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: 1103

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 Introduction

1103 型六速旋转粘度计，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 宽电压带，50Hz 或者 60Hz 的电源驱动。其结构见图（1），明细见表（1）。
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 1103 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。

Manufactured by Qingdao ChuangMeng Instrument Technology Co., Ltd., 1103-model viscometer is the viscosity-measuring instrument for which the standard power adapter gives power supply, and it is applicable to 100~240V wide voltage belt, 50Hz or 60Hz power driving, and there are two speed types, namely 6-speed and 12-speed. See Diagram (I) for its structure and Table (I) for the details.

This is a typical coaxial cylinder viscometer in the annular space (shearing clearance) formed by placing the test fluid between the outer sleeve and the floater.

In viscosity measurement, when the outer sleeve rotates at a set speed, the fluid will produce a viscosity resistance, and thus

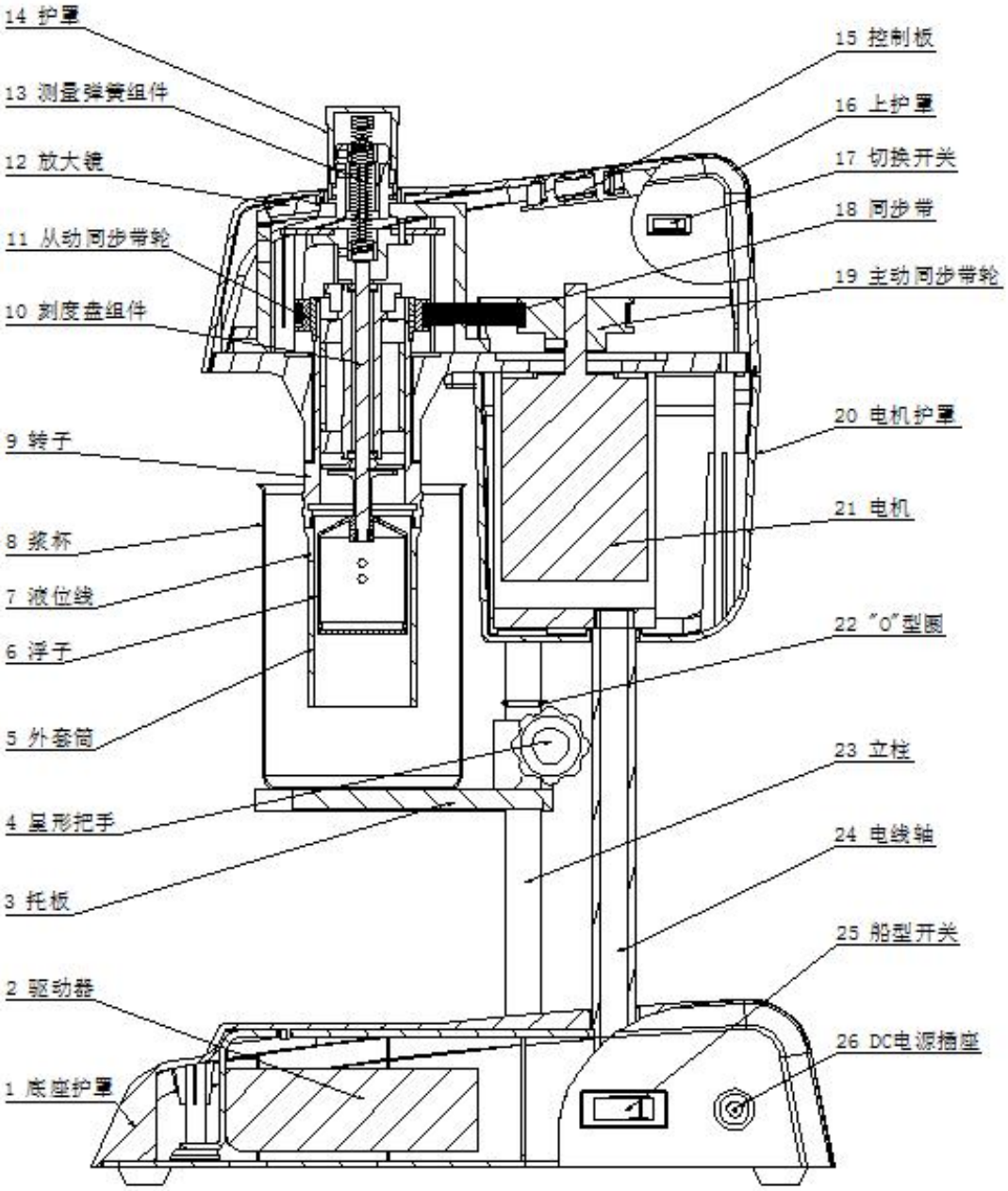
the viscosity of the fluid will be measured. When the outer sleeve produce a torque on the floater through the fluid, this torque acts on a precision spring, its deflection can be measured, and then make a comparison between the measuring result, measuring conditions and instrument constants. This system can imitate the real process in the industrial process.

Given a shearing rate, the coaxial cylinder rotational viscometer can make the viscosity measurement. This is a linear function relationship. For instance, the relational graph between the shearing stress and shearing rate is a straight line. In many cases, many fluids may not follow Newton's law, but their rheology is relatively close to Newton's law, so the viscometer can be still in use, and the viscosity can also be accurately measured. It is worth noticing that the calibration of the recommended 1103-model viscometer is a linear calibration following Newton's mode. This means that if the liquid sample does not conform to Newton's linear calculation method, and at this time, the viscometer will not be applicable. In this case, viscosity measurement and speed calculation will be subject to another linear calculation method, which is more applicable to the characteristics of such kinds of fluids.

When the standard outer sleeve, floater and torsional spring rotate in 300 rounds/minute, the measurement unit of the viscometer is centipoise (or milli pascal/second). At other rotating speeds, the read data must be conducted a series of simple multiplying conversion. The sixth part will present the calculation method of viscosity of plastic fluids (such as drilling fluid).

If choosing different rotating speeds or using different combinations of torsional spring-floater, the scope of shearing rate may have some changes. In order to expand the scope of shearing stress and thus measure all sorts of

liquids, we have designed different series of torsional springs, which can carry out reciprocal conversion easily.



图（1）结构图 Diagram (I)Structure diagram

序号	名称	序号	名称	序号	名称
1	底座护罩 Base cover	10	刻度盘组件 Dial assembly	19	主动同步带轮 Driving synchronous pulley
2	驱动器 Driver	11	从动同步带轮 Driven synchronous pulle	20	电机护罩 Motor cover
3	托板 Supporting plate	12	放大镜 Magnifying lens	21	电机 Motor
4	星形把手 Star grip knob	13	测量弹簧组件 Measuring spring assembly	22	"O"型圈 "O"-ring
5	外套筒 Outer sleeve	14	护罩 Cover	23	立柱 Upright column
6	浮子 Floater	15	控制板 Control panel	24	电线轴 Electric wire shaft
7	液位线 Liquid level line	16	上护罩 Upper cover	25	船型开关 Rocker switch
8	浆杯 Slurry cup	17	切换开关 Shift switch	26	DC 电源插座 DC power socket
9	转子 Rotor	18	同步带 Synchronous pulley		

表（1）结构明细表 Table (I) Detailed table of structure

Ⅱ.安全原则 Safety principle

A．安全操作 Safe operation

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。

Laboratory technicians 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.

B．浮子标准 The floater’s standards

配有 1103 型粘度计的标准 B1 浮子，不可测试高于 93 摄氏度的样品。

The standard B1 floater equipped with 1103-model viscometer cannot be used to test the sample higher than 93℃.

Ⅲ.粘度测试 Viscosity testing

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（1）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。

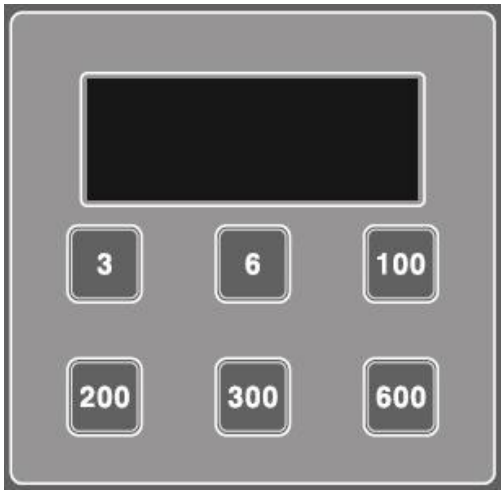
1103 型粘度计有六种不同的速度进行测试，速度范围是 3 转/分钟到 600 转/分钟，旋转速度由控制面板决定。使用时，先接通电源，再选择所需的速度按键，从刻度盘上读取不同的剪切应力值。

There is a scale line at the 350ml of the slurry cup. Add the newly stirred test fluid to the liquid level line. The liquid level line on the outer sleeve can clearly show the proper immersion depth. It can be seen from

Diagram (I) that if the immersion depth exceeds the scale line, the bearing of the float may be damaged. If other containers are used, the distance between the bottom of the outer sleeve and the bottom of the container should be no less than 1.27 cm.

NOTE:If the standard BI floater is hollow, it cannot be used to test the sample higher than 93℃.

1103 model viscometer has six different speeds for testing, and the scope of speed is 3 rounds/minute to 600 rounds/minutes, and the rotating speed is decided by the control penal. When using it, first switch on the power, and then select the required speed button, read different values of shearing stress from the dial.



图（2）1103 型粘度计控制面板

Diagram (II) Control panel of 1103 model viscometer

Ⅳ.外套筒、浮子和扭力弹簧 Outer sleeve, floater and torsional spring

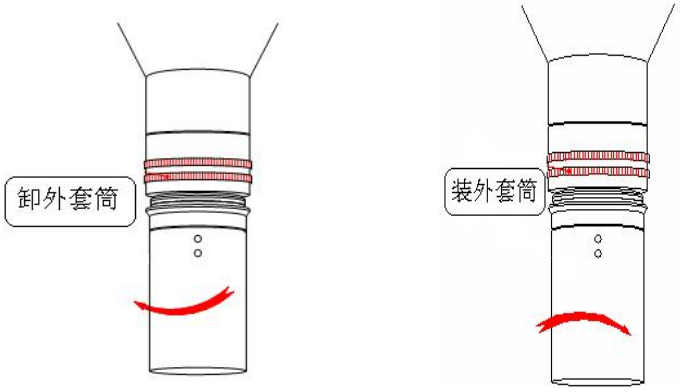
R1-B1-F1 外套筒-浮子-扭力弹簧组合适用于所有旋转粘度计。为了计算所测试液体的剪切速率，可能也会使用其它类型的外套筒-浮子-扭力弹簧组合。有的组合可能会使剪切应力的读数出现较大的误差，这种组合不符合要求。

The combination of R1-B1-F1 outer sleeve-floater-torsional spring is applicable to all viscometers. In order to calculate the shearing rate of the tested liquid, other types of combination of outer sleeve-floater-torsional spring may also be adopted. Some combinations may cause greater errors in the shearing stress readings, and such kinds of combinations do not meet the requirements.

A．外套筒的拆除与安装 Assembling and disassembling of the 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 3）。顺时针转动外套筒，使其向上旋转到最高位置。

Rotate the outer sleeve anticlockwise, and at this moment, the outer sleeve can be slowly removed, see Diagram (Ⅲ). Rotate the outer sleeve clockwise, and make it rotate upward to the maximum position.

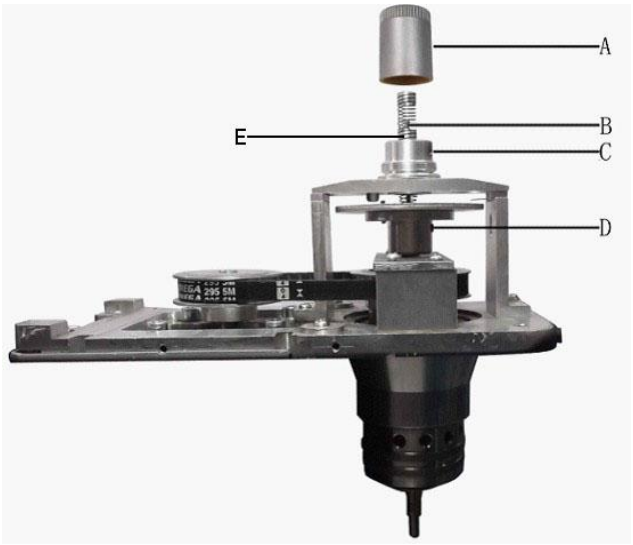


图（3）外套筒的拆装 Diagram (Ⅲ) Assembling and disassembling of outer sleeve

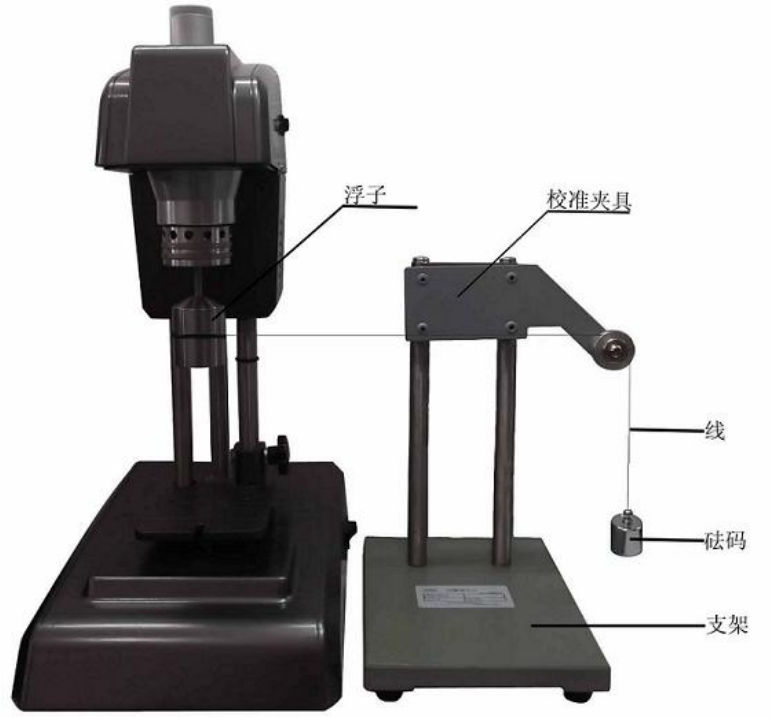
B．浮子的拆除与安装 Assembling and disassembling of the floater

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 side of the float shaft is cone-shaped, and it is inserted into a taper hole. When disassembling the floater, it requires to pull the floater downward and keeping it rotating anticlockwise at the same time. When assembling the floater, it requires to push the floater upward and keeping it rotating clockwise.

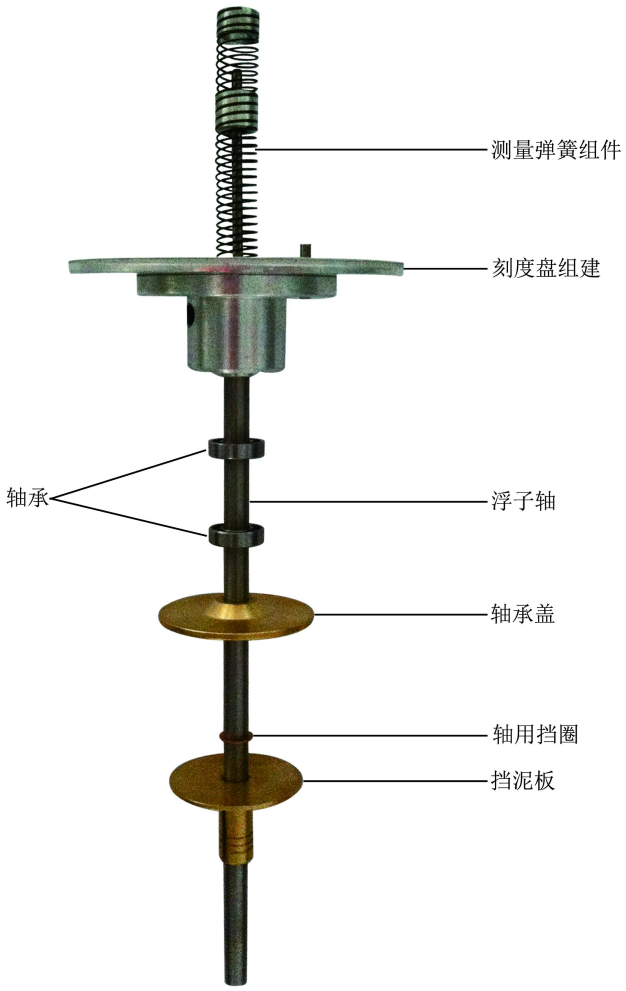


图（4）扭力弹簧的拆装 Table (VI) Assembling and disassembling of torsional spring



图（5）静负载校准装置

Diagram (Ⅴ) Static load calibration device



图（6）扭力测试组装图

Diagram (Ⅵ) Assembly drawing of torsion test

Ⅴ.仪器校准 Instrument calibration

1103 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。

1103 series viscometer should be inspected on a regular basis, and once a problem is found, it is necessary to carry out calibration and maintenance. Only when the instrument is calibrated regularly can the measurement precision be more accurate. Here two calibration methods are described to carry out calibration by applying torque to the float shaft.

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 4）B 部分。

使用 NLJ-A 型扭簧测力校准装置进行静负载校准，参照（图 5）

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 2）选择一个重量。

It is easily to operate static load calibration, and if the spring needs to be adjusted, its adjustment results can easily be confirmed. The standard liquid calibration requires a thorough calibration of the entire instrument. It is more accurate than static load calibration in checking the deflection of the floater, the eccentricity of the outer sleeve, etc. Please refer to Diagram (Ⅳ) B.

Carry out static load calibration with 1105 model torsional spring force-measuring and calibrating device, Please refer to Diagram (V).

1. Disassemble the outer sleeve, rotate the floater in the anti-clockwise direction and push it upward (the floater cooperates with the shaft taper), and then assemble the floater.

2. Take a piece of thin silk thread without elasticity, paste one end of the silk thread to the surface of the floater with a small piece of gummed paper, then rotate the silk thread towards the left for 2 ~ 3 rounds around the surface of the floater, and make the silk thread tie to the hook through a horizontal fast pulley or special force-measuring shelf.

3.Choose a weight based on (Table II).

砝码 Weight （g）	允许转动范围 Allowable rotation range （格 style）	实测 Measurement （格 style）	砝码 Weight （g）	允许转动范围 Allowable rotation range （格 style）	实测 Measurement （格 style）
5	21.55~22.21		40	172.45~177.70	
10	43.11~44.42		45	194.00~199.90	
15	64.66~66.63		50	215.57~222.13	
20	86.23~88.85		55	237.12~244.30	
25	107.78~111.06		60	258.68~266.56	
30	129.34~133.28		65	280.23~288.77	
35	150.89~155.49		70	301.80~310.99	

表（2）扭力弹簧刚度线性测试表

Table (II) linear test table of torsion spring stiffness

B.流体校准 Liquid 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 1）.

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 the calibration of fluids that are in conformity with Newton’s certification. The calibrated fluid can be 20,50,100,200 and 500cP. Every bottle of liquid that meets the ASTM standard is equipped with a comparison table of viscosity and temperature.

1. Ensure that the instrument to be tested is clean before immersing the outer sleeve and float into the standard liquid. If necessary, remove the outer sleeve and clean the float thoroughly. Make sure that the float shaft and outer sleeve are intact.

Attention： The batch number on the label of the standard liquid must match to the number on the viscosity / temperature chart.

2. Add the calibrated liquid to the liquid level line of the slurry cup, and place the slurry cup on the tray of the instrument. Lift the tray up until it is immersed to the proper depth. Refer to (Table I).
3. Put the thermometer in the sample to be tested, and choose a safe place to prevent it from breaking.
4. Start up, set 300 rounds for 3 minutes, and balance the temperatures of floater, outer sleeve, sample and the environment.
5. Record the readings on the dial for 300 rounds and 600 rounds, and the reading of the thermometer is exact to 0.1°C (0.15°F).
C．扭力弹簧校准 Calibration of the torsional spring
参考（图 6）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.挂 5~70g 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》。
Please refer to Table (VI) for parts Identification.
Note: Make sure that the float shaft is not bent, and then start adjusting the torsional spring.
1. Disassemble the outer sleeve, rotate the floater in the anti-clockwise direction and push it upward (the floater cooperates with the shaft taper), and then assemble the floater.
2. Take a piece of thin silk thread without elasticity, paste one end of the silk thread to the surface of the floater with a small piece of gummed paper, then rotate the silk thread towards the left for 2 ~ 3 rounds around the surface of the floater, and make the silk thread tie to the hook through a horizontal fast pulley or special force-measuring shelf.
3. Hang a 5~65g standard weight for calibration, and the dial readings should conform to Testing Table of Stiffness and Linearity of Torsional Spring

Ⅵ.数据计算 Data calculation

1． 牛顿粘度的计算 Calculation of Newtonian viscosity
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:

When operating at 300rpm, the reading on the R1 B1 F1 combined dial is Newtonian viscosity. If using other springs, it is necessary to multiply the dial readings with “f” factor (spring constant).

Determine Newtonian viscosity cP with the viscometer, and apply the following formula:
$N = S \times \theta \times f \times C$

注释 Note:
S = 速度因子 speed factor
θ = 刻度盘读数 dial readings
f = 弹簧系数 spring coefficient
C = 外套筒-浮子因子 outer sleeve- floater factor
N = 牛顿粘度 Newtonian viscosity – 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。
Example: use a R2 B1 combination at the speed of 600 rpm and f5.0 spring, one dial reading is 189.

N = 0.5 ×189 × 5×0.315 = 149 cP

1 mPa.s 等于 1 cP
1 mPa.s equals to 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。
Note: Calibration-intended standard liquid has the scope of viscosity and the standard R-B-F combination will be used for testing. If choosing improperly, the test data will be affected.

外套筒-浮子组合 Outer sleeve- floater combination	外套筒-浮子因子 Outer sleeve- floater 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（3）外套筒-浮子因子
Table (Ⅲ) Outer sleeve - floater factor

转速 Rotating 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（4）速度因子 300 rpm = 1
Table(V) Speed factor300 rpm = 1

2.计算弹簧常数(重量法)Calculating spring constant (Gravimetric method)

K1 =G×r×g / θ

注释 Note：

K1 = 弹簧常数——Dynes/cm/° def

K1 = spring constant——Dynes/cm/° def

G = 负载——克

G = load at gram

g = 981 = 引力常数(厘米/ sec2)

g = 981 = gravitational constant (cm/ sec2)

半径 r = 1.725 厘米

r = 1.725cm

θ =刻度盘读数

θ= dial reading

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:

Example: the required setting is F1 torsional spring, and the constant of torsional spring is the combination of 386 Dynes/cm/° def and R1 B1. Use the 50g weight, and the formula is:

K1 = 50 × 1.725 × 981 / 386 = 219.2

3. 数据测试及计算 Data testing 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

Adjust the room temperature at 20±5℃, and work in strict accordance with the "test operation method". If making measurement at the well site, reduce the time delayed for taking the sample as much as possible, and record the sampling site and condition on the measurement table.

The instrument coefficient is C = 5.11

a.牛顿液体绝对粘度： Absolute viscosity of Newtonian liquid:

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。

Adjust the speed of the instrument to 300r/min, until the readings on the dial are constant, and the readings are absolute viscosity values.

η =300r/min （读数） mPa・s

η=300r/min (reading) mPa·s

b.塑性流体粘度 Viscosity of plastic fluid

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。

1) Adjust the speed of the instrument to 600r/min, until the readings on the dial are constant, and 1/2 of the readings are apparent viscosity values.

2) Adjust the speed of the instrument to 300r/min, and the differences between its readings and the readings of 600r/min are apparent viscosity values.

3) Stir the drilling fluid at a high speed for 10 seconds, and after rotating at the speed of 3r/min, the maximum value is the initial shearing force. Set it aside for 10 minutes, and record static shearing force.

视粘度： η 视 = 1/2 ×600 r/min (读数) mPa・s

Apparent viscosity: η = 1/2 ×600 r/min (reading) mPa·s

塑性粘度： η 塑 = 600 r/min (读数) －300r/min（读数）mPa・s

Plastic viscosity: η plastic = 600 r/min (reading) －300r/min (reading) mPa·s

动 切 力： τ 0 = 5.11（300r/min 读数 － η 塑）Pa

Dynamic shearing force: τ0 = 5.11 (300r/min reading －η plastic) Pa

静 切 力： τ 初 = 5.11×3r/min (读数) Pa (静置 1 分钟)

τ (initial) = 5.11×3r/min (reading) Pa (Set it aside for 1 minute)

τ 终 = 5.11×3r/min (读数) Pa (静置 10 分钟)

τ (final)= 5.11×3r/min (reading) Pa (Set it aside for 10 minutes)

c.假塑流体 Pseudoplastic fluid：

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：

Its flowing characteristic is that it begins to flow when there is shearing stress, but the viscosity decreases with the increase of the shearing stress, and the flow of the pseudoplastic fluid obeys the power function. The formula is:

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

n——流性指数 其值在 0~1 之间

n——epidemic index its value is between 0 and 1

k——稠度系数

k—— consistency coefficient

流性指数 n = 3.32lg 600r/min (读数) / 300r/min（读数） (无因次)

Liquidity index n = 3.32lg 600r/min (reading) / 300r/min (reading) (zero dimension)

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

Consistency coefficient k = 5.11×300r/min (reading) / 511 " Pa·s "

Ⅶ.测量范围 Range of measurement

外套筒-浮子 Outer sleeve- floater	R1- B1	R2- B1	R3- B1	R1 -B2	R1- B3	R1 -B4
基本数据 Basic data						
外套筒半径 Radius of the outer sleeve,, R0,cm	1.8415	1.7588	2.5866	1.8415	1.8415	1.8415
浮子半径 Radius of the floater,R1, cm	1.7245	1.7245	1.7245	1.2276	0.8622	0.8622
浮子高 Height of the floater, L, cm	3.800	3.800	3.800	3.800	3.800	1.900
剪切间隙 Shearing clearance, cm	0.1170	0.0343	0.8621	0.6139	0.9793	0.9793
半径比 Radius ratio, R1/R0	0.936	0.09805	0.667	0.666	0.468	0.468
最高使用温度 Maximum operating temperature, °C (°F)	99(200)	99(200)	93(200)	99(200)	93(200)	93(200)
最低使用温度 Minimum operating temperature, °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 Instrumental Constant, K Standard F1 torsional spring ？ = Kfq / N	300.0	94.18	1355	2672	7620	15,200
剪切应力范围 Scope of the shearing stress						

剪切应力常数为有效浮子表面 The constant of the shearing stress is the effective floater surface K2,cm(-3) 剪切应力范围 the scope of the shearing stress,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
F1 q = 1°	5.11	5.11	5.11	10.1	20.4	40.9
F1 q = 300°	1533	1533	1533	3022	6125	12300
剪切速率 Shearing rate						
剪切速率常数 K3,秒 1 / rpm 剪切速率范围内,秒 1 g = K3 The constant of the shearing rate K3, within the scope of the shearing rate 1 / rpm per second, 1 g = K3 per second	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 Viscosity range (1)						
最大转速 Maximum rotating speed 600,	0.5(3)	0.5(3)	2.3	4.5	12.7	25
注释 Note: 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。 (1) Calculate the standard torsional spring (f = 1). For other torsional springs, multiply the scope of viscosity with f factor. 最低粘度计算了最小剪切应力和最大剪切速率。 (2) The minimum viscometer has calculated the minimum shearing stress and the minimum shearing rate. 出于实用目的最低粘度仅限于 0.5 cP 因为泰勒漩涡。 (3) For practical purposes, the minimum viscometer is only limited to 0.5 cP due to Taylor vortex.						

表(5）测量范围指示粘度计

Table (V) Indicating viscometer within the range of measurement

Ⅷ.故障排除与维护 Trouble-shooting and maintenance

1.故障排除 Trouble-shooting

故障 Fault	原因 Cause
刻度盘读数不稳 The dial readings are unstable	1.浮子轴轴承生锈 1.The bearing of the float shaft is rusted 2.浮子轴弯曲 2.The float shaft is bent 3.外套筒失准 3. The outer sleeve is out of alignment
数据不准 The data is inaccurate	1.浮子轴轴承生锈 1.The bearing of the float shaft is rusted 2.浮子轴弯曲 2.The float shaft is bent 3.外套筒弯曲 3. The outer sleeve is bent 4.扭力弹簧损坏或安装不正确 4.The torsional spring is damaged or its installation is incorrect 5.电机需要更换 5. The motor needs to be replaced
噪音过大 The noise is much too loud	1.电机故障 1. Motor failure 2.壳体螺丝松动或安装不当 2. The shell screw is loosen or the installation is improper.
外套筒径跳过大 The radial beat of the outer sleeve is too large	1.外套筒损坏 1. The outer sleeve is damaged 2.传动轮或传动皮带损坏 2. The driving wheel or driving belt is damaged.
按键失灵 Keypad failure	1.主控制板故障 1. The main control panel is damaged
电机不运行 The motor is not operated	1.电机损坏 1. The motor is damaged 2.驱动器损坏 2. The driver is damaged 3.电源插头未插好 3. The attaching plug is not well inserted

2.维护 Maintenance

a.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。

b.正常使用的粘度计是不需要加油或润滑的。

c.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。

d.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。

a. Promptly clean the floater and the outer sleeve after each test, and regularly inspect the indentations, wear and tear or other damages.

b.The normally used viscometer does not require oiling or lubrication.

c.Take down the floater and the outer sleeve in the transporting process to avoid that the float shaft is bent and the outer sleeve is damaged, and test the bearing of the float shaft on a regular basis.
d.In the absence of a sample, if the operating instrument observes the operation of the floater and outer sleeve at 3 rpm or 6 rpm, there should not be the fluctuations of over ±1. The insensitive float shaft should be replaced in a timely manner. The dials should be maintained by professional maintenance personnel.

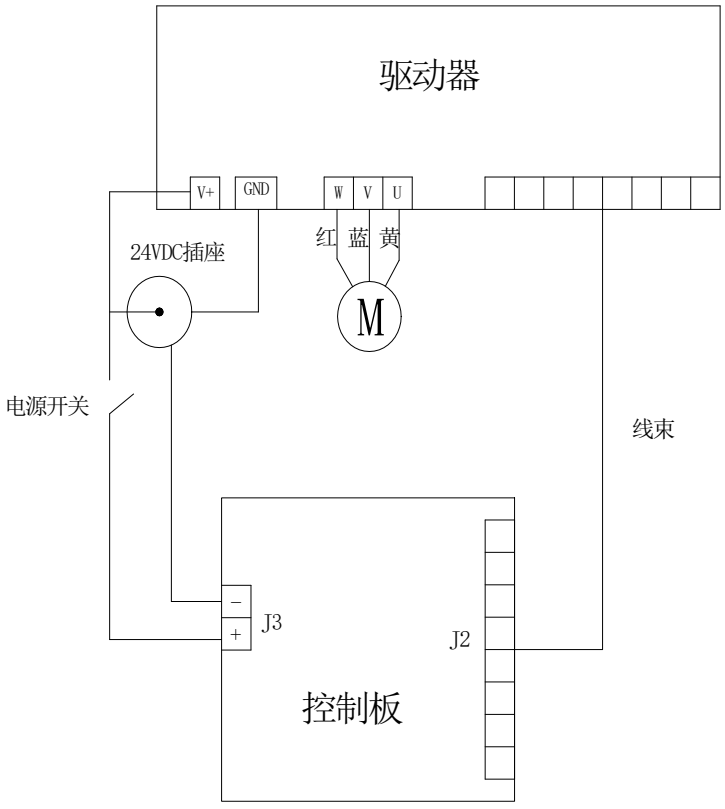
Ⅸ.规格 Specifications

型号 Model	转速 Rotating speed	电源 Power	尺寸 H×W×L Size H×W×L			净重 Net weight	毛重 Gross weight
1100	3, 6, 100, 200,300, 600	220V 50Hz/60Hz	410	150	280	9KG	10KG
1101	3, 6, 100, 200,300 , 600	100V-240V 50Hz/60Hz	430	190	340	10KG	15KG
1103	3, 6, 100, 200,300 , 600	100V-240V 50Hz/60Hz	420	190	280	6.9KG	13.4KG

Ⅹ.配件 Fittings

扭力弹簧 Torsional spring			
编号 No.	F.	常数 Constant	剪切应力 Shearing stress
110031A	F0.2	77.2	307
110031	F1	386	1533
外套筒 Outer sleeve			
11003306	R1, 316 不锈钢 R1, 316 stainless steel		
11003306A	R2, 316 不锈钢 R1, 316 stainless steel		
11003306B	R3, 316 不锈钢 R1, 316 stainless steel		
浮子 Floater			
1100326	B1,316 不锈钢,空心 B1,316 stainless steel, hollow		
1100326A	B2, 316 不锈钢,空心 B1,316 stainless steel, hollow		
1100326B	B3, 316 不锈钢,空心 B1,316 stainless steel, hollow		
1100326C	B4, 316 不锈钢,空心 B1,316 stainless steel, hollow		
样品杯 Sample cup			
1102A	加热器, 110 伏特,60 Hz,2 安培 Heater, 110 volt,60 Hz,2 ampere		
1102	加热器, 220 伏特,50Hz,1 安培 Heater, 110 volt,60 Hz,2 ampere		
110015	浆杯		

	Slurry cup
校准 Calibration	
1101	1105 型扭簧测力校准装置 1105 model torsional spring force-measuring and calibrating device
G0400	标准液,10 cP,16 盎司(475 毫升) Standard liquid,10 cP, 16 ounce(475 milliliter)
G0401	标准液,20 cP,16 盎司(475 毫升) Standard liquid,20 cP, 16 ounce(475 milliliter)
G0402	标准液,50 cP,16 盎司(475 毫升) Standard liquid,50 cP, 16 ounce(475 milliliter)
G0403	标准液,100 cP,16 盎司(475 毫升) Standard liquid,100 cP, 16 ounce(475 milliliter)
G0404	标准液,200 cP,16 盎司(475 毫升) Standard liquid,200 cP, 16 ounce(475 milliliter)
G0405	标准液,500 cP,16 盎司(475 毫升) Standard liquid,500 cP, 16 ounce(475 milliliter)



图（7）电路图

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: 1103

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		电源线 Power cord	1	
3		电源适配器 The power adapter	1	
4		钻井液杯 Sluryy cup	1	
5		浮子 Float	1	
6		外套筒 Outer sleeve	1	
7		内六角扳手 Hexagon bar	1	
8		使用手册 Instruction Manual	1	
9		合格证 Certificate	1	