



氧化锆氧量分析仪 Zirconia Oxygen Analyzer

使用说明书 Instruction Manual



一、概 述

General Description

直插式氧化锆氧量自动分析仪是在总结国内外多年研究和应用经验后，研制成功的新型氧量分析仪，适用于分析各种工业锅炉、窑炉及加热炉中烟气的含氧量。它的主要特点是氧探头的结构设计及铂电极的化学配方、制作工艺充分考虑了被测炉气组分极端复杂

这一特点，可保证氧探头在水平直插条件下应用时具有足够长的寿命。而其信号转换部分以单片微处理器为核心，通过软件实现仪表大部分功能，硬件配置重点强化仪表的抗干扰措施。

type straight-inserted zirconia oxygen analyzer is a successful new type oxygen analyzer referring to many years of domestic and overseas research outcomes and practical experience. It is designed to analyze oxygen content in smoke from various kinds of industrial boilers, ovens and heating-furnaces. The product mainly features with its unique structural design of the oxygen probe and the chemical prescription of platinum electrode. In addition, the manufacturing process of the new analyzer fully considers the extreme complexity of furnace gas components to be measured, which enables sufficient lifetime of oxygen probe applied in the condition of horizontal straight insertion. Besides, single-chip microprocessor is the key for signal transmission, with which most of instrumental functions can be achieved via software, while the hardware configuration reinforces the anti-interfering treatment of instrument.

从提高氧量测量值可靠性入手，延长氧探头的连续使用寿命，并使仪表具备与氧探头要求相适应的自诊断功能及抗干扰能力。本仪表在改进氧化锆的配方和完善氧化锆头金属化工艺及仪表信号转换器实现智能化等方面有较大改进，具体内容如下：

Start with improving reliability of oxygen content measuring value; prolong constant using lifetime of oxygen probe; make instrument own functions of self-diagnose and anti-interfering marched with requirements of oxygen probe. Great improvements for instrument have been achieved including improving zirconia prescription, perfect metal process of zirconia head and achieving intelligentize of instrument signal transmission etc. For details as following:

- (1) 改进氧化锆的配方和烧制工艺，使其具有较高的电导率和致密度。

Improving zirconia prescription and firing process can make it have higher conductance ratio and density;

- (2) 多孔性铂电极的化学配方及制作工艺可保证氧化锆探头在锅炉烟气中有足够的使用寿命。

Porous platinum electrode chemical prescription and manufacturing process enable zirconia probe having sufficient lifetime in boiler smoke;

- (3) 仪表具有多种线性量程选择。

Instrument has many choices for linearity scale.

- (4) 仪表温度控制系统所给出的升温曲线能满足氧化锆材料对升温速度的要求。

Temperature-ascending curve presented in control system of instrument temperature can meet the requirement of temperature-ascending speed of zirconia material.

(5) 仪表信号具有必要的自诊断功能。

Instrument signal has essential self-diagnose function.

二、 工作原理

Operating Theory

本仪器依据浓差电池原理构成, 和其它电池一样, 它具有两个半电池, 而在两电极之间, 用氧化锆作固体电介质。

The instrument, as well as other battery, has half and two batteries in accordance with components of concentration cell theory. Between two electrodes, zirconia will be used as solid electric medium.

在高温下, 当氧化锆两侧有氧浓差时, 就形成了氧浓差电池, 电池电动势的大小可根据 Nernst 公式计算, 即:

Under high temperature, concentration cell is formed when two sides of zirconia have oxygen concentration. Electromotive force value of batteries can be calculated in accordance with Nernst formula as following:

$$E = \frac{RT}{nF} \ln \frac{P''O_2}{P'O_2}$$

式中:

In the formula:

E—浓差电池输出, mV;

E stands for concentration cell output, mV;

n—电子转移数, 在此为 4;

n stands for electron transfer coefficient. Here is 4;

R stands for ideal gas constant, 8.314 W·S / mol;

R—理想气体常数, 8.314 W·S / mol;

F stands for Faraday constant, 96500 C;

F—法拉第常数, 96500 C;

T stands for absolute temperature, K;

T—绝对温度, K;

$P''O_2$ stands for high concentration side oxygen partial pressure

$P''O_2$ —高浓度侧氧分压;

$P'O_2$ stands for low concentration side oxygen partial pressure

$P'O_2$ —低浓度侧氧分压。

当电池工作温度固定于 700℃ 时, 上式为: $E = 48.261 \lg \frac{P''O_2}{P'O_2}$

When operating temperature of battery is fixed in 700℃, the above formula will be

由上式可知, 在温度 700℃ 时, 当固体电介质一侧氧分压为空气(20.6%)时, 由浓差电池输出电动势 E, 就

可以计算出固体电介质另一侧氧分压，这就是氧化锆氧量自动分析仪的测氧原理。

We can know from above formula, we can calculate the other side oxygen partial pressure of solid electric medium based on concentration cell outputting electromotive force E under the condition that the temperature is 700℃, one side oxygen partial pressure of solid electric medium is air (20.6%). This is oxygen measuring theory of zirconia oxygen analyzer.

三、主要技术参数

Main technical parameter

3.1 测量范围 Measuring range

显示: 0~25.0 %O₂: (三位数字显示)

Display: 0~25.0 %O₂(display three figures)

模拟量输出(线性): 0~5.00 %O₂, 0~10.0 %O₂, 0~25.0 %O₂

Output module(linearity): 0~5.00 %O₂, 0~10.0 %O₂, 0~25.0 %O₂

3.2 测量精度: 3% (满量程)

Measuring precision: 3%(full scale)

3.3 响应时间: <5S(90%测量值)

Responding time: <5s(90% measuring value)

3.4 温度精度: 700±1℃

Temperature precision: 700±1℃

3.5 显示内容: Displaying content:

氧浓(O₂%)、oxygen concentration(O₂%),

氧势(mV)、oxygen potential(mV),

炉温(℃)、furnace temperature (℃),

加热电压 (V)、heating-up voltage (V) ,

量程上、下限 (O₂%)、upper-lower limit of scale (O₂%) ,

报警上、下限 (O₂%)、upper-lower limit of alarm (O₂%)。

3.6 键盘设定: 探头零电势校正, 报警上、下限设定,

Keyboard enactment: zero potential correction of probe, enactment of alarm upper-lower limit

3.7 自诊断内容及故障类别符号:

Identifying symbol of self diagnose content and failure class

E—0 氧量上限

E—0 oxygen content upper limit

E—1 氧量下限

E—1 oxygen content lower limit

E—2 温度异常(高)

E—2 temperature abnormality (high)

E—3 温度异常(低)

E—3 temperature abnormality (low)
E—4 升温异常(快)
E—4 temperature-ascending abnormality (fast)
E—5 升温异常(停)
E—5 temperature-ascending abnormality (stop)
E—6 氧势异常
E—6 oxygen potential abnormality
E—7 断偶
E—7 break

3.8 输出: 0—10mA 或 4—20mA

Output: 0—10mA OR 4—20mA

3.9 负载电阻: 0-1.0 k Ω (0-10mA 输出), 0-500 Ω (4-20mA 输出)

Load resistance: 0-1.0 k Ω (0-10mA output), 0-500 Ω (4-20mA output)

3.10 氧探头长度为:0.2m、0.4m、0.6m、0.8m、1.0m、1.2m。

Length of oxygen probe: 0.2m, 0.4m, 0.6m, 0.8m, 1.0m, 1.2m

四、 使用条件

Operating condition

4.1 信号转换器的使用条件

Operating condition of signal converter

4.1.1 仪器安装环境应无易燃、易爆和强腐蚀性气体, 并要求通风良好。

Installation environment of instrument shall be far from flammable, explosive and strong corrosive gas. And it shall be ventilative.

4.1.2 工作环境温度: 0-50℃

Working environment temperature: 0-50℃

4.1.3 工作环境湿度: <90%

Working environment humidity: <90%

4.1.4 供电电压: 220V.AC \pm 10% 50Hz

Power supply voltage: 220V.AC \pm 10% 50Hz

4.1.5 功率消耗: <200W

Power consume: <200W

4.2 氧探头的现场安装条件

Site installing condition of oxygen probe

氧探头的现场安装场所必须满足下列条件:

Site installing of oxygen probe must meet the following conditions:

4.2.1 避开震动场合;

Keep away from shaking occasion;

4.2.2 要有足够的工作空间。

Have enough working space;

4.2.3 烟气温度和压力要在仪器规定范围内。(烟气温度<700℃)

Smoke temperature and pressure shall be controlled within the stipulated range of instrument. (Smoke temperature is less than 700℃.)

五、 仪器的组成

Instrument component

整套仪器由氧探头、信号转换器（氧量变送器）及有关附件组成。

The whole instrument is composed of oxygen probe, signal converter (oxygen content transmitter) and relevant accessories.

5.1 氧探头 Oxygen probe

氧探头由防尘装置、氧化锆管、加热电炉、测温热电偶、接线盒以及壳体等主要部件组成。整个装置采用全封闭型结构，以增加整个装置的密封性能，提高使用寿命。

Oxygen probe is mainly composed of dustproof equipment, zirconia tube, heating electric cooker, temperature-measuring thermocouple, junction box and shell body etc. The whole equipment is fully enclosed to improve using lifetime.

氧化锆管是该检测器的核心，由它产生氧浓差电势信号，使用时应注意避免剧烈震动，以免损坏。

Zirconia tube is the key of inspecting instrument, which can produce oxygen concentration electrical potential signal. Pay attention to avoid strong shocking while using it. Otherwise, damage will be caused.

氧探头内加热电炉的作用是提供氧化锆元件正常工作所需的温度，为延长加热电炉的寿命，在工艺上做了特殊的处理。由于氧探头本身带有加热装置，因而在低于 700℃ 的环境中仍能正常工作。

Heating electric cooker in oxygen probe helps to provide normal operating temperature needed by zirconia element. Special treatment has been made on process for prolonging lifetime of heating electric cooker. Oxygen probe still can work under environment temperature lower than 700℃, because of being equipped with heating equipment.

5.2 信号转换器 Signal converter

ZrO₂-II 型氧化锆氧量自动分析仪的信号转换器实际上是一个小型的测控系统，由单片机作为中央控制系统。

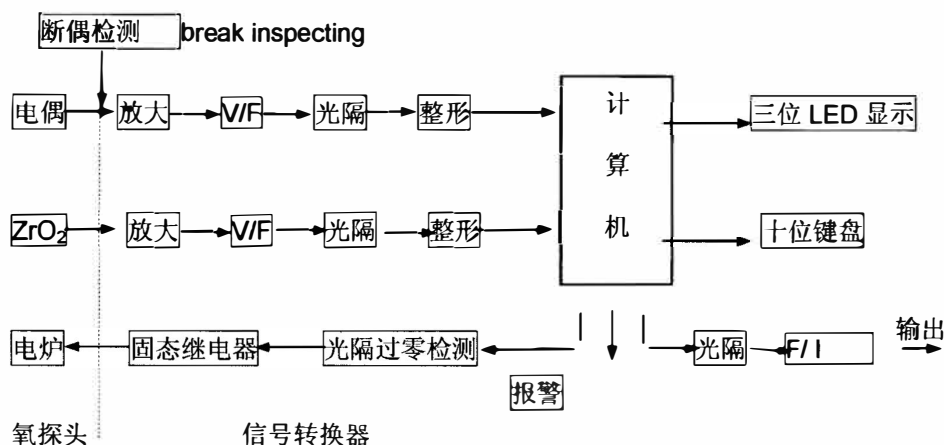
Signal converter of ZrO₂-II type zirconia oxygen analyzer actually is a small measurement and control system with single chip as center control system.

将来自氧探头的模拟信号(氧势、热电势)分别转换成 0-10KHz 调频信号，经光电隔离后送至计算机，采用调频方式能将仪表输入、输出相互隔离，这样就消除了诸如大电流跳变所引起的干扰，能够克服高共模电压，因而大大提高了仪表的抗干扰能力。应用程序主要由主程序和子程序组成，所有的程序都采用模块结构编制，便于修改、增加软件功能，以满足不同用户的特殊需要。程序运算采用了三位浮点数，保证了运算的精度，对氧浓、炉温的计算，采用查表线性插值法，对炉温的控制采用增量式 PID 算式控制。信号转换器的电气原理框图见图 1

First, individually transform analog signal (oxygen potential and thermoelectric potential) from oxygen probe to 0-10KHz frequency modulation signal; then, deliver frequency modulation signal to computer after photo electricity isolation; using frequency modulation method can separate input and output of instrument, which can eliminate interference

caused by great current jump and conquer high common mode voltage. In doing so, anti-interfering ability of instrument is greatly improved. Applying procedure consists of main procedure and sub procedure. All procedures are compiled by using module structure.

It is easy to amend and add software function in order to meet special requirement of different customers. Three floating point numbers is used by procedure calculation to ensure precision of calculation. Linear interpolation is adopted to calculate oxygen concentration and furnace temperature. PID formula is used to control furnace temperature. The figure of electric theory of signal converter is as picture 1.



电偶 thermocouple ; 放大 magnify ; 光隔 light separation ; 整形 plastic ; 计算机 computer; 三位 LED 显示 three LED displaying; 十位键盘 ten figure keyboard;
电炉 electric cooker ; 固态继电器 solid relay ; 光隔过零检测 light separation zero-pass inspecting ;
报警 alarm ; 输出 output ; 氧探头 oxygen probe ; 信号转换器 signal converter。

图 1 信号转换器电气原理框图

Picture1 the figure of electric theory of signal converter

六、 仪器的安装 Instrument mounting

6.1 取样点位置的选择: Position selection of sample point

选择取样点的原则有: Rules for selecting sample point

6.1.1 所取的气样能快速反映工艺状态的变化情况, 即气体要具有代表性;

Gas sample selected can quickly reflect changing circumstantiality of process status, that is, gas shall have representative.

6.1.2 取样点的温度、压力、流量等参数不应变化太大;

Temperature parameter, pressure parameter, flux parameter etc. of sample points should not have great changes.

Inserting depth of oxygen probe shall reach airflow position of flue in order to avoid dead district.

To take samples at the bottom of tube and flue is forbidden.

There should be no leakage from stokehole and flue near sample points, which may cause measurement tolerance.

Sample point should situate in place easy to maintain, examine and repair.

氧探头的安装参照图 3、图 4、进行

Please according picture 3 and 4 to install oxygen probe

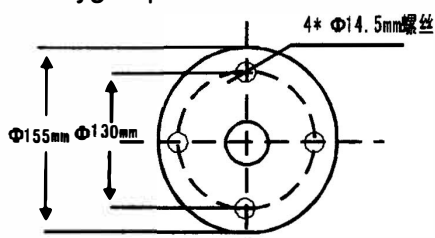
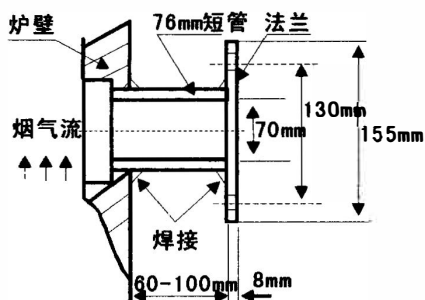


图3 氧探头安装法兰尺寸

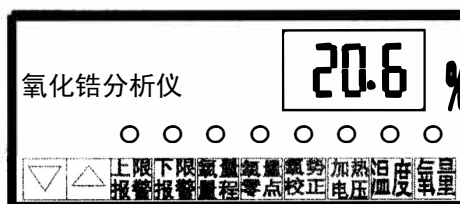
Picture 3 Mounting flange size of oxygen probe

紧固螺丝 fasten screw ; 接线盒 junction box ; 穿线孔 line-punching hole ; 安装法兰 installing flange ; 保护管 protecting tube ; 过滤器 filter; 螺丝 Screw



Picture 4 Mounting flange of oxygen probe welded on furnace wall

炉壁 furnace wall 短管 short tube 法兰 flange 烟气流 smoke airflow 焊接 welding



Picture 5 Converter figure

预先加工好带法兰的 $\Phi 76\text{mm}$ 设备短节，按要求选好取样位置(炉壁或管道)，开一个 $\Phi 76$ 的孔，将短节以水平方式焊接到设备上，焊接时要保证焊接处不漏气。对带余热锅炉流程，在选定取样点位置后， $\Phi 76\text{mm}$ 设备短节应根据保温厚度适当加长穿过炉体保温砖，与炉体钢壳焊牢，露出部分长度大于 60mm。必须注意：应保证设备短节与炉体保温砖之间的密封，绝对不能泄漏。把氧探头插入短节，在短节法兰与氧探头法兰间垫上 2-4mm 厚的石棉垫，旋紧 4 个螺栓，使其不漏气即可。

Machining equipment shorts with $\Phi 76\text{mm}$ flange in advance; choose sample (furnace wall or tube) to take samples according to requirements; open a $\Phi 76$ hole; weld shorts to equipment by horizontal method. Leakage on welding place is forbidden when welding. For boiler flow with excessive heat, after selecting position of sample point, $\Phi 76\text{mm}$ equipment shorts should be appropriately prolonged to pass through heat preservation brick of furnace body in according with heat preservation degree. Then it should be tightly welded to steel shell of furnace body with more than 60mm length protrusion.

We must pay attention to the sealing between equipment shorts and heat preservation brick of furnace body. Leakage is forbidden. Insert oxygen probe into shorts; asbestine cushion with thickness of 2-4mm shall be put between short flange and oxygen probe flange; screw on 4 bolts tightly so that leakage is avoided.

注意:由于探头的参比气是靠空气自然对流提供的,探头必须水平安装,参比气和标准气接口相应朝下.探头端部防护套管的缺口位置(可调整方向)也应垂直向下,以防积灰.

Note: Because sample gas of probe is provided based on air natural convection, probe must be horizontal installed. Connecting of sample gas and standard gas should be in down direction. Gap position of protective tube on probe head should also be vertically down. In doing so, dust can be proof against.

6.3 信号转换器的安装 Signal converter mounting

信号转换器的外形尺寸: 水平 \times 垂直 \times 深 160 \times 80 \times 250mm

Size of signal converter: horizontal \times vertical \times depth 160 \times 80 \times 250mm

仪表盘面的开孔尺寸: 水平 \times 垂直 152 $^{+1}$ \times 76 $^{+1}$ mm

Hole size of instrument panel: horizontal \times vertical 152 $^{+1}$ \times 76 $^{+1}$ mm

信号转换器用随机配备的安装夹板及螺丝安装在仪表盘上,亦可安装在现场仪表保护箱内。

Signal converter is installed on instrument panel by installing splint and screw. It can also be installed in protective box of site instrument.

6.3.1 信号转换器与氧探头之间的连接

Connecting between signal converter and oxygen probe

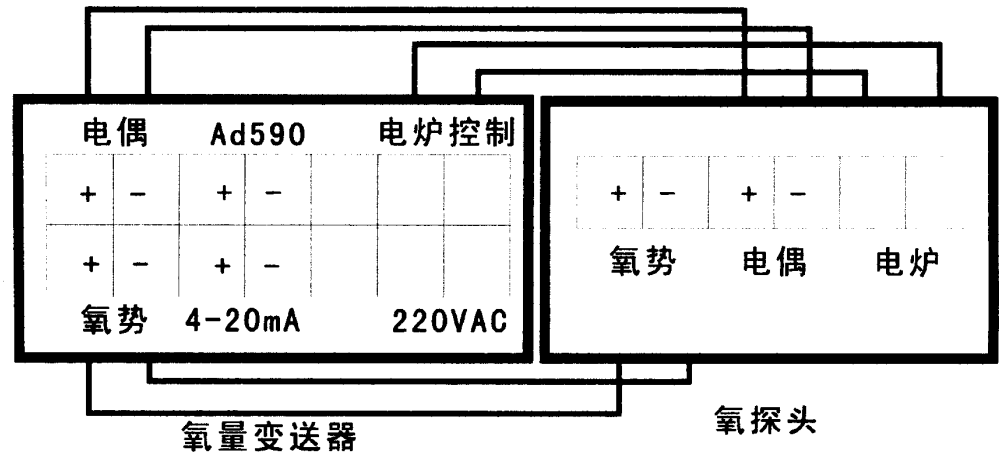
信号转换器盘装于控制室,氧探头安装于现场,它们之间连接线有:氧势信号线两根采用 RVVP2 \times 1.5 带屏蔽二芯电缆线敷设、电偶冷端补偿导线两根,采用 K 分度号 KX-G 型 2 \times 1.5 带屏蔽二芯补偿导线敷设、电炉加热线两根,采用 RVV2 \times 2.5 二芯电缆线敷设。信号转换器与氧探头之间的接线见图 6。

Signal converter panel is installed in control room, while oxygen probe is installed in site.

Connecting wires between signal converter and oxygen probe are including the following:

Two pieces of Oxygen potential signal wires; using RVVP2 \times 1.5 type shielding two cores cable to install; Two pieces of thermocouple cold end compensational cable: using K type KX-G 2 \times 1.5 shielding two cores compensational cable to install; Two pieces of electric cooker heating wire: using RVV2 \times 2.5 two cores cable to install. Connecting picture

between signal converter and oxygen probe is as following picture 6:



电偶 thermocouple; 电炉控制 electric cooker control; 氧势 oxygen potential; 氧量变送器 oxygen content transmitter; 氧探头 oxygen probe

图 6 信号转换器与氧探头接线图

Picture 6 Connecting picture between signal converter and oxygen probe

6.3.2 接线时应注意下列要求:

Notes for wiring:

6.3.2.1 加热线与信号线应分开穿管;

Heating wire and signal wire shall individually pass through tube;

6.3.2.2 锆管的氧势、热电偶温度补偿信号线都是具有极性的信号线，安装时应注意极性的正确连接。

Oxygen potential signal wire of zirconia tube and temperature compensational signal wire of thermocouple are all signal wires of polar. So, pay attention to connect polar correctly while mounting.

七、使用方法

Operating method

信号转换器的使用 Usage of signal converter

7.1 开机及状态说明 Switch-on and status description

置信号转换器于“测量”状态（出厂时，信号转换器已置于测量状态），开机后，显示屏显示“——”符号，表示开机正常，2S 后进入程序升温状态，显示屏交叉显示“UUU”及温度，温度键对应指示灯亮，经 1h 炉温到达 700℃，并自动退出程序升温状态转入氧量测量程序，氧量键对应指示灯亮，LED 窗口显示当时氧量，输出通道给出与所选择的测量范围及当时氧量有关的模拟量(0-10mA 或 4-20mA)。

Make signal converter be in the status of measuring (that is initial status for delivering); after switch-on, the display will appear “——” symbol, which means normal “switch-on”; two seconds later, enter into procedure temperature-ascending status. The display will

cross-appear “UUU”and temperature. Then, indicator light relevant to temperature-key is

on. When furnace temperature reaches 700℃ one hour later, it will automatically retreat from procedure temperature-ascending status, and turn into oxygen content measuring procedure. At this time, indicator light relevant to oxygen-content-key is on. LED window displays temporal oxygen content. Output channel will present analog value (0-10mA OR 4-20mA) relevant to measuring range to be selected and temporal oxygen content.

开机后各状态说明如表 1

Status description after “switch-on” as table 1

表 1 开机后状态说明
Table 1 Status description after “switch-on”

状态 Status	显示 display	输出 output	说明 description
开 机 switch-on	— — — —		开机后稳定约 2S Stabilize for 2S after “switch-on”
程序升温 Procedure temperature -ascending	升温符“UUU”、 temperature-ascending symbol“UUU” 温度值各 1S Temperature value each 1S	0-1000℃对应为 0-10mA 或 4-20mA 0-1000℃ corresponds to 0-10mA OR 4-20mA	按键不影响输出 Keys won't effect output
氧量测量 Oxygen content measuring	氧 量 Oxygen content	由数字开关“2”“3”的位 置决定 Depending on “2”“3” position of number “on-off”	按键不影响输出 Keys won't effect output

7.2 在线查询参数 Online parameter query

在线查询参数的具体按键操作说明如表 2

Specific key-manipulation of online parameter query as following table 2

表 2 测量状态下按键操作详细说明

Table 2 Detailed key-manipulation description under measuring status

按键 keys	显示内容 displaying content
氧量 oxygen content	氧量 (O ₂ %) oxygen content (O ₂ %)
温度 temperature	炉温 (°C) furnace temperature (°C)
加热电压 heating voltage	电炉加热电压 (V) electric cooker heating voltage
氧势 oxygen potential	经零电势校正后的氧探头电势 (mV) Electric potential of oxygen prober after zero electric potential correction (mV)
氧势、氧量零点(同时按) oxygen potential, oxygen content zero point(press at the same time)	显示氧探头输出电势 (mV) display output electric potential of oxygen probe (mV)
氧量零点 oxygen content zero point	显示测量范围下限设定值 (O ₂ %) Display lower-limit enactment value of measuring range (O ₂ %)
氧量量程 oxygen content scale	显示测量范围上限设定值 (O ₂ %) Display upper-limit enactment value of measuring range (O ₂ %)
上限报警 upper-limit alarm	显示氧量上限报警设定值 (O ₂ %) Display upper-limit alarm enactment value of oxygen content
下限报警 lower-limit alarm	显示氧量下限报警设定值 (O ₂ %) Display lower-limit alarm enactment value of oxygen content

在“程序升温”状态下，仪表显示升温符号及当时温度值，在正常“测量”状态下，仪表显示当时“氧量”值，当要查询“温度”或“氧量”以外的其它参数时，只要按下面板对应键，在显示窗口立即显示对应参数值，但按键动作不影响程序升温时温度或测量状态时氧量所对应的模拟输出量，且在 10S 后显示内容自动返回，恢复显示程序升温状态时的温度或测量状态时的氧量值。总之，在测量时，任何按键动作不影响与氧量相对应的模拟量输出，仅仅是显示内容的改变，且在 10S 后返回。

Under the status of procedure temperature-ascending, instrument will display temperature-ascending symbol and temporal temperature value; Under the status of normal measuring, instrument will display temporal oxygen content value; When looking for other parameters instead of temperature or oxygen content, you only need to press corresponding key on the keyboard. Then corresponding value will appear in the displaying

Window. However, key-pressing action will not have an effect on corresponding analog output value of temperature of procedure temperature-ascending and oxygen content under measuring status. And displaying content will automatically return back 10 seconds later. Then the instrument will get back to display temperature value of procedure temperature-ascending or oxygen content under measuring status. In general, when measuring, any action of key-pressing will not affect analog output corresponding to oxygen content. It will only display content-changing and return back 10 seconds later.

7.3 仪器的校正 Instrument calibration

由于氧化锆元件参数的离散性，由于氧化锆元件在使用过程中的老化，由于安装点参比气的流通情况不尽相同，可能使氧化锆元件的测量产生较大误差。因此，不仅对新安装的氧化锆探头需要进行在线校准，而且必须定期（3-6 个月）对运行中的探头进行校准。

Great error of measuring zirconia element may be caused because of many reasons including discrete character of zirconia element parameter, aging of zirconia element during operating, different circulating of sample gas in installing position etc. So, it is not only necessary to on-line calibrate new-mounted zirconia probe, but also necessary to periodically calibrate prove in operating (three to six months).

在实验室或现场,把氧探头和转换器按图 6 正确连接好并接通电源,一小时后温度达到 700℃. 旋开探头上的标准气螺栓,将瓶装 5%含量的氮中氧标准气体通过减压器将其流量控制在 100ml/分钟,用无味乳胶管送入探头的标气口内.观察转换器的氧量显示值,若氧量偏差较大则需按一下“氧势校正键”,再通过按“加”或“减”键使显示值增加或减少一些,再按“氧量”键,查看氧量是否在 5%左右,若未达到标准请重复此步骤调整.若无法调到标准,说明锆管已老化,需换新锆管.

In laboratory or on site, first, correctly connect oxygen probe and converter in accordance with picture 6; then switch on power supply; one hour later, temperature will reach 700℃. Screw off bolt of standard gas on probe; control flux of 5% oxygen in nitrogen standard gas within 100ml/minute through reducer; then, deliver it into standard gas port of probe by flavourless latex tube. Now, observe oxygen content value of converter. If there is great deviation of oxygen content, you need to press “oxygen content calibration” key. Then press “+” or “—” key to add or reduce value; Next, press “oxygen content” key to check whether oxygen content keeps within 5%. If it doesn't keep within 5%, please repeat the step. If you still can not achieve it, it means that zirconia is aging and you need to replace zirconia tube.

无标气现场校准:旋开探头上的标准气螺栓,使空气进入标准气导管,按一下转换器面板上的“氧势校正键”,通过按“加”或“减”键使显示值为 $\pm 0.1\text{mv}$ 以内.再按下“氧量”键应显示 20.6 即可,校准结束应将标准气螺栓重新旋紧即可正常使用.

Site calibration of non-standard gas: screw off bolt of standard gas on probe; let air enter into standard gas tube; next, press “oxygen potential calibration” key on converter panel; next, press “+” or “—” key to control displaying value within $\pm 0.1\text{mv}$; then, press “oxygen content” key. The displaying value must be 20.6. Screw on bolt of standard gas after calibrating; then it can normally work.

7.4 上下限报警设定值的改变 Change for upper-lower limit alarm enactment value

按上限报警(或下限报警)键，此时显示上限报警(或下限报警)设定值，如需进行改变，按“加”或“减”键，直至符合要求为止。

Press “upper-limit alarm”(or “lower-limit alarm”) key, then, enactment value of upper-limit alarm or lower-limit alarm will appear. If you need to change the value, you only need to press “+” or “-” key until the value is up to the mustard.

7.5 异常报警说明 Description of abnormal alarm

在发生异常时，LED 窗口显示故障类别，并将报警接点接通，此时，输出不自锁。详细说明如表 3。

When abnormity happens, LED window will display failure class. Then switch on alarm relay. At this time, output will not lock by itself. For details, please see the following table 3.

表 3 异常报警功能说明

Table 3 Function description of abnormal alarm

显示 <i>display</i>	报警内容 <i>Alarm content</i>	可能故障 <i>Possible failure</i>
E—0	氧量上限 upper-limit of oxygen content	
E—1	氧量下限 lower-limit of oxygen content	
E—2	温度异常（高）temperature abnormity(high) 炉温高于 750℃ Furnace temperature is above 750℃	
E—3	温度异常（低）temperature abnormity(low) 炉温低于 650℃ Furnace temperature is below 650℃	
E—4	温升异常（快）temperature-ascending abnormity (fast) 程序升温时，温度上升太快，不受控制。 Ascending of temperature is too quick and out of control when procedure temperature- ascending.	固态继电器击穿 Solid relay puncture
E—5	温升异常（停）temperature-ascending abnormity (stop) 程序升温时，停止升温。Ascending of temperature is stooped when procedure temperature-ascending.	电炉丝断 electric cooker wire broke 固态继电器截止 Solid relay cut-off
E—6	氧势异常 oxygen potential abnormity 检测到氧电势高于 120mV Oxygen electric potential is above 120mV.	
E—7	断偶 break	断偶或电偶极性接反 Break or wrongly connect polar of thermocouple

注：表 3 不包括由于仪器信号故障所造成的氧量测量值偏高、偏低或不稳定，其故障排除方法可参考 7.1.3 仪器校准的步骤进行。

Note: table 3 is excluding higher, lower or unstable of measuring value of oxygen content caused by instrument signal failure. For these failures, please refer steps of 7.1.3 (instrument calibration) to eliminate failure.

仔细检查氧探头是否符合第 5 节所述安装要求后，在氧探头电炉温度达到 700℃后，仪表应显示系统当时氧含量，并输出与氧量对应的模拟量。

Carefully inspect whether mounting of oxygen probe is meeting the requirements stipulated in section 5. After electric cooker temperature of oxygen probe is up to 700℃, the instrument should display system temporal oxygen content, and output analog value corresponding to oxygen content.

八、故障判别及排除方法

Failure identification and elimination method

故障处理步骤 Steps for dealing with failure

1、将氧探头从取样口抽出，在现场与信号转换器按说明书要求正确接线，并使氧化锆探头升温至 700℃。测量锆管的零电势及高温内阻，应分别小于 $\pm 5\text{mV}$ 及 500Ω （出厂时，锆管零电势及高温内阻分别小于 $\pm 3\text{mV}$ 及 100Ω ），如能符合要求，说明氧化锆管性能良好。若零电势及高温内阻分别大于 $\pm 5\text{mV}$ 及 500Ω 以上，需换新锆管.然后按照 7.1.3 节说明的方法进行校准。

Draw out oxygen probe from sample port; correctly connect oxygen probe with signal converter according to user's manual on site; make temperature of zirconia probe up to 700℃. Zero electric potential and high-temperature inner resistance of measured zirconia tube should individually be less than $\pm 5\text{mV}$ and 500Ω . (Zero electric potential and high-temperature inner resistance of zirconia tube is individually less than $\pm 3\text{mV}$ and 100Ω when deliver; If it can meet the requirement, it means that performance of zirconia tube is good. If zero electric potential and high-temperature inner resistance is individually more than $\pm 5\text{mV}$ and 500Ω , it means that you need to replace zirconia tube. Then refer steps of 7.1.3 to calibrate it.

2、在氧探头“氧势”端子处卸下内部探头连线，将手动电位差计输出信号由“氧势”端子输入，不同的毫伏输入，信号转换器应显示不同的氧量，其关系参见附录 A“氧浓度—浓差电势对照表”。

Disassembly connecting wire of inner probe on the “oxygen potential” terminal of oxygen probe; input output signal of hand-control type electric potential difference from the “oxygen potential” terminal; input different milli-volt, different oxygen content will appear on signal converter. For details, please refer to attached A--“table of oxygen concentration---concentration potential”

3、确认氧化锆探头性能，氧量测量及温度控制系统均正常后，重新将氧探头装回取样口。

Firstly ensure that performance of zirconia probe, measuring of oxygen content and temperature control system are all in good condition, then install oxygen probe into sample port again.

九、仪表成套性
The whole instrument

全套仪表装箱清单：Packing list of the whole instrument

信号转换器 Signal converter	1 台 1 piece	转换器安装螺丝 mounting screw for converter	2 套 2 sets
氧探头 Oxygen probe	1 台 1 piece	检验合格证 test certificate	1 件 1 piece
使用说明书 User's manual	1 本 1 piece		

附录 A 氧浓度—浓差电势对照表 (0.1—15%O₂)

Attached A Table of oxygen concentration---concentration potential (0.1—15%O₂)

(计算条件: 参比气氧浓度为 20.6%, 工作温度 700℃)。

(calculating condition: sample gas oxygen concentration is 20.6%; operating temperature is 700℃.)

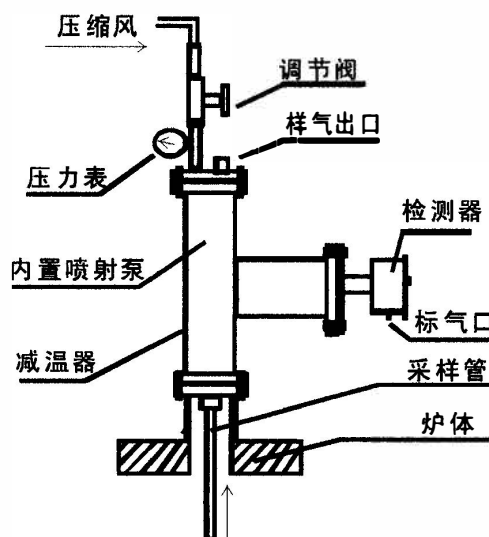
氧浓度%(V/V) Oxygen concentration	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
电势 mV Electric potential	111.7	97.14	88.64	82.67	77.93	74.11	70.88	68.03	65.62	63.41
氧浓度%(V/V) Oxygen concentration	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	6.00	7.00
电势 mV Electric potential	54.91	48.88	44.20	40.38	37.15	34.35	31.88	29.67	25.85	22.62
氧浓度%(V/V) Oxygen concentration	8.00	9.00	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0
电势 mV Electric potential	19.82	17.36	15.15	13.15	11.33	9.65	8.10	6.65	5.30	4.03
氧浓度%(V/V) Oxygen concentration	18.0	19.0	20							
电势 mV Electric potential	2.83	1.70	0.62							

附录 B 高温型检测器的原理及系统组成

Attached B theory and system component of high temperature type inspecting instrument

高温型检测点的气体温度可达 0-1400℃，高温型是采用抽气或正压自喷的方式，将炉气引入减温器装置内，经扩容、减压、降温后使其实际温度降至 600℃ 以下，从而实现对高温气体的检测。

Gas temperature of high temperature type inspecting point is up to 0-1400℃; High temperature type adopts extraction method or positive pressure self-spouting method to put furnace gas into inducer equipment. After through expanding capacity, reducing pressure and temperature, its actual temperature will fall under 600℃. In doing so, we can do inspection on high temperature gas.



压缩风 compressing wind ; 调节阀 adjusting valve; 压力表 pressure gauge; 样气出口 sample gas outlet ; 内置喷射泵 inner ejecting valve ; 检测器 inspecting instrument ; 标气口 standard gas port ; 减温器 temperature-reducing instrument ; 采样管 sample tube ; 炉体 furnace body.

高温型检测器的原理图

Theory map of high temperature type inspecting instrument

由于高温型检测器的特殊结构，在安装时请注意以下几方面：

- 1 当待测气体温度在 800℃ 以上时，高温型检测器的取样管应呈垂直形式安装，以防高温取样管因自重产生弯曲变形。
- 2 如果炉气压力为负压或为忽正忽负时，应选用负压型高温型检测器。以 50-100kPa 压力的压缩风接入抽气系统，调节控制阀，将被测气体抽入采样装置中。

- 3 如果炉气压力为正压时，应选用正压型高温型检测器。利用正压自喷使待测气体进入采样装置，并通过调节阀控制喷出气体的压力保持在微正压状态（50kPa 以下）。
- 4 如果减温器内温度过低（ $<150^{\circ}\text{C}$ 时），由于硫化物结露会造成喷射泵堵塞，应采用保温材料将减温器进行保温。必要时，可将压缩风金属管道铺在炉体高温处，加盖保温材料，使压缩风加热到 $>150^{\circ}\text{C}$ 再接入喷射泵，只要样气出口的气体温度 $>150^{\circ}\text{C}$ 喷射泵就不会堵塞。

Because of special structure of high temperature type inspecting instrument, please pay attention to the following notes when mounting:

1. When target gas temperature is above 800°C , sample tube of high temperature type inspecting instrument should be vertically installed in order that high temperature sample tube will not bend and distort because of self weight.
2. If furnace gas pressure is negative or either negative or positive, you had better choose negative pressure high temperature type inspecting instrument. Connect it into extrusion system by compressing wind of 50-100kPa pressure; adjust control valve; extrude target gas into sample equipment.
3. If furnace gas pressure is positive, you had better choose positive pressure high temperature type inspecting instrument. Make use of positive pressure self-spouting to let target gas into sample equipment. By adjusting valve, control pressure of spouting gas under positive pressure (below 50kPa).
4. If temperature in temperature-reducing instrument is less than 150°C , block of injection pump may be caused by sulfide frost. So you had better use warm-keeping material to maintain temperature in temperature-reducing instrument.

If necessary, you can put mental tube of compressing wind on high temperature place of furnace body and cover warming-up material. It will not until the temperature of compressing wind is more than 150°C that it is time to connect with injection pump. As long as gas temperature of sample gas outlet is more than 150°C , block of injection pump will not happen.