 Fracture of rotating part of downhole motor	循环泵压固定，悬重几乎不降低，上提钻柱或加大钻压泵压无变化，无进尺。 The circulating pump pressure is fixed, the suspension weight hardly decreases, lifted up the drill string or add the drilling pressure, the pump pressure is no change, and no footage either	起钻检查更换螺杆钻具 Pull out for inspection and replace downhole motor	
	钻头未能接触井底 The bit failed to touch the bottom of the well.	钻头保径齿损坏、脱落等造成井壁缩径或井斜变化率过大（狗腿过大），造成钻具稳定器与井壁摩擦，减小甚至完全承受了钻压 The damage and shedding of bit diameter guard teeth will lead to borehole wall shrinkage or excessive rate of deviation change (dog leg is too big), resulting in friction between drill tool stabilizer and borehole wall, which reduces or even fully withstands drilling pressure.	钻进中从加钻压泵压变化幅度减小到泵压变化不明显，逐步到完全无变化，机械钻速逐渐减慢，直到无进尺。 During drilling, when drilling weight is added, the pump pressure changes from small change range to no obvious change gradually to no change at all, and the mechanical drilling speed gradually slows down until there is no footage.	起钻检查更换钻头 Pull out for inspection and replace the bit	

Name of customers
Drilling position, purpose and estimated service time
Information about well structure, working section, drilling fluid conditions, etc
Downhole motor performance calculation method
Power section input power = drilling fluid flow * power section working pressure loss
$N_{入}=Q\times\Delta P$
Among them:$N_{入}$——power section input power (kW)
Q - Drilling Fluid Flow (L/s)
ΔP - power section work pressure loss (MPa)
Maximum input power of power section = drilling fluid flow * maximum working pressure loss of power section
$N_{入max}=Q\times\Delta P_{max}$
Among them:$N_{入}$max——maximum power section input power (kW)
Q - Drilling Fluid Flow (L/s)
ΔP_{max} - maximum working pressure loss of the power section (MPa)
Power section output power = power section torque × power section speed /9.549
$N_{出}=M\times n/9.549$
Among them:$N_{出}$——maximum power section input power (kW)
M -- power section torque (kn.m)
n -- power section speed (r/min)
$N_{出max}=M_{max}\times n/9.549$
Among them: $N_{出max}$ - maximum input power of power section (kW)
M_{max} - Maximum Torque of Power section (kN.m)
N-power section speed (r/min)

泵压现象 Pump Pressure Phenomenon	可能故障 Possible failure	可能原因 Judgment method	判断方法 Judgment method	解决办法 Solutions	备注 Remarks
循环泵压下降 Circulating Pump Pressure Decrease	井下故障 Down-hole fault	钻头喷嘴脱落	泵压下降是突然的，检查地面固定设备，可计算出下降值；若泵压下降不大则对钻进速度影响较小。	酌情处理 Deal with it according to the circumstance	
		螺杆钻具故障：螺杆钻具定转子间隙过大 Downhole motor fault: stator-rotor clearance on downhole motor is too large	通过立管压力和MWD（如果在用）的电压值观察，泵压下降是缓慢的；泵排量不变时下降的幅度不大，在2MPa左右，钻进速度逐渐减小，井下动力钻进时马达容易制动而无进尺。 Through the observation of riser pressure and MWD (if in use) voltage value, When the pump displacement is constant, the decrease range is not big, at about 2MPa, the drilling speed gradually decreases, the power section is easy to brake and no footage.	如果很快到达预定井深，可加大钻井液流量后继续钻进，无法加大流量时，应起钻更换螺杆钻具 If the expected well depth is reached soon, the flow rate of drilling fluid can be increased and the drilling can be continued. If the flow rate can not be increased, downhole motor should be pull out and replaced	
		螺杆钻具故障：转动部分断裂 Downhole motor fault: breakage of rotating part	泵压下降是突然的，上提钻柱或加大钻压泵压均无变化，无进尺 The drop of pump pressure is sudden. There is no change in pump pressure when the drill string is lifted up or when the drill pressure is increased. There is no footage.	起钻检查更换螺杆钻具 Pull out for inspection and replace downhole motor	
		螺杆钻具故障：旁通阀刺漏 Downhole motor fault: by-pass valve leak	泵压下降较快，下降值固定，难以通过计算作比较，钻进速度降低较多，也可能无进尺。 The pump pressure drops rapidly and the dropping value is fixed. It is difficult to compare by calculation. The drilling speed decreases a lot, and there may be no footage.	起钻检查更换螺杆钻具 Pull out for inspection and replace downhole motor	

7.定向钻进的影响因素提示

螺杆钻具频繁使用在定向钻进中，具有弯壳体、稳定器等特殊结构，因而使用时需要注意以下问题。

7.1造斜率

螺杆钻具可以有各种不同的结构形式，使用不同形式的钻具组合，加之地层结构和岩石可钻性的影响，难以确定螺杆钻具的造斜率。仅就螺杆钻具的结构，分析其对造斜率的影响：

1.弯点距钻头越近，造斜率越高，所以使用万向轴弯壳体比使用弯接头具有较高的造斜率，弯壳体弯角形式对造斜率影响也较大；

2.稳定器也是影响螺杆钻具造斜率的关键因素，稳定器的形式、尺寸和距钻头的距离，对造斜率均有影响；

3.弯角越大，造斜率越高；

4.螺杆钻具不同部位的角度之间及其与非对称稳定器的共面误差较大时，对造斜率影响很大，或者使井眼方位难以控制。

7.2机械钻速

螺杆钻具造斜率与机械钻速是一对矛盾的组合，相互牵制。拟获得较高的造斜率，其螺杆钻具的弯角、稳定器等与钻柱组合必定不利于提高机械钻速。而且，定向钻进中还需控制钻压、转速等钻井参数以保证方位角和曲率符合设计要求，更限制了其获得较高机械钻速的可能。所以，定向钻进中应综合考虑造斜率与机械钻速，兼顾而优化是最佳方案。

钻进过程中，随着井斜角的增加，正常情况机械钻速会下降。如果下降过大或其他故障，可参看本手册故障分析及应对措施的建议。

需要特别指出，本手册螺杆钻具参数表中给出的推荐钻压和最大钻压是在设计假定条件下给出的，而不是一成不变的。定向钻进过程中，能够维系反扭角确定的扭矩相对应的马达工作压降的钻压才是真正允许的最优钻压。

7.3泵压

定向钻进过程中，随着井深的增加泵压或立管压力会随之增大，正常请参见本手册5.5泵压一节。若增加的比例失常甚至出现憋泵，请参看本手册6.8故障分析及应对措施的建议。

7.4复合钻进

复合钻进是指顶驱或转盘驱动钻柱旋转的同时螺杆钻具驱动钻头旋转的钻进方式。

复合钻进中螺杆钻具通常带有弯接头、弯壳体及稳定器，钻头的偏移距较大，钻头在自转的同时，可能存在公转，所以井眼尺寸通常大于钻头直径。复合钻进会使螺杆钻具和其他井下钻具受到更大的侧向力。根据理论计算复合钻进时螺杆钻具的极限应力是常规正常钻进时的4倍。因此，实施复合钻进操作应更平稳。对于拟获得较大造斜率的钻具组合，应尽量减小顶驱或转盘的转速。

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。(表七)

弯外壳角度(0°-3°) Angle of Bend Housing(0°-3°)	转盘速度(rpm) SpeedofTurnplate(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

N R：为不推荐。

N R：Means not recommended。

注：弯外壳角度超过1.5°，禁止开动转盘导向钻进。

Note：If angle of bend housing exceeds 1.5°, turnplate is forbidden to steer drilling.

特别提示：实施追求进尺为目的的复合钻进时，应限制钻头的偏移距。在钻头的偏移距较大的钻具组合下实施复合钻进时，应尽量减小顶驱或转盘的转速。

Special note: the offset of the bit should be limited when implementing compound drilling for the purpose of pursuing footage. The rotation speed of top drive or rotary table should be reduced as far as possible when compound drilling is carried out under the combination of drilling tools with large bit offset.

7.5反扭角

螺杆钻具给钻头输出扭矩的同时，也会对钻柱产生反扭矩，这个反扭矩通常由转盘或顶驱承受。而反扭矩会使得钻柱产生扭转变形，钻头处扭转变形的角度称为反扭角。直井或复合钻进时，反扭角没有什么影响，不需考虑。但在定向钻进中，由于弯接头、弯壳体等工具的弯曲角所在的平面，是未来的井眼方向。为保证井眼方向沿着预定的方向延伸，就必须保证工具的弯曲角所在的平面与预定的井眼方向一致。螺杆钻具工作前，工具的弯曲角所在的平面与正北方向的夹角称为安装角。如果安装角与预计的井眼方向一致，螺杆钻具工作时，由于反扭角的存在，使得工具的弯曲角所在的平面与预定的井眼方向不一致，这样钻出的井眼就与井眼方向不一致。所以，实际钻进中，工具的安装角应与预定的井眼方向不一致，其差值正好是钻柱的反扭角。这样才能保证螺杆钻具输出扭矩时，工具的弯曲角所在的平面与预定的井眼方向一致，从而保证井眼方向沿着预定的方向延伸。

反扭角的大小取决于螺杆钻具的输出扭矩和钻柱的抗扭截面模量，其影响因素为：

·钻压及所产生的螺杆钻具工作压降

·钻柱及其钻具组合

·井眼尺寸及井斜角的大小

8.定货须知

螺杆钻具产品的使用效果与其使用工况、介质条件、钻具组合等因素密切相关。因此，定货时正确地选择钻具型号和结构形式甚为重要。如果选型时存有疑问，请及时与本公司联系。

为了能及时、正确地提供所需要的螺杆钻具，请您在选择螺杆钻具时确认以下事项：

1、连接螺纹的要求

（无要求时提供标准螺纹连接）

□无要求；

□特殊要求：_____

2、弯角形式

（无要求时，提供直螺杆钻具）

□弯接头，角度为：_____度_____分，安装位置为：□旁通阀上部，□旁通阀下部

□单弯壳体，角度为：_____度，弯点位置为：□弯壳体上部，□弯壳体下部

□反向双弯(DTU)：角度为：_____×_____

□同向双弯(弯接头+弯壳体)，弯接头角度为_____度，弯壳体角度为_____度

□同向双弯（双弯壳体）：_____×_____

□其他形式 _____

□地面可调弯壳体

3、稳定器形式

（无要求时不提供稳定器）

□螺旋稳定器，条数为：_____

□直条对称稳定器，条数为：_____

□直条非对称稳定器，条数为：_____

□其他形式：_____

□可换稳定器

4、是否要求转子中空分流

（无要求时，不提供中空转子）

□非中空分流　□ 中空分流

5、温度定子

（无要求时，提供常温钻具）

□常温（≤120°C）　□ 高温（≤150°C）　□ 超高温（≤180°C）

6、是否有以下附加结构要求

（无要求时不提供以下附加结构）

□提升短节　□ 定向接头　□ 转子防脱落装置

7、如果可能，定货时还应提供以下信息

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、使用井段、钻井液条件等有关信息

螺杆钻具性能计算方法

马达输入功率=钻井液流量×马达工作压降

$N_{入}=Q\times\Delta P$

其中：$N_{入}$——马达输入功率（kW）

Q——钻井液流量（L/s）

ΔP——马达工作压降（MPa）

马达最大输入功率=钻井液流量×马达最大工作压降

$N_{入max}=Q\times\Delta Pmax$

其中：$N_{入max}$——马达最大输入功率（kW）

Q——钻井液流量（L/s）

ΔP_{max}——马达最大工作压降（MPa）

马达输出功率=马达扭矩×马达转速/9.549

$N_{出}=M\times n/9.549$

其中：N出——马达最大输入功率（kW）

M——马达扭矩（kN.m）

n——马达转速（r/min）

$N_{出max}=M_{max}\times n/9.549$

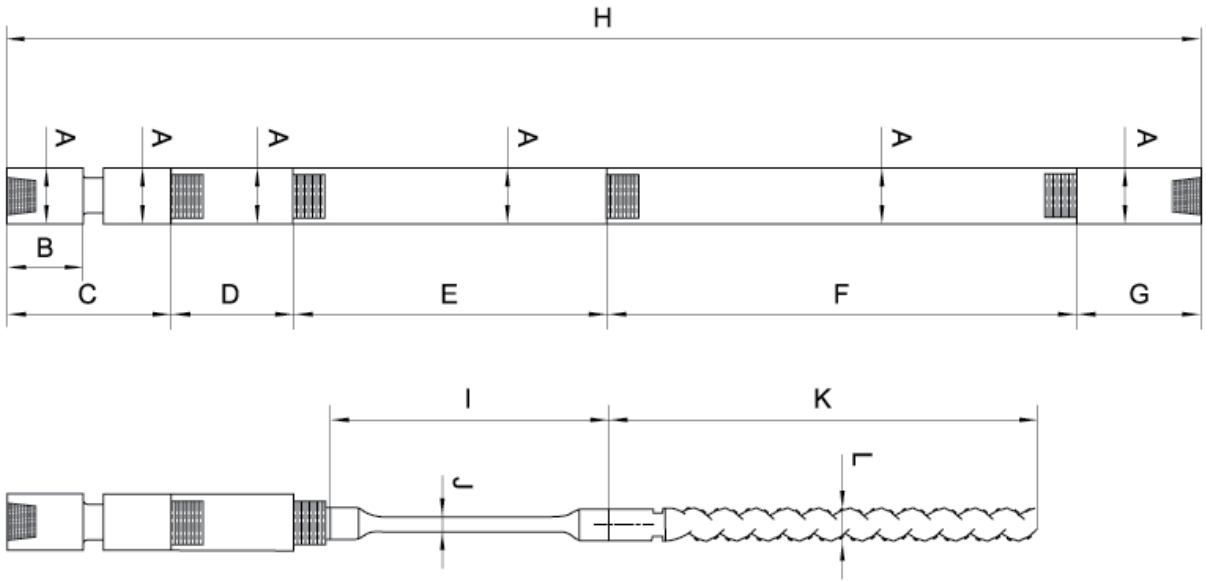
其中：$N_{出max}$——马达最大输入功率（kW）

M_{max}——马达最大扭矩（kN.m）

n——马达转速（r/min）

小规格螺杆钻具打捞尺寸图

The Fishing Size Drawing of small Size Downhole Motor



注:此打捞尺寸对应下页打捞尺寸表格

Note:Please refer to the last page to see the fishing, dimensions table about this fishing dimensions drawing

螺杆钻具允许承受最大拉力：(见表八)

(Table.8)Allowable Max Pull of Downhole Power section：

钻具规格 Size	作用在钻头上 Workingondrillingbit		作用在壳体上 Workingonhousing	
	KN	LBS	KN	LBS
LZ54	290	65170	420	94380
LZ73	290	65170	420	94380
LZ89	295	66300	640	143820
LZ95/LZ102	380	84900	870	195505
LZ120/LZ127	520	116850	1150	258425
LZ135	820	184270	1650	370755
LZ159/LZ165	1250	280900	1900	426965
LZ172/LZ178	1370	307860	1935	434830
LZ185	1370	307860	1935	434830
LZ197	1540	346070	2600	584270
LZ203	1585	356180	3220	723595
LZ216	2395	538200	3700	831460
LZ244/LZ286	2590	582020	4530	1017980

小规格螺杆钻具打捞尺寸表(表九)

(Table.9)The Fishing Size Table of Small Size Downhole Power section

钻具型号 Size / 尺寸型号 Code	5LZ54X3.5	5LZ57X3.5	5LZ60X3.5	5LZ73X3.5
A	ϕ54	ϕ57	ϕ60	ϕ73
B	77	77	77	128
C	196	196	196	297
D	241	241	241	241
E	855	855	855	590
F	1080	1080	1080	2080
G	150	150	150	190
H	NR	NR	NR	NR
I	968	968	968	566
J	ϕ38	ϕ38	ϕ38	ϕ45
K	980	980	980	2025
L	ϕ35	ϕ35	ϕ35	ϕ45

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表(表十)

(Table.10) The Fishing Size Table of Small Size Down hole Power section(Stright or Bend Housing)

钻具型号 Size / 尺寸代号 Code	9LZ89	5LZ95	5LZ102X7.0	7LZ102X7.0	5LZ120	5LZ127X7.0	7LZ127X7.0	5LZ135X7.0	7LZ135X7.0	5LZ159X7.0
A	A	ϕ96	ϕ102	ϕ102	ϕ121	ϕ127	ϕ127	Φ137	Φ137	ϕ160
B	B		ϕ112	ϕ112	ϕ145	ϕ146	ϕ146	Φ160	Φ160	ϕ210
C	C	153.5	154	154	192	209	209	205	205	256
D	D				329	520	520	515	515	518
E	E	620	620	620	871	787	787	747	747	1082
F	F	1331	1331	1331	1714	1639	1639	1620	1620	2348
G	G	2380	2280	2850	2785	3700	3700	4510	4510	3600
H	H		229	229	225	252	252	300	300	370
I	I		186	186	97	27	27	75	75	290
J	J	3919	4027	4597	5039	5848	5848	6765	6765	6650
K	K	ϕ66	ϕ70	ϕ70	ϕ96	ϕ95	ϕ95	Φ102	Φ102	ϕ114
L	L		155	155	294	398	398	261	261	298
M	M	818	842	842	1068	1015	1015	936	936	1355
N	N	671	685	685	800	757	757	799	799	933
O	O	2034	2034	2604	2571	3482	3482	4325	4325	3425
P	P	ϕ60	ϕ66	ϕ69	ϕ71	ϕ80	ϕ80	Φ84	Φ84	ϕ94
Q	Q	ϕ64	ϕ60	ϕ60	ϕ70	ϕ90	ϕ90	Φ97	Φ97	ϕ108
R	R	ϕ64	ϕ38	ϕ38	ϕ84	ϕ48	ϕ75	Φ48	Φ48	ϕ98
S	S	ϕ64	ϕ72	ϕ72	ϕ88	ϕ92	ϕ92	Φ97	Φ97	ϕ110
T	T	791	796	796	923	980	980	980	980	1366
U	U	208	208	208	315	310	310	335	335	310
V	V	ϕ65	ϕ69	ϕ69	ϕ85	ϕ91.5	ϕ91.5	Φ123	Φ123	ϕ110
W	W	ϕ80	ϕ88	ϕ88	ϕ103	ϕ116	ϕ116	Φ101	Φ101	ϕ140
X	X	ϕ76	ϕ81	ϕ81	ϕ99	ϕ105	ϕ105	Φ118	Φ118	ϕ126

注

1、图中所示钻具为新型(V型)结构，万向轴为花瓣型。

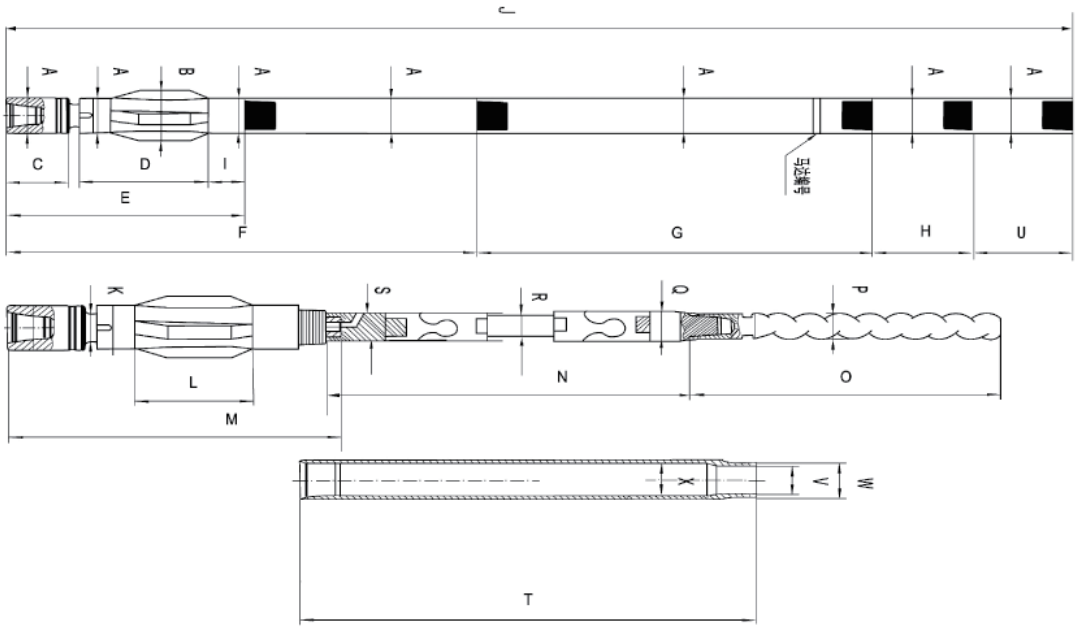
2、表中提供的尺寸仅供参考，如需要具体尺寸请与公司联系。

1.Downhole power sections 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 detai led and specific dimension, 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 Down hole Power section(Stright or Bend Housing)

钻具型号 Size / 尺寸代号 Code	7LZ159X7.0	5LZ165V	5LZ165·5V	5LZ172X7.0VII	5LZ172·5X7.0VII	7LZ172·5X7.0VII	7LZ172·5X7.0VII	5LZ172VII	5LZ172·5VII	7LZ172VII
A	ϕ160	ϕ165	ϕ165	ϕ176	ϕ176	ϕ176	ϕ176	ϕ175	ϕ175	ϕ175
B	ϕ210	ϕ213	ϕ213	ϕ212	ϕ212	ϕ212	ϕ212	ϕ213	ϕ213	ϕ213
C	256	256	256	277	277	277	277	234	251.5	251.5
D	518	518	518	555	555	555	555	546	560	560
E	1082	1082	1082	1104	1104	1104	1104	1105	1134	1134
F	2348	2348	2348	2324	2324	2324	2324	2351	2380	2380
G	3600	4360	4700	4210	5000	5000	5600	4360	5000	5000
H	370	370	370	365	365	365	365	370	370	370
I	290	290	290	251	251	251	251	290	276	276
J	6650	7408	7748	7209	7999	7999	7999	7391	8080	8080
K	ϕ114	ϕ118	ϕ118	ϕ129	ϕ129	ϕ129	ϕ129	ϕ129	ϕ129	ϕ129
L	298	298	298	339	339	339	339	318	393	393
M	1355	1355	1355	1380	1380	1380	1380	1415	1439	1439
N	933	933	933	1042	1042	1042	1042	1042	1042	1042
O	3425	4185	4525	4010	4800	4800	5400	4128	4800	4800
P	ϕ96	ϕ98	ϕ98	ϕ104	ϕ107.5	ϕ114	ϕ114	ϕ102.6	ϕ106	ϕ114
Q	ϕ108	ϕ110	ϕ110	ϕ120	ϕ120	ϕ120	ϕ120	ϕ120	ϕ120	ϕ120
R	ϕ98	ϕ97	ϕ97	ϕ98	ϕ98	ϕ98	ϕ98	ϕ98	ϕ98	ϕ98
S	ϕ110	ϕ110	ϕ110	ϕ120	ϕ120	ϕ120	ϕ120	ϕ120	ϕ120	ϕ120
T	1366	1366	1366	1361	1361	1361	1361	1371	1371	1371
U	310	310	310	310	310	310	310	310	310	310
V	ϕ110	ϕ115	ϕ115	ϕ121	ϕ121	ϕ121	ϕ121	ϕ121	ϕ121	ϕ121
W	ϕ140	ϕ147.6	ϕ147.6	ϕ156.4	ϕ156.4	ϕ156.4	ϕ156.4	ϕ153.8	ϕ153.8	ϕ153.8
X	ϕ126	ϕ130	ϕ130	ϕ142	ϕ142	ϕ142	ϕ142	ϕ142	ϕ142	ϕ142

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。

1.Downhole power sections 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 detai led and specific dimension, please contact us.

常规螺杆钻具打捞尺寸表

The Fishing Size Table of Small Size Down hole Power section(Stright or Bend Housing)

钻具型号 Size / 尺寸代号 Code	7LZ172·5VII	5LZ178X7.0	5LZ178·5X7.0	7LZ178·5X7.0	7LZ178·5X7.0	4LZ178·7X7.0	5LZ185X7.0II	5LZ197X7.0II	7LZ197X7.0II	5LZ197·5II
A	ф175	ф180	ф180	ф180	ф180	ф180	ф185	ф197	ф197	ф197
B	ф213	ф212	ф212	ф212	ф212	ф212	ф238	ф238	ф238	ф238
C	234	277	277	277	277	277	288	292.5	326	292.5
D	546	577	577	577	577	577	619	582	582	582
E	1105	1098	1098	1098	1098	1098	1222	1253	1253	1253
F	2351	2344	2344	2344	2344	2344	2455	2526	2516	2326
G	5600	4210	5000	5000	5600	5800	5000	5000	5600	5600
H	370	365	365	365	365	365	352	355	355	355
l	290	223	223	223	223	223	358	326	326	326
J	8631	7229	8019	8019	8619	8819	8120	7998	8782	8598
K	ф129	ф130	ф130	ф130	ф130	ф130	ф142	ф148	ф148	ф148
L	318	417	417	417	417	417	298	377	362	377
M	1415	1403	1403	1403	1403	1403	1536	1590	1591	1590
N	1042	1042	1042	1042	1042	1042	1037	1073	1073	1073
O	5368	4010	4800	4800	5400	5600	4720	4765	5465	5365
P	ф108	ф104	ф107.5	ф114	ф114	ф106	ф116	ф125	ф134	ф125
Q	ф120	ф120	ф120	ф120	ф120	ф120	ф108	ф140	ф140	ф140
R	~98	ф98	ф98	ф98	ф98	ф98	ф110	ф128	ф128	ф128
S	ф120	ф120	ф120	ф120	ф120	ф120	ф130	ф142	ф142	ф142
T	1371	1394	1394	1394	1394	1394	1359	1388	1426	1388
U	310	310	310	310	310	310	313	320	311	320
V	ф121	ф122	ф122	ф122	ф122	ф122	ф130	ф146	ф146	ф146
W	ф153.8	ф157.5	ф157.5	ф157.5	ф157.5	ф157.5	ф157.6	ф181.2	ф180	ф181.2
X	ф142	ф142	ф142	ф142	ф142	ф142	ф152	ф160	ф165	ф160

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。

1.Downhole power sections 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 detai led and specific dimension, please contact us.

常规螺杆钻具打捞尺寸表

The Fishing Size Table of Small Size Down hole Power section(Stright or Bend Housing)

钻具型号 Size / 尺寸代号 Code	5LZ203 II	7LZ203X7.0 II	5LZ203·5 II	5LZ216 II	5LZ216·5 II	3LZ244X7.0 II	7LZ244X7.0 II	5LZ244·5 II	3LZ286X7.0	5LZ286X7.0
A	ϕ203	ϕ203	ϕ203	ϕ216	ϕ216	ϕ245	ϕ245	ϕ245	ϕ287	ϕ287
B	ϕ238	ϕ238	ϕ238	ϕ308	ϕ308	ϕ308	ϕ308	ϕ308	ϕ402	ϕ402
C	292.5	326	292.5	291	291	281	281	281	351	351
D	582	582	582	678	678	788	788	788	785	785
E	1253	1253	1253	1253	1253	1344	1344	1344	1452	1452
F	2326	2516	2526	2532	2532	2829	2829	2829	3212	3212
G	5000	5600	5600	4500	5300	5600	5600	5600	5600	5600
H	355	355	355	355	355	446	446	446	500	500
I	326	326	326	231	231	215	215	215	289	289
J	7998	8782	8898	7746	8546	9235	9235	9235	9312	9312
K	ϕ148	ϕ148	ϕ148	ϕ146	ϕ146	ϕ185	ϕ185	ϕ185	217	217
L	377	362	377	509	509	465	465	465	425	425
M	1590	1591	1590	1579	1579	1668	1668	1668	1800	1800
N	1073	1073	1073	1000	1000	1238	1238	1238	1500	1500
O	4765	5465	5365	4389	5189	5426	5426	5426	5400	5400
P	ϕ125	ϕ134	ϕ125	ϕ131	ϕ140	ϕ157	ϕ162	ϕ150	ϕ180	ϕ180
Q	ϕ140	ϕ140	ϕ140	ϕ148	ϕ148	ϕ145	ϕ145	ϕ145	ϕ200	ϕ200
R	ϕ128	ϕ128	ϕ128	ϕ138	ϕ138	ϕ140	ϕ140	ϕ140	ϕ166	ϕ166
S	ϕ142	ϕ142	ϕ142	ϕ148	ϕ148	ϕ175	ϕ175	ϕ175	ϕ200	ϕ200
T	1388	1426	1388	1406	1406	1621	1621	1621	1934	1934
U	320	311	320	360	360	360	360	360	无	无
V	ϕ146	ϕ146	ϕ146	ϕ160	ϕ160	ϕ177	ϕ177	ϕ177	ϕ205	ϕ205
W	ϕ175	ϕ180	ϕ175	ϕ186	ϕ186	ϕ211	ϕ211	ϕ210.9	ϕ262	ϕ262
X	ϕ160	ϕ165	ϕ160	ϕ180	ϕ180	ϕ205	ϕ205	ϕ205	ϕ234	ϕ234

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。

1.Downhole power sections 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 detai led and specific dimension, please contact us.

螺杆钻具技术参数表（表十一）Technical Parameters of Downhole Power section（Table.11）

规格型号 CodeofPower section		单位 Unit	5LZ57×7.0	5LZ73×7.0	5LZ89×7.0	9LZ89×7.0	5LZ95×7.0	7LZ95×7.0	5LZ120×7.0	7LZ120×7.0	5LZ127·5×7.0	7LZ127·5×7.0	5LZ135×7.0	7LZ135×7.0	5LZ165×7.0V
适用井眼尺寸 Recommended HoleSize		mm	83～121	83～121	105～143	105～143	114～150	114～150	152～200	152～200	152～200	152～200	159～200	159～203	215～244
		in	$3_{1/4}$～$4_{3/4}$	$3_{1/4}$～$4_{3/4}$	$4_{1/8}$～$5_{5/8}$	$4_{1/8}$～$5_{5/8}$	$4_{1/8}$～$5_{7/8}$	$4_{1/8}$～$5_{7/8}$	6～$7_{7/8}$	6～$7_{7/8}$	6～$7_{7/8}$	6～$7_{7/8}$	$6_{1/4}$~8	$6_{1/4}$~8	$8_{1/8}$～$9_{5/8}$
输入流量 InputFlowRate		L/S	2	3	5	5	10	10	15	15	15	15	20	20	30
马达压降 Power sectionPressureLoss		Mpa	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	4.0	4.0	3.2	3.2	3.2
钻头转速 SpeedoftheBit		r/min	246	198	250	245	205	190	160	160	150	191	201	198	198
工作扭矩 WorkingTorque		N·m	200	324	465	504	1195	1234	1192	2208	2242	2291	2610	3248	3248
最大扭矩 Maximum Torque		N·m	300	486	698	756	1791	1791	1788	3313	3363	3313	4567	4872	4872
输出功率 OutputPower		KW	5.4	7	12.8	13.6	27	25	20.8	38.8	37	48	64	70.7	70.7
推荐钻压 RecommendedDrillingWeight		KN	5	10	16	16	25	25	30	38	40	46	40	40	60
最大钻压 MaximumDrilngWeight		KN	10	15	30	30	40	40	60	70	80	90	80	80	120
螺纹连接 Thread Connection	上 Top		$1_{1/2}$REG	$2_{3/8}$REG	$2_{7/8}$REG	$2_{7/8}$REG	$2_{7/8}$REG	$2_{7/8}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$4_{1/2}$REG
	下 Bottom		$1_{1/2}$REG	$2_{3/8}$REG	$2_{7/8}$REG	$2_{7/8}$REG	$2_{7/8}$REG	$2_{7/8}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$3_{1/2}$REG	$4_{1/2}$REG
钻具长度 TheDrillLength		mm	2822	3423	2911	2911	3920	3920	5039	5039	5848	5848	6765	6765	6948

螺杆钻具技术参数表Technical Parameters of Downhole Power section

规格型号 CodeofPower section	单位 Unit	5LZ165·5×7.0V	3LZ172×7.0	4LZ172×7.0	5LZ172×7.0VII	7LZ172×7.0VII	5LZ172·5×7.0VII	5LZ178×7.0	7LZ178·5×7.0	5LZ185×7.0	7LZ185·5×7.0	5LZ197×7.0	5LZ197·5×7.0
适用井眼尺寸 Recommended HoleSize	mm	215～244	215～244	215～244	215～244	215～244	215～244	215～244	213～251	215～244	215～244	244～311	244～311
	in	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$8_{1/8}$～$9_{5/8}$	$9_{1/8}$～$12_{5/8}$	$9_{5/8}$～$12_{1/4}$
输入流量 InputFlowRate	L/S	30	30	30	35	35	35	35	35	35	35	40	40
马达压降 Power sectionPressureLoss	Mpa	4.0	4.0	4.0	3.2	4.0	4.0	4.0	4.0	4.0	4.0	3.2	4.0
钻头转速 SpeedoftheBit	r/min	185	289	229	180	141	187	187	141	184	173	133	133
工作扭矩 WorkingTorque	N·m	4341	2225	3245	4245	7308	5017	5017	7308	5060	5939	6447	8059
最大扭矩 Maximum Torque	N·m	6512	3337	4867	6368	10963	7526	7526	10963	7590	8908	9674	12089
输出功率 OutputPower	KW	88.5	70.7	80	84	113	103.5	103.5	113	103	113	95	118
推荐钻压 RecommendedDrillingWeight	KN	70	70	70	70	100	80	80	100	90	120	100	120
最大钻压 MaximumDrilngWeight	KN	140	140	140	140	160	160	160	200	180	240	200	240
螺纹连接 Thread Connection 上 Top		$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$5_{1/2}$REG	$5_{1/2}$REG
螺纹连接 Thread Connection 下 Bottom		$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$4_{1/2}$REG	$6_{5/8}$REG	$6_{5/8}$REG
钻具长度 TheDrillLength	mm	7748	7265	6955	7265	7265	8055	7229	8019	8120	8090	8202	8802

螺杆钻具技术参数表Technical Parameters of Downhole Power section

规格型号 CodeofPower section	单位 Unit	6LZ197×7.0	7LZ197×7.0	5LZ203·5×7.0	6LZ203×7.0	7LZ203·5×7.0	5LZ216·5×7.0	7LZ216×7.0	3LZ244×7.0	5LZ244·5×7.0	7LZ244×7.0	3LZ286×7.0	5LZ286×7.0
适用井眼尺寸 Recommended HoleSize	mm	244～311	244～311	244～311	244～311	244～311	273～323	273～323	311～445	311～445	311～445	375～660	375～660
	in	$9_{5/8}$～$12_{1/4}$	$9_{5/8}$～$12_{1/4}$	$9_{5/8}$～$12_{1/4}$	$9_{5/8}$～$12_{1/4}$	$9_{5/8}$～$12_{1/4}$	$10_{3/4}$～$12_{3/4}$	$10_{3/4}$～$12_{3/4}$	$12_{1/2}$～$17_{1/2}$	$12_{1/2}$～$17_{1/2}$	$12_{1/2}$～$17_{1/2}$	$14_{3/4}$～26	$14_{3/4}$～26
输入流量 InputFlowRate	L/S	40	45	40	40	45	45	45	60	60	60	80	90
马达压降 Power sectionPressureLoss	Mpa	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.2	3.2
钻头转速 SpeedoftheBit	r/min	133	139	133	133	139	145	120	120	133	118	165	138
工作扭矩 WorkingTorque	N·m	8462	9499	8059	8462	9499	8234	8895	11360	12092	14972	11840	13895
最大扭矩 Maximum Torque	N·m	12693	14250	12089	12693	14250	12347	15567	17040	18138	22459	17760	20842
输出功率 OutputPower	KW	124	145	118	124	145	132	138	150	177	194	215	210.5
推荐钻压 RecommendedDrillingWeight	KN	130	140	120	130	140	140	190	160	160	190	170	170
最大钻压 MaximumDrilngWeight	KN	240	240	240	240	240	260	300	300	300	320	320	340
螺纹连接 Thread Connection 上 Top		$5_{1/2}$REG	$5_{1/2}$REG	$5_{1/2}$REG	$5_{1/2}$REG	$5_{1/2}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$7_{5/8}$REG	$7_{5/8}$REG
螺纹连接 Thread Connection 下 Bottom		$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$6_{5/8}$REG	$7_{5/8}$REG	$7_{5/8}$REG
钻具长度 TheDrillLength	mm	8802	8802	8802	8802	8802	8569	7769	9235	9245	9245	9312	9312

注：此说明书最终解释权归潍坊盛德石油机械制造有限公司所有，如有变动以实物为准。

免责声明

本手册内容系潍坊盛德石油机械制造有限公司知识产权，版权归潍坊盛德石油机械制造有限公司所有。我们本着对用户负责的态度，精心地编写该手册，但不保证本手册的内容完全准确无误。潍坊盛德石油机械制造有限公司有权在不知会用户的前提下对产品不断地进行改良、升级及对手册内容进行修正，实际状况请以产品实物为准。本手册为纯技术文档，无任何暗示及影射第三方之内容，且不承担排版错误等导致的用户理解歧义。最终解释权归潍坊盛德石油机械制造有限公司所有。

科技求盛　创新争优　品质精良

诚信为德

潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO., LTD.
公司地址/Add：山东省潍坊市奎文区机场路2088号
No.2088,Airport Rd.,Kuiwen District,Weifang,Shandong Province
公司邮编/Zip：261041
销售电话/Tel：0536-8820186
公司传真/Fax：0536-8820688
售后服务/Tel：0536-8820189
http：//www.sdshengde.com
//www.sindpec.com

盛德石油机械

盛德 · LZ · 螺杆钻具

本企业已通过 ISO9001：2015 认证
Our company has received the ISO9001:2015 certification

合 格 证

Certificate of Quality

潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO., LTD.

出厂测试结果
Shop Test Result

测试项目 Test Item		单位 Unit	测试结果 Test Result
马达性能测试 Power section Perfor-mance test	输入流量 Input Flow Rate	L/S	–
	工作压差 Operting Differential Pressure	MPa	–
	输出转速 Output Speed	r/min	–
	输出扭矩 Output TorqUe	KN.m	–
	输出功率 Output Power	KW	–
旁通阀测试 Bypass-Valve Test		开启 turn on / 关闭 Turn off	
工作温度 Working Temperature		℃	≤
理论效率 The017etiCa1EffiCiencY		%	≥

试验员：TestClerk

检验员：Checker

合 格 证
Certificate of Quality

产品名称 Product Name	螺杆钻具 Helicoid Hydraulic Power section
产品型号 Part Number	
出厂编号 Factory Numbef	
出厂日期 Release Date	

本产品按SY/T5383—2010标准 执行，经检验合格准予出厂。

Carried Standard by SY/T5383—2010, grant leave the factory after verified check out .

质检专章
Quality Control Dedicated Chapter
潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO., LTD.

科技求盛　创新争优　品质精良　诚信为德

潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO., LTD.
公司地址/Add：山东省潍坊市奎文区机场路2088号
No.2088,Airport Rd.,Kuiwen District,Weifang,Shandong Province
公司邮编/Zip：261041
销售电话/Tel：0536-8820186
公司传真/Fax：0536-8820688
售后服务/Tel：0536-8820189
http：//www.sdshengde.com
//www.sindpec.com

盛德石油机械

盛德 · LZ · 螺杆钻具

本企业已通过 ISO9001：2015 认证
Our company has received the ISO9001:2015 certification

合 格 证

Certificate of Quality

潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO., LTD.

出厂测试结果
Shop Test Result

测试项目 Test Item		单位 Unit	测试结果 Test Result
马达性能测试 Power section Perfor-mance test	输入流量 Input Flow Rate	L/S	–
	工作压差 Operting Differential Pressure	MPa	–
	输出转速 Output Speed	r/min	–
	输出扭矩 Output TorqUe	KN.m	–
	输出功率 Output Power	KW	–
旁通阀测试 Bypass-Valve Test		开启 turn on / 关闭 Turn off	
工作温度 Working Temperature		℃	≤
理论效率 The017etiCa1EffiCiencY		%	≥

试验员：TestClerk

检验员：Checker

合 格 证
Certificate of Quality

产品名称 Product Name	螺杆钻具 Helicoid Hydraulic Power section
产品型号 Part Number	
出厂编号 Factory Numbef	
出厂日期 Release Date	

本产品按SY/T5383—2010标准 执行，经检验合格准予出厂。

Carried Standard by SY/T5383—2010, grant leave the factory after verified check out .

质检专章
Quality Control Dedicated Chapter
潍坊盛德石油机械制造有限公司
WEIFANG SHENGDE PETROLEUM MACHINERY MANUFACTURING CO., LTD.