青岛创梦仪器有限公司

Qingdao ChuangMeng Instrument Co., Ltd.

旋 转 粘 度 计

Rotational Viscometer

型号 Model: 1101

使用手册

Instruction Manual

版本 1.0

Version 1.0

请你仔细阅读《使用手册》，正确掌握本产品的安装和使用方法。阅读后请将本《使用手册》妥善保管，以备今后进行检修和维护时使用。

Carefully read this User Manual to learn how to install and use the product correctly. After reading, properly keep the User Manual as a reference for future maintenance and repair.

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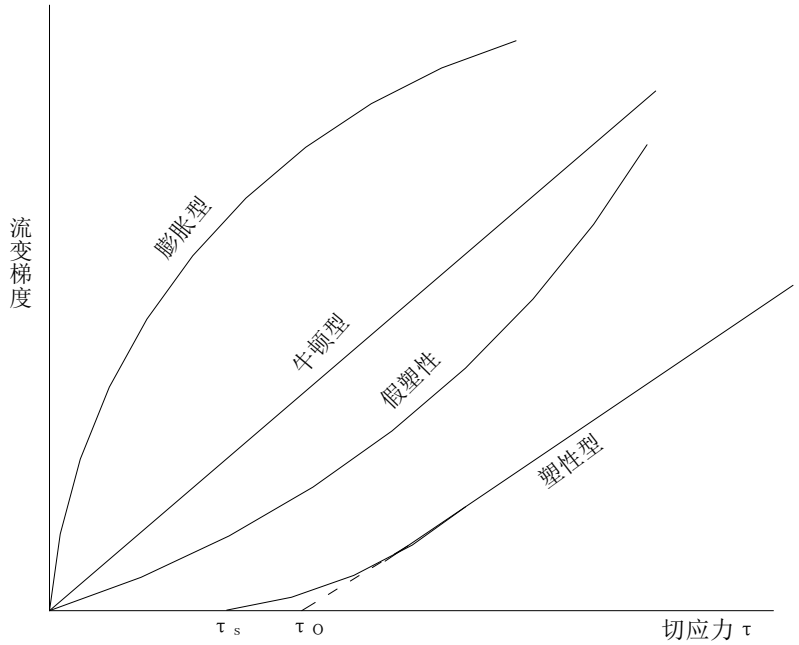
Ⅰ.概述

旋转粘度计可进行各流变参数的测量，是按照美国石油协会（API）规范制造，根据多点测量数值绘制流变曲线，确定液体在流动过程中的流型，选用合适的计算公式，对非牛顿流体进行较精确的测量，用于现场钻井液流变参数的研究分析，同时，可进行动、静切力、流性指数和稠度系数等一系列技术参数的测定。有利于安全、快速、科学钻井的需要。具有操作方便，测试准确的特点。

Rotaty viscometer can be used for the measurement of rheological parameters. It is made in accordance with the American Petroleum Institute (API) specification. Draw the rheological curve according to the multi-point measuring value, determining the flow pattern of liquid in the course of flow, choosing the appropriate formula and accurately measuring the non - Newtonian fluids, which are used for the study of Rheological parameters of field drilling fluid and also can be used as the determination of a series of technical parameters such as action, static shear, flow index and consistency coefficient. It is good for a safety, fast and scientific drilling. Also, it can operate easily and test accurately.

（图一）四种流型示意图

Figure Ⅰ Schematic diagram of four types of flow patterns



流变梯度 Rheological gradient
膨胀型 Expansion type
牛顿型 Newtonian
假塑性 Pseudoplastic
塑性型 Plastic type
切应力 Shearing stress

1101 型旋转粘度计，是青岛创梦仪器有限公司生产的粘度测量仪器，由标准的电源适配器供电，可适用 100~240V 50Hz/60Hz 的电源驱动，模拟井下钻井液的恒定温度进行流变参数的测量，也可以对其他流体进行加热恒温。可控制样品的温度（室温~93℃）。

这是一款典型的将测试液包含在外套筒和浮子之间形成的环形空间(剪切间隙)里的同轴圆筒旋转粘度计。

粘度测量时，当外套筒以一个设定的速度旋转时，流体会产生一个粘性阻力，由此测出流体的粘度。外套筒通过液体对浮子产生一个扭矩，此扭矩作用于一个精密弹簧，其挠度可以测量，然后将测量结果与测试条件和仪器常量进行比较。此系统可模拟工业加工过程中所遇到的真实流程。

给定一个剪切速率之后同轴圆筒旋转粘度计就可以进行粘度测量。这是一种线性函数关系，例如：剪切应力与剪切速率的关系图像为一条直线。很多情况下，可能许多流体并不遵循牛顿定律，但其流变学比较接近牛顿定律，因此粘度计仍然可以使用，而且粘度也可以较准确的测量。应当注意的是，推荐的 1101 型粘度计的校准是一种线性的，牛顿模式的校准。这意味着，如果液体样品不符合牛顿线性计算方法，此时粘度计不再适用。在这种情况下，粘度测量以及速度计算应当使用另一种非线性计算方法，这种方法适用于此类流体的特点。

当标准的外套筒、浮子、和扭力弹簧以 300 转/分钟运转时，粘度计的测量单位为厘泊(或毫帕斯卡/秒)。在其他转速情况下，所读数据需进行一系列简单的乘法转换。第六部分会给出塑料流体（例如钻井液）的粘度计算方法。

如果选择不同的转速或者使用不同的扭簧-浮子组合，剪切速率的范围可能会发生改变。为了拓宽剪切应力的范围从而测量各种各样的液体，我们设计了不同系列的扭力弹簧，并且这些弹簧可以很容易的相互转换。

The rotational viscometer, produced by Qingdao Chuangmeng Instrument Co., ltd., and powered by a standard power adapter, is applicable to 100~240V, 50Hz/60Hz power driver. And the constant temperature of the simulated drilling fluid is simulated to measure the rheological parameters. Other fluids can also be heated at constant temperature. The temperature of the sample can be controlled (room temperature ~93 ℃).

This is a typical coaxial cylinder rotating viscometer containing the test fluid in the annular space (shear clearance) formed between the outer cylinder and the float.

In viscosity measurements, the fluid produces a viscous resistance when the outer cylinder rotates at a prescribed speed. The viscosity of the fluid is thus measured. The outer sleeve passes a liquid to produce a torque to the floater, which acts on a precision spring, whose deflection can be measured, and then compares the measurements with test conditions and instrument constants. This system can simulate the real process encountered in the process of industrial processing.

A coaxial cylinder rotational viscometer can be used for viscosity measurements after given a shear rate. This is a linear function relationship. For example, the relation between shear stress and shear rate is a straight line. Many fluids may do not follow Newton's law in many cases, but its rheology is close to Newton's law. Therefore, the viscometer can still be used. And the viscosity can be measured more accurately. It should be noted that the calibration of the recommended type 1101 viscometer is a linear, Newton mode calibration which means that if the liquid sample does not conform to the Newton linear calculation method, the viscometer will no longer be applicable. Under this circumstance, another nonlinear calculation method should be used for viscosity measurement and velocity calculation, which is applicable to the characteristics of such fluids.

The unit of measurement is CPS (or Pascal / s) when the standard outer sleeve, float, and torsion spring are operated at 300 revolutions per minute. At other speeds, the data requires a series of simple multiplication transformations. Part six will give a method of calculating the viscosity of a plastic fluid (such as a drilling fluid).

The range of shear rates may change, if choose a different speed or use a combination of different torsion springs and floats. In order to broaden the range of shear stress to measure a wide variety of liquids, we designed different series of torsion springs and these springs can be easily converted to one another.

Ⅱ.安全原则 Safety principle

A. 安全操作 Safe operating

实验室技术员必须熟悉仪器的操作程序，并且了解有潜在危险的仪器设备。此仪器可用 100 伏至 240 伏的电源供电。保持双手、衣服和其他物品远离仪器的旋转部分。

可选用加热器通过电进行加热。确保电源以及其他线路与浆杯良好接触，并且将其接地。

在进行清洗、维修之前一定要关闭粘度计，切断电源。严禁将粘度计弄湿。如果样品溢出，请用湿布擦拭干净。切勿将水倒进机座，因为水会损坏电器元件。

The laboratory technician must be familiar with the operating procedures of the instrument and understand the potentially dangerous instruments and equipment. This instrument can be powered from 100 volts to 240 volts. Keep hands, clothes, and other objects away from the rotating parts of the instrument. Heaters can be selected to heat. Ensure that power and other lines are in good contact with the slurry cup and connect it to the ground. Close the viscometer and cut off the power supply before cleaning and maintenance. Do not make the viscometer wet. Wipe it clean with a damp cloth if the sample overflows. Never pour water into the machine because the water will damage the electrical components.

B. 浮子标准 Float standard

配有 1101 型粘度计的标准 B1 浮子，不可测试高于 93 摄氏度的样品。

Equipped with standard B1 float of viscometer 1101, samples above 93 degrees Celsius can not be tested.

C. 可选加热器的安全操作 Safe operation of optional heater

在使用可选加热器测量加热样品时，应当采取适当措施来避免样品飞溅出来时造成烫伤，严禁用手触摸加热器。

加热器的温度不可超过 93 摄氏度。

When using optional heaters to measure heating samples, proper measures should be taken to avoid scalding when the sample splashes out. Never touch the heater.

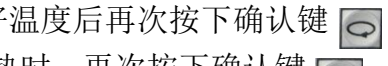
The temperature of the heater should not exceed 93 degrees celsius.

Ⅲ.粘度测试 Viscosity test

浆杯在 350ml 处有一个刻度线，将刚搅拌好的测试液体加至液位线处。外套筒上的液位线能够清晰的显示合适的浸入深度。从图（一）可以看出，如果浸入深度超过此刻度线，可能会损坏浮子的轴承。如果使用其他样品容器，外套筒底部与容器底部的距离应当不小于 1.27 厘米。

警告：标准的 BI 浮子是中空的，不可测试高于 93 摄氏度的样品。

1101 型粘度计有六种不同的速度进行测试，速度范围是 3 转/分钟到 600 转/分钟，旋转速度由控制面板决定。使用时，先接通电源，再选择所需的速度按键，从刻度盘上读取不同的剪切
应力值。

当接加热器时，先按下右下角的确认键  ，再按上下选择键  ，选择想要的温度（工作温度为室温~93℃）。设置好温度后再次按下确认键  ，按键上方的红灯亮时，则开始加热。想要停止加热时，再次按下确认键  ，红色指示灯灭。

The cup has a graduated line at the 350ml. And add the newly stirred test fluid to the level line. The level line on the outer sleeve can clearly show the proper immersion depth. It can be seen from the graph I, the bearings of the float may be damaged if the immersion depth exceeds the current line of degree. If other sample

containers are used, the distance between the bottom of the outer sleeve and the bottom of the vessel shall be no less than 1.27 cm.

Notice：The standard BI float is hollow and can not be tested over a sample of 93 degrees celsius.

Viscometer 1101 can be tested at six different speeds, the speed range is 3 revolutions per minute to 600 revolutions per minute which is determined by the control panel. First connect the power supply, and then select the required speed button. Finally read different shear stress from the dial.

When you connect the heater, press the confirmation key at the bottom right . Then press the up and down select key ,select the desired temperature (operating at room temperature ~93 degrees Celsius). Once the temperature is set, press the confirmation button again . When the red light above the button is lit, it begins to heat up. When you want to stop heating, press the confirmation button again . Red lights go out.

图（三）1101-6 型粘度计控制面板

Figure Ⅲ Control panel of viscometer 1101-6

Ⅳ.外套筒、浮子和扭力弹簧

Outer sleeve, float and torsion spring

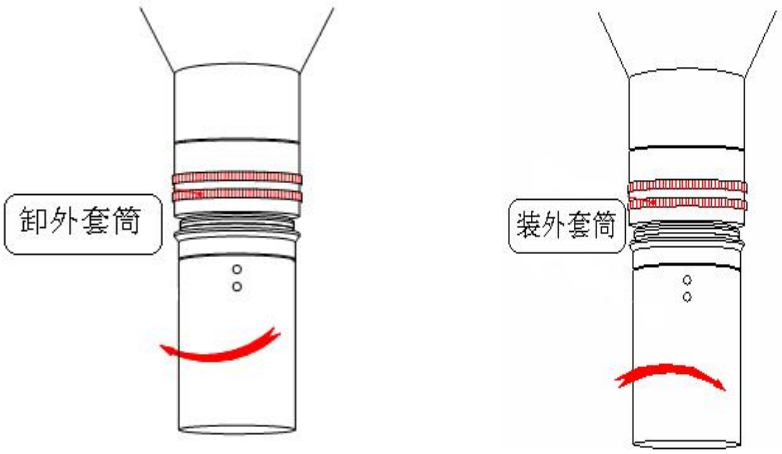
R1-B1-F1 外套筒-浮子-扭力弹簧组合适用于所有粘度计。为了计算所测试液体的剪切速率，可能也会使用其它类型的外套筒-浮子-扭力弹簧组合。有的组合可能会使剪切应力的读数出现较大的误差，这种组合不符合要求。

R1-B1-F1 outer sleeve - float torsion spring combination applies to all viscometer. Others can be used in order to calculate the shear rate of the liquid under test.

A. 外套筒的拆除与安装 Removal and installation of outer cylinder

逆时针转动外套筒，这时外套筒可以被慢慢的拆除，参见（图五）。顺时针转动外套筒，使其向上旋转到最高位置。

Turn the outer sleeve counter clockwise, the outer casing can be removed slowly at this moment, See Figure five. Turn the outer sleeve clockwise to make it turn up to the top position.



Unloading outer sleeve　　Loading outer sleeve

图（四）外套筒的拆装

Figure Ⅳ Disassembly and assembly of outer sleeve

B. 浮子的拆除与安装 Removal and installation of float

浮子轴的末端是锥形的，并且插入一个与之相匹配的锥形孔里。拆除浮子时，要在向下拉动浮子的同时逆时针旋转。安装浮子时，要在向上推动浮子的同时逆时针旋转。

The end of the float shaft is tapered. And insert a cone that matches it. When removing the float, turn the counter clockwise while pulling the float downward. When installing the float, turn the counter clockwise while pushing the float upwards.

C. 扭力弹簧的拆装 Disassembly and assembly of torsion spring

扭力弹簧的各部件见（图六）

①拆除防尘帽（A）.

②将螺钉（C）和（D）松动，这时可以拆除弹簧，注意不要拉伸弹簧。

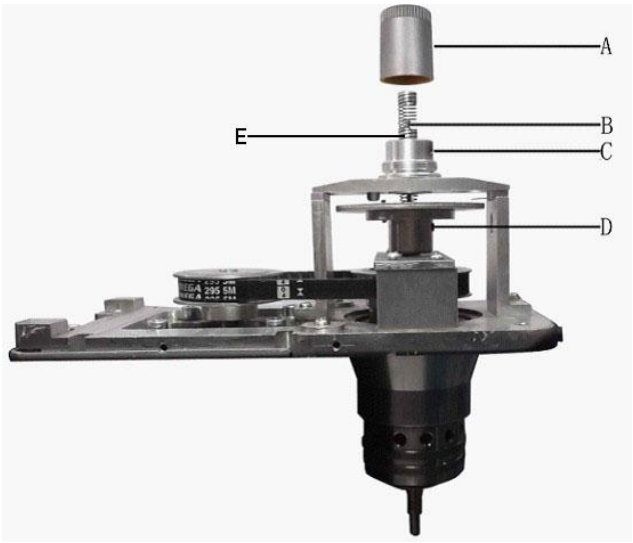
③安装新弹簧，确保芯轴（B）底部正确定位。将螺钉（D）安装在与弹簧脱离芯轴(B)底部时的同一条直线上。拧紧螺钉（D），它可以对夹紧环施加压力，从而可以紧固弹簧。

The components of the torsion spring are shown in Figure Ⅵ.

① Remove dust cap (A)

② Loosen the screws (C) and (D), then remove the spring, and take care not to draw the spring.

③ Fit new spring to make sure the spindle (B) bottom is positioned properly. Fit the screw (D) to the same line as the spring from the bottom of the mandrel (B). Tighten the screw (D), which can apply pressure on the clamping ring so that the spring can be fastened.



图（五）扭力弹簧的拆装

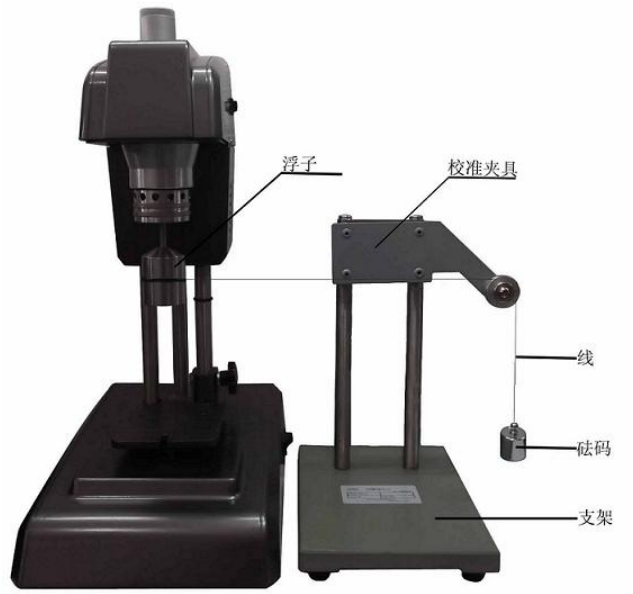
Figure Ⅴ Disassembly and assembly of torsion spring

注意：*在拧紧螺钉（C）之前要确保调节芯轴（B）的顶部与钮结（E）的顶部有一定的间隙。*

要做到这一点，可能需要轻轻的压缩或者拉伸弹簧。

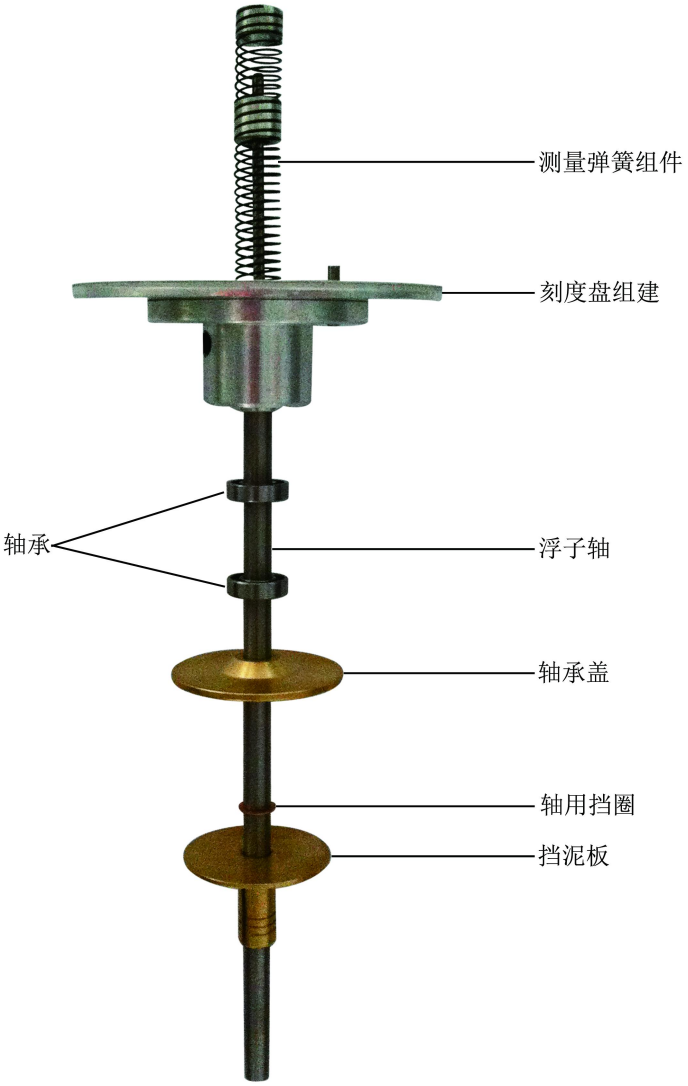
拧紧螺钉（C），拧紧螺钉（C）必须顶在钮结（E）上。

Notice:*Make sure that the top of the mandrel (B) has a clearance between the top of the mandrel and the top of the knob (E) before tightening the screws (C). You may need to gently compress or stretch the spring to achieve it. Tighten the screws (C) and tighten the screws (C) on top of the button (E).*



图（六）静负载校准装置

Figure Ⅵ Static load calibration



图（七）扭力测试组装图

Figure Ⅶ Assembly drawing of torsion test

轴承	Bearing	测量弹簧组件	Parts of measuring spring
刻度盘组建	Dial assembly	浮子轴	Float shaft
轴承盖	Bearing cap	轴用挡圈	Shaft ring
挡泥板	Mudguard		

Ⅴ.仪器校准 Instrument calibration

1101 系列的粘度计应当定期检查，如果发现问题，应当进行校准和维修。只有按期校准，仪器才能较为准确的测量精度。通过向浮子轴施加扭矩来进行校准，这里讲述两种校准方法。

The 1101 series of viscometer shall be checked periodically and calibration and maintenance shall be carried out if problems are found. Only when the instrument is calibrated regularly can the measurement be more accurate. The torque is adjusted by applying torque to the float shaft. There are two ways.

A. 静负载校准 Static load calibration

静负载校准更容易操作，如果弹簧需要调整，其调整结果很容易得到证实。标准的液体校准需要对整台仪器进行彻底校核，它在检验浮子弯曲问题、外套筒偏心问题等方面比静负载校准更加精确。参见（图六）B 部分。

使用 1105 型扭簧测力校准装置进行静负载校准，参照（图七）

1．卸下外套筒，将浮子逆时针方向旋转并向上推（浮子与浮子轴锥度配合），装上浮子。

2．取一段没有弹性的细丝线，用小块胶纸将丝线的一端粘在浮子的表面，然后将丝线向左绕浮子表面旋转 2~3 圈，通过一水平的固定轮或专用测力架，使丝线的另一端系挂钩。

3．根据（表三）选择一个重量。

4．根据需要，调整扭力弹簧。参照（图六）C“调整扭力弹簧”部分。

我公司 F1 弹簧的公差有两种：50 克的为 127±1/2 度；100 克的为 254±1/2 度。当主轴旋转时，1/2 度的误差是允许的。当流体被测试时，这个误差通常会变小。至少要在刻度盘上读三次数据，然后取平均值。如果弹簧不是一个线性状态，这表明浮子轴是弯曲的，此时仪器需要维修。

Static load calibration is easier to operate, its adjustment results can be easily verified if the spring needs to be adjusted. Standard liquid calibration requires thorough calibration of the instrument. It is more accurate than static load calibration in checking the problems of float bending and outer cylinder eccentricity. See Figure Ⅵ section B.

Static load calibration using NLJ-A torsion spring force calibration device (refer to Fig. seven)

1. Remove the outer sleeve, turn the floater counterclockwise and push upward (the float is matched with the taper of the float shaft) and float.

2. Take a piece of flexible thread. And the end of the thread is glued to the surface of the float with a small piece of adhesive tape. Then rotate the yarn around the float to the left for 2~3 circles. Tie the other end of the thread through a horizontal fixed wheel or a special dynamometer.
3. Select a weight according to table three.
4. Adjust torsion spring as required. Refer to (Figure Ⅵ) C "adjust the torsion spring" section.

There are two kinds of tolerances for F1 springs in our company: 50 grams is 127 + 1/2 degrees; 100 grams is 254 + 1/2 degrees. An error of 1/2 degrees is allowed when the spindle is rotated. This error usually decreases when the fluid is tested. Read the data at least three times on the dial, and then take the average. If the spring is not a linear state, which indicates that the float shaft is bent, the instrument needs servicing.

扭力弹簧总成（R1-B1 组合）	扭力弹簧常数 K1 Dynes/cm/° def	扭力弹簧系数	重量（克）				
			10	20	50	100	200
			刻度盘读数				
F-0.2	77.2	0.2	127.0	254.0	-	-	-
F-0.5	193.0	0.5	50.8	101.6	254.0	-	-
F-1	386.0	1	25.4	50.8	127.0	254.0	-
F-2	772.0	2	-	25.4	63.5	127.0	254.0
F-3	1158.0	3	-	-	43.0	84.7	169.4
F-4	1544.0	4	-	-	-	63.5	127.0
F-5	1930.0	5	-	-	-	50.8	101.6
F-10	3860.0	6	-	-	-	-	50.8

表（二）扭力弹簧刚度线性测试表(假设半径是 1cm)
Figure (two) linear test of torsion spring stiffness (assumed radius is 1cm)

B.流体校准 Fluid calibration

此程序仅适用于符合牛顿认证的流体的校准。校准液体可以是 20,50,100,200 和 500cP。所有符合 ASTM 标准的每一瓶液体都配有一个粘度温度对照表。
1．在把外套筒和浮子浸入标准液之前要保证被检测的仪器是干净的。如果有必要的话，拆除外套筒，彻底清洗浮子。确保浮子轴和外套筒是完好无损的。
注意：*标准液标签上的批号必须与粘度/温度图上的数字匹配。*
2．将校准液加至浆杯的液位线处，把浆杯放在仪器的托盘上。向上提升托盘，直到浸到适当深度。参照（图一）.
3．将温度计放入被测样品中，选择一个安全位置防止破碎。

4．开机设定 300 转运行 3 分钟，平衡浮子、外套筒、样品与环境的温度。
5．记录 300 转、600 转时刻度盘上的读数，温度计的读数精确到 0.1°C (0.15°F)。
This procedure is only applicable to calibration of fluids subject to Newton certification. The calibration fluid can be 20,50100200 and 500cP. Every bottle of liquid that meets the ASTM standard is equipped with a viscosity temperature counter.
1. Ensure that the instrument to be detected is clean before placing the outer casing and float into the standard solution. Remove outer sleeve and thoroughly clean float if necessary. Make sure the float shaft and outer sleeve are intact.
Notice: *The batch number on the standard liquid label must be matched to the number on the viscosity / temperature chart.*
2. Add the calibration solution to the level line of the cup and place the cup on the tray of the instrument. Lift the tray up until it is dipped to the proper depth. Refer to (Figure Ⅱ)
3. Place the thermometer in the sample to be tested, and choose a safe place to prevent it from break
4. Turn on the machine, turn 300, run for 3 minutes, balance the float, the outer sleeve, the sample and the temperature of the environment.
5. The readings on the dial are recorded at 300 rpm and 600 rpm, and the reading of the thermometer is accurate to 0.1°C (0.15°F).

c.扭力弹簧校准 Torsion spring calibration

参考（图六）进行部件识别
注意:确保浮子轴不弯曲,然后开始调整扭力弹簧。
1．卸下外套筒，将浮逆时针方向旋转并向上推（浮子与浮子轴锥度配合），装上浮子。
2．取一段没有弹性的细丝线，用小块胶纸将丝线的一端粘在浮子的表面，然后将丝线向左绕浮子表面旋转 2~3 圈，通过一水平的固定轮或专用测力架，使丝线的另一端系挂钩。c.挂 5~65g 标准砝码进行校验，读出刻度盘数应符合《扭力弹簧刚度线性测试表》。
Refer to (Figure Ⅵ) for component identification
Notice: Make sure the float shaft is not bent, then start adjusting the torque spring.
1. Remove the outer sleeve, rotate the floater counter clockwise and push upward (with the taper of the float shaft) and float.
2. Take a piece of flexible thread. And the end of the thread is glued to the surface of the float with a small piece of adhesive tape. Then rotate the yarn around the float to

the left for 2~3 circles. Tie the other end of the thread through a horizontal fixed wheel or a special dynamometer.
3. Hang 5~65g standard weights for calibration and the number sets should be consistent with the "linear torsion spring stiffness test table".

Ⅵ.数据计算 Data calculation

A. 牛顿粘度的计算

在 300rpm 运行时，R1 B1 F1 组合刻度盘上的读数就是牛顿粘度。如果使用其他弹簧需要表盘读数乘以“f”因子(弹簧常数)。
用粘度计确定牛顿粘度 cP，使用下面的公式:
N = S × θ × f × C
注释：
S = 速度因子(见表五)
θ= 刻度盘读数
f = 弹簧系数(见表三)
C = 外套筒-浮子因子(见表四)
N = 牛顿粘度- cP
示例:使用一个 R2 B1 组合 600 rpm 的速度与 f5.0 弹簧,一个表盘读数 189。
N = 0.5 ×189 × 5×0.315 = 149 cP
1 mPa.s 等于 1 cP

注意:校准用标准液有粘度的范围,使用标准的 R-B-F 组合用于测试。如果选择不当,会影响到测试数据。

A.Calculation of Newton viscosity
At the 300rpm run, the readings on the R1 B1 F1 combination dial are the Newton viscosity. If other springs are used, the dial readings should be multiplied by the "F" factor (spring constant).
Determine Newton viscosity cP with a viscometer, using the following formula:
N = S × θ × f × C
Notes：
S = Speed factor (see Figure Ⅴ)
θ= dial reading
f = spring coefficient (see figure Ⅲ)
C = outer sleeve - float factor (see figure Ⅳ)
N = Newtonian viscosity - cP

Example: use a R2 B1 combination of 600 rpm speed with the f5.0 spring, a dial reading of 189.

N = 0.5 ×189 × 5×0.315 = 149 cP

Notice: Calibration uses standard liquid with a range of viscosity and uses a standard R-B-F combination for testing. If chosen improperly, the test data will be affect

外套筒-浮子组合 Outer sleeve -float assembly	外套筒-浮子因子 Outer sleeve -float factor
R1-B1	1.000
R1-B2	8.915
R1-B3	25.392
R1-B4	50.787
R2-B1	0.315
R2-B2	8.229
R2-B3	24.707
R2-B4	49.412
R3-B1	4.517
R3-B2	12.431
R3-B3	28.909
R3-B4	57.815

表（三）外套筒-浮子因子

Figure (Ⅲ) outer sleeve -float factor

转速 Speed	速度因子 Speed factor
1	333.3
2	166.6
3	100
6	50
10	10
20	5
30	3.33
60	3
100	1.667
200	1.5
300	1
600	0.5

表（四）速度因子 300 rpm = 1

Figure IV Speed factor 300 rpm = 1

B. 计算弹簧常数(重量法) Calculate spring constant (weight method)

$$K1 = G \times r \times g / \theta$$

注释：K1 = 弹簧常数——Dynes/cm/° def

G = 负载在克

g = 981 = 引力常数(厘米/ sec2)

半径 r = 1.725 厘米

θ=刻度盘读数

例如:所需的设置为 F1 扭簧, 扭力弹簧常数是 386 Dynes/cm/° def 与 R1 B1 组合。使用 50 克砝码,公式是:

$$K1 = 50 \times 1.725 \times 981 / 386 = 219.2$$

Notes:

K1 = spring constant -- Dynes/cm/ degrees def

G = load in G

G = 981 = gravitational constant (cm / sec2)

Radius r = 1.725 cm

θ = dial reading

For example, the required setting is F1 torsion spring, the torsion spring constant is 386 Dynes/cm/ degrees def and R1 B1 combination. Using 50 grams of weights, the formula is:

$$K1 = 50 \times 1.725 \times 981 / 386 = 219.2$$

C. 数据测试及计算：Data test and calculation:

将室温调整在 20±5℃，严格按照“测试操作方法”工作。如在井场测量时，应尽可能减少取样所耽搁的时间，取样地点、条件应记录在测量表上。

仪器系数为 C = 5.11

1、牛顿液体绝对粘度：

将仪器转速调整 300r/min，等到刻度盘上的读数恒定，其读数为绝对粘度值。

η=300r/min （读数） mPa·s

2、塑性流体粘度：

1）仪器转速调整 600r/min，待刻度盘上的读数恒定，其读数的 1/2 为视粘度值。

2）将仪器转速调整为 300r/min，其读数与 600r/min 读数之差为塑性粘度。

3）将钻井液在高速下搅拌 10 秒钟，以 3r/min 转速开始旋转后的最大度数值即为初切力。静置 10 分钟记录静切力。

视粘度： η视 =1/2 ×600 r/min (读数) mPa·s

塑性粘度：η塑 = 600 r/min（读数）－300r/min（读数）mPa·s
动 切 力：τ_0 = 5.11（300r/min 读数 －η塑）Pa
静 切 力：τ初 = 5.11×3r/min（读数） Pa （静置 1 分钟）
τ终 = 5.11×3r/min（读数） Pa （静置 10 分钟）

3、假塑流体：

其流动特点是有切应力就开始流动，但粘度随切应力的增大而降低，假塑性流体的流动服从幂函数，其表达式：

$$\tau = k \left(\frac{dv}{dx}\right)^n$$

$$\lg \tau = \lg k + n \lg \frac{dv}{dx}$$

n——流行指数 其值在 0~1 之间

k——稠度系数

流性指数 n = 3.321g 600r/min（读数） / 300r/min（读数） （无因次）

稠度系数 k = 5.11×300r/min （读数） / 511 " Pa·s "

Adjust the room temperature at 20 + 5 degrees centigrade, in strict accordance with the "test operation method" work. For example, the delay time of sampling should be reduced as much as possible at wellsite survey. The sampling place and condition shall be recorded on the table.

The instrument coefficient is C = 5.11

1. Newton liquid absolute viscosity:

Adjust the instrument speed by 300r/min and wait until the readings on the dial are constant. Its readings are absolute viscosity values.

2. Viscosity of plastic fluid:

1）Adjust the instrument speed by 600r/min and wait until the readings on the dial are constant. Half of its reading is the apparent viscosity value.

2) The speed of the instrument is adjusted to 300r/min, and the difference between the readings and the 600r/min readings is plastic viscosity.

3) Stir the drilling fluid at high speed for 10 seconds, and the maximum value at which the rotation speed starts at 3r/min is the initial shear force. Set aside for 10 minutes and record static shear force.

Apparent viscosity: η = 1/2 x 600 r/min (visual reading) mPa·S

Plastic viscosity: η = 600 r/min (visual reading) - 300r/min mPa - S (visual reading)

Shear force: τ0 = 5.11 (300r/min readings - η plastic) Pa

Static shear force: τ (start) = 5.11 x 3r/min (first reading) Pa (standing for 1 minutes)

τ (final) = 5.11 x 3r/min (reading) Pa (standing for 10 minutes)

3. Pseudoplastic fluid:

The flow characteristic is that the shear stress begins to flow, but the viscosity decreases with the increase of shearing stress. The flow of a pseudo plastic fluid obeys a power function. Its expression:

$$\tau = k \quad (\frac{dv}{dx})^n$$

$$\lg\tau = \lg k + n \lg\frac{dv}{dx}$$

n—— Prevalence index with the value between 0~1

k —— Consistency coefficient

Flow index n = 3.32lg 600r/min (reading) / 300r/min (reading) (dimensionless)
Consistency factor k = 5.11 * 300r/min (Readings) / 511 Pa • s"

Ⅶ.测量范围 Measuring range

外套筒-浮子	R1- B1	R2- B1	R3- B1	R1 -B2	R1- B3	R1 -B4
基本数据 Basic data						
外套筒半径, R0,cm	1. 8415	1. 7588	2. 5866	1. 8415	1. 8415	1. 8415
浮子半径,R1, cm	1. 7245	1. 7245	1. 7245	1. 2276	0. 8622	0. 8622
浮子高, L, cm	3. 800	3. 800	3. 800	3. 800	3. 800	1. 900
剪切间隙, cm	0. 1170	0. 0343	0. 8621	0. 6139	0. 9793	0. 9793
半径比, R1/R0	0. 936	0. 09805	0. 667	0. 666	0. 468	0. 468
最高使用温度, °C (°F)	99 (200)	99 (200)	93 (200)	99 (200)	93 (200)	93 (200)
最低使用温度, °C (°F)	0 (32)	0 (32)	0 (32)	0 (32)	0 (32)	0 (32)
仪器常数,K 标准的 F1 扭力弹簧？= Kfq / N	300. 0	94. 18	1355	2672	7620	15, 200
剪切应力范围 Shear stress range						
剪切应力常数为有效浮子表面 K2,cm(-3)剪切应力范围,dynes / cm2t = K1K2q	0.01323	0.01323	0.01323	0.0261	0.0529	0.106
F0.2 q = 1°	1.02	1.02	1.02	2.01	4.1	8.2
F0.2 q = 300°	307	307	307	605	1225	2450
F0.5 q = 1°	2.56	2.56	2.56	5.04	10.2	20.4
F0.5 q = 300°	766	766	766	1510	3060	6140
F1 q = 1°	5.11	5.11	5.11	10.1	20.4	40.9
F1 q = 300°	1533	1533	1533	3022	6125	12300

F2 q = 1°	10.22	10.22	10.22	20.1	40.8	81.8
F2 q = 300°	3066	3066	3066	6044	12250	24500
F3 q = 1°	15.3	15.3	15.3	30.2	61.3	123
F3 q = 300°	4600	4600	4600	9067	18400	36800
F4 q = 1°	20.4	20.4	20.4	40.3	81.7	164
F4 q = 300°	6132	6132	6132	12090	24500	49100
F5 q = 1°	25.6	25.6	25.6	50.4	102	205
F5 q = 300°	7665	7665	7665	15100	30600	61400
F10 q = 1°	51.1	51.1	51.1	100.7	204	409
F10 q = 300°	15330	15330	15330	30200	61200	123000

剪切速率						
剪切速率常数 K3, 秒 1 / rpm 剪切速率范围内, 秒 1 g = K3	1.7023	5.4225	0.377	0.377	0.268	0.268
N = 0.9 rpm	1.5	4.9	0.4	0.4	0.24	0.24
N = 1.8 rpm	3.1	9.8	0.7	0.7	0.48	0.48
N = 3 rpm	5.1	16.3	1.1	1.1	0.80	0.80
N = 6 rpm	10.2	32.5	2.3	2.3	1.61	1.61
N = 30 rpm	51.1	163	11.3	11.3	8.0	8.0
N = 60 rpm	102	325	22.6	22.6	16.1	16.1
N = 90 rpm	153	488	33.9	33.9	24.1	24.1
N = 100 rpm	170	542	37.7	37.7	26.8	26.8
N = 180 rpm	306	976	67.9	67.9	48.2	48.2
N = 200 rpm	340	1084	75.4	75.4	53.6	53.6
N = 300 rpm	511	1627	113	113	80.4	80.4
N = 600 rpm	1021	3254	226	226	161	161
粘度范围 (1)						
最大转速 600,	0.5(3)	0.5(3)	2.3	4.5	12.7	25
注释: (1)计算出标准扭力弹簧(f = 1)。对于其他扭簧粘度范围乘以 f 因子。 (2)最低粘度计算了最小剪切应力和最大剪切速率。 (3)出于实用目的最低粘度仅限于 0.5 cP 因为泰勒漩涡。						

表(五）测量范围指示粘度计

Figure (five) measuring range indicating viscometer

Ⅷ.和维故障排除护 Troubleshooting and maintenance

A. 故障排除 Troubleshooting

故障 Troubles	原因 Causes
刻度盘读数不稳 The dial is reading out of gauge	1. 浮子轴轴承生锈 2. 浮子轴弯曲 3. 外套筒失准 1. Float shaft bearings are rusty 2. Float shaft bending 3. Outer sleeve misalignment
数据不准 inaccurate data	1. 浮子轴轴承生锈 2. 浮子轴弯曲 3. 外套筒弯曲 4. 扭力弹簧损坏或安装不正确 5. 电机需要更换 1. Float shaft bearings are rusty 2. Float shaft bending 3. Outer sleeve bending 4.Torque spring is damaged or incorrectly installed 5. The motor needs replacing
噪音过大 Excessive noise	1. 电机故障 2. 壳体螺丝松动或安装不当 1. Motor fault 2. Loose or improper mounting of shell screws
外套筒径跳过大 Outer sleeve skip big	1. 外套筒损坏 2. 传动轮或传动皮带损坏 1. Damaged outer casing 2. The driving wheel or belt is damaged
按键失灵 Button failure	1. 主控制板故障 1. main control panel failure
电机不运行 The motor does not work	1. 电机损坏 2. 驱动器损坏 3. 电源插头未插好 1. Motor damage 2. Drive corrupted 3. The power plug is not plugged in

B .维护 Maintenance

①浮子和外套筒在每次测试后应及时清洗,定期检查压痕、磨损或其他损伤。
②正常使用的粘度计是不需要加油或润滑的。
③在运输过程中将浮子外套筒取下避免浮子轴弯曲及外套筒受损，定期测试浮子轴轴承。
④在没有样品的情况下,操作仪器在 3 rpm 或 6 rpm 观察浮子和外套筒的运转状态,不应该有超过±1 的波动。不灵敏的浮子轴轴承应及时更换。刻度盘应由专业的维修人员维修。
①The float and the outer sleeve shall be cleaned in time after each test, and the indentation, abrasion or other damage shall be checked regularly.
②The normal use of the viscometer is no need to refuel or lubrication.
③In the course of transportation, remove the float outer sleeve, avoid the damage of the float shaft and the outer sleeve, and test the bearing of the float shaft periodically.
④In the course of transportation, remove the float outer sleeve, avoid the damage of the float shaft and the outer sleeve, and test the bearing of the float shaft periodically. The insensitive float shaft takes timely replacement. The dials should be maintained by professional one.

Ⅸ.规格 Specifications

编号	型号	转速	电源	尺寸 H×W×L			净重	毛重
1101	1101	3, 6, 100, 200,300 , 600	100V-240V 50Hz/60Hz	430	190	340	10KG	15KG
1101B	1101B	1, 2, 3, 6,10,20, 30, 60,100,200, 300 ,600	100V-240V 50Hz/60Hz	420	190	280	6.9KG	13.4KG

X.配件 Parts

扭力弹簧			
编号	F.	常数	剪切应力
110031A	F0.2	77.2	307
110031B	F0.5	193	766
110031	F1	386	1533
110131C	F2	772	3066
110031D	F3	1158	4600
110031E	F4	1544	6132
110031F	F5	1930	7665
110031G	F10	3860	15330
外套筒			
11003306	R1, 316 不锈钢		
11003306A	R2, 316 不锈钢		
11003306B	R3, 316 不锈钢		
浮子			
1100326	B1,316 不锈钢,空心		
1100326A	B2, 316 不锈钢,空心		
1100326B	B3, 316 不锈钢,空心		
1100326C	B4, 316 不锈钢,空心		
样品杯			
1106	加热器, 220 伏特,50Hz,1 安培		
110015	浆杯		
校准			
1101	NLJ-A 型扭簧测力校准装置		
G0400	标准液,10 cP,16 盎司(475 毫升)		
G0401	标准液,20 cP,16 盎司(475 毫升)		
G0402	标准液,50 cP,16 盎司(475 毫升)		
G0403	标准液,100 cP,16 盎司(475 毫升)		
G0404	标准液,200 cP,16 盎司(475 毫升)		
G0405	标准液,500 cP,16 盎司(475 毫升)		

图（八）零件示意图

Figure Ⅷ　Sketch map of parts

青岛创梦仪器有限公司 装箱单

Qingdao Chuangmeng Instrument Co., Ltd. Packing list

生产企业：青岛创梦仪器有限公司
Manufacturing enterprise: Qingdao Chuangmeng Instrument Co.,Ltd.
生产地址：青岛市城阳区流亭街道兴海路 3 号
Production address: No. 3 Xinghai Road, Liuting Street, Chengyang District, Qingdao
主机型号: 1101
Model of the main motor:
出厂编号：
Manufacturing No:

序号 No	编号	名称及规格 Name and specification	数量 Quantity	备注 Remarks
1		主机 Main engine	1	
2		控制线 Control line	1	
3		加热器 Heater	1	
4		电源线 Power line	1	
5		电源适配器 The power adapter	1	
6		钻井液杯 Sluryy cup	1	
7		浮子 Float	1	
8		外套筒 Outer sleeve	1	
9		使用手册 Instruction Manual	1	
10		合格证 Certificate	1	