KYKY
中科科仪

ZQJ-291 HLD

USER MANUAL

北京中科科仪技术发展有限责任公司
KYKY TECHNOLOGY DEVELOPMENT LTD.

ZQJ-291　HLD

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USER MANUAL

KYKY TECHNOLOGY DEVELOPMENT LTD,.

CONTENTS

NOTICES

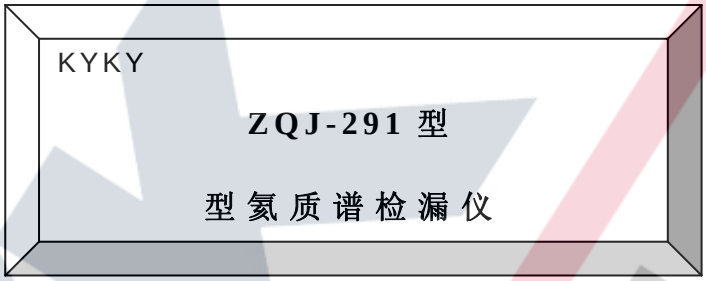
1. To be sure the supply power plug is good.

2. In order to avoid the HLD fault, please abide by operation specifications of HLD.

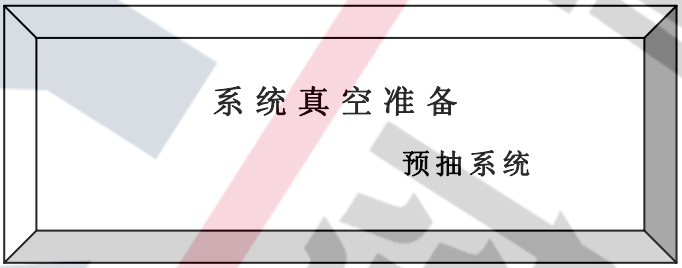
3. To be careful of operation, don't put other things on the panel lest hurting the LCD.

WORK STEPS

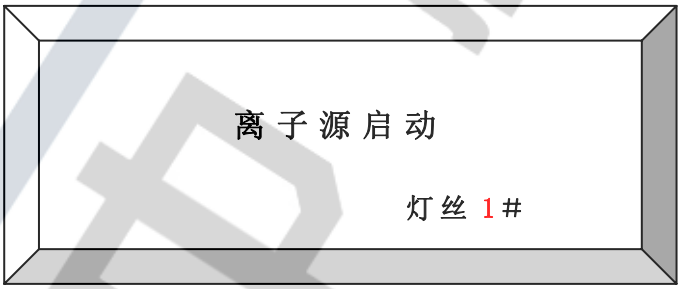
1. Switch on the HLD, LCD displays the following information:



Wait for a while, it displays "ready for vacuum" -> "roughing"-> "turbo pump starting" -> "turbo pump is normal" -> "waiting" -> "detecting system vacuum" -> "vacuum is ok". Until this time, the system will spend another 7 minutes on being ready for vacuum.

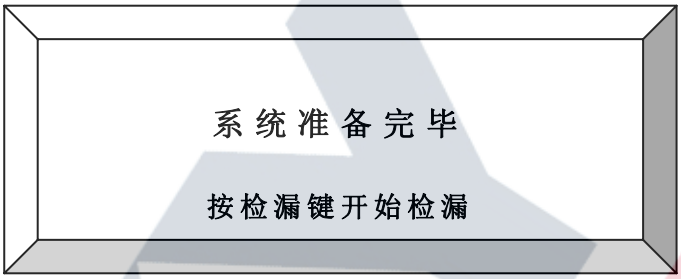


2. During this process, the LCD will displays "starting up ion", and the second line is "filament No.1 or No.2", the filament will be work..



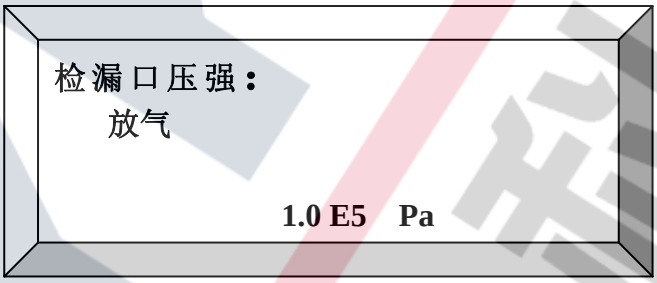
3. At the left-top of LCD is "leak rate", and right-top of LCD is "zero". Then the HLD begins to adjust zero.

4. All of these steps is automatically completed, at the end, LCD displays “system is ready” and “please push the test button to work”.



OPERATION Operations after the HLD is ready:

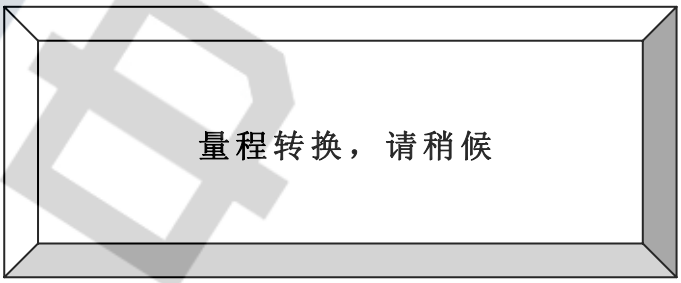
1. There are 2 keys of 检漏 & 放气 , 放气 is designed for venting the inlet port, if push this key, the LCD displays the pressure “ **1 .0E5 Pa”**, then the operator can take out the work.



2. After taking out the work, push 检漏 key to test, when the pressure of valve reaches the preset value, the test valve will be opened.

3. With 选项 key, you can enter the menu, the details is introduced in the behind sections.

4. The 量程 key can control the mode of signal range between manual and auto. In the auto mode the leak signal displays from 0.1× 10^{-10} Pa.m^3/s to 9.9×10^{-3} Pa.m^3/s, in the manual mode, the leak signal doesn’t change, unless you change by ▲ and ▼ keys.



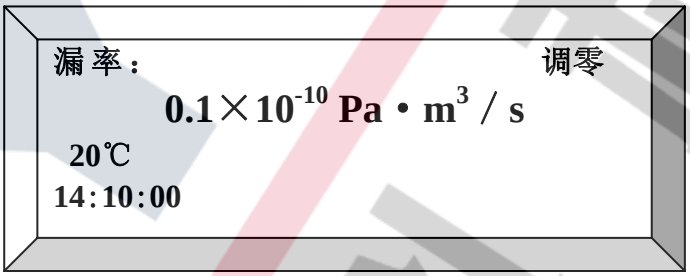
Note: During switching the range, if the leak signal is in range of -7, push the up arrow, it displays "量程转换，请稍等", then the range is changed to 10^{-8}~10^{-5} Pa • m^3/s, by the same way, if the leak is in range of -8, push the down arrow, the range can be also changed to 10^{-10}~10^{-7} Pa • m^3/s.

5. The 音频 key can open and close the speaker, the speaker will sound if the leak signal is more than ejecting point, the ejecting point is described in the *menu* section.

6. The 漏孔 key can open inner leak in order to check if the HLD is correct, after checking, push again to return the test status.

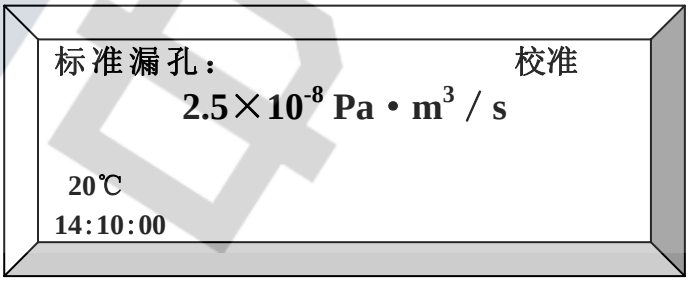
7. The 退出 key is to exit the system, you can push "退出" to cancel, and push "确认" to end the test work, then switch off the power。

8. The 调零 key can zero the current leak signal, this is to say, push this key, you can adjust the current value as the background, then on the top right corner of the LCD displays "调零".



Note: We don't suggest that you should use this function if the leak signal is higher than 2.0× 10^{-8} Pa • .m^3/s.

8. The 校准 key can do calibration with inner leak or external leak (default is inner leak), during the test status, if you choose the inner leak, the HLD can calibrate automatically with the inner leak parameters. If you choose the external leak, you can operate by the message shown on the LCD. During the process, the HLD can compensate temperature error.



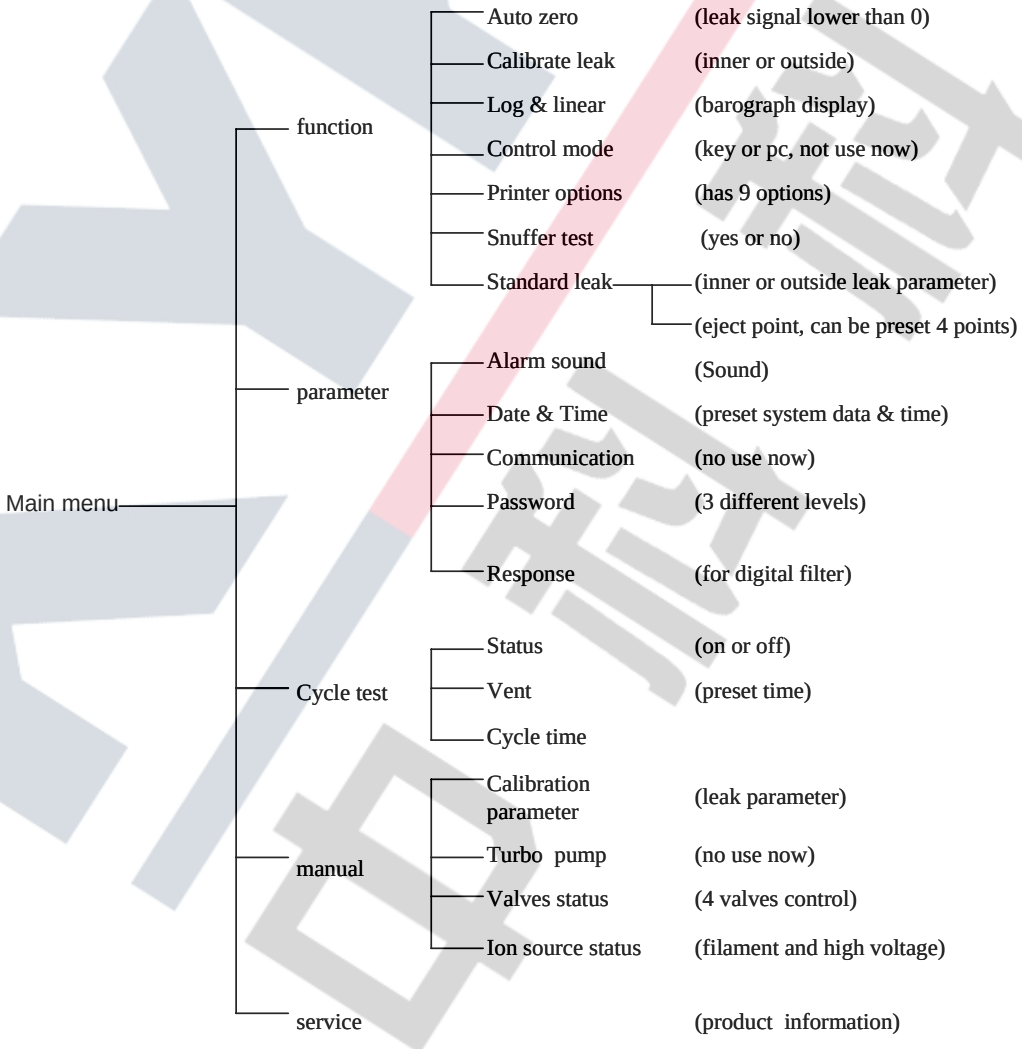
During calibrating, if the leak signal is lower, it displays “信号过小”, then you can push 校准 key to do peak automatically.

9. The 打印 key can set the printer information. When you are ready for testing the work, you can push this key, after testing, push this key again, then the printer prints the maxim signal value between these two pushing times, the details of printer are described in the behind sections.

10. The 确认 key is used to validate all the information, and ▲ ▼ ◄ ► Keys are to adjust the parameter and display the menu.

MENU

At any status you can enter the main menu by inputting password, there are 3 different levels, and they have different menus, if passwords are cancelled, you can operate these free options which has been set before, you can refer to next section to know how to preset different level passwords.



1. Auto zero: during in test mode, if the leak signal is lower than 0, you can determine whether it is zero automatically by 确认 ◄ ► keys.

2. Calibration leak: you can select the inner or outside leak to do calibration, the operation method likes above.

3. Log or linear: you can choose the display mode, in log mode the leak signal range is from 0.1E-10 to 9.9E-3, operation method just like above.

4. Printer options: you can define the contents of print, it includes HLD style and number, work name, time, temperature, standard leak, test leak value, eject point and pass or not. The HLD number is the factory number. The work number can be set by ▲ ▼ keys, and push 确认 Key to validate, after this, the printer can be automatically increased the number per time. Temperature is the inner value of HLD. Leak signal value is the maximum between two times of pushing the 打印 key. It can judge if the work is passed or not by eject point and current leak signal, all these options you can preset by 确认 and ▲ ▼ keys.

5. Sniffer test: it is able to choose, in the case of this mode, the pressure of opening test valve is 20Pa.

6. Parameter set: the normal parameter is controlled by level 1, push 确认 key to do this.

6.1. Standard leak parameter: these parameters is only for calibration, you can set by pushing 确认 Key, there are 2 options of inner and outside leak, with ▼ ▲ keys to choose, and with 确认 key to enter, you can adjust leak parameter by ▼ ▲ keys. Push the 确认 to validate.

6.2. Alarm sound: there are 4 eject points you can preset, with 确认 ▼ ▲ keys to change the value, during test, you can choose the eject point number by ▼ ▲ keys. If current leak signal is higher than some eject point, the speaker will sound, the volume can be adjusted by ▼ ▲ keys.

6.3. Date & Time: the system date and time can be adjusted by ▼ ▲ keys and push key 确认 to validate.

6.4. Communication: it is not used now.

6.5. Password setup: before you reset password, you must input the old password, then you can preset the new one, the password is made up of 4 numbers, with ▲ ▼ keys can change.

Note: Password has 3 levels, the third level is the highest level, and the first level is the lowest level, higher level has the right to enter lower level; All the level is explicated as follows:

N0.1 level: Function selection

Parameter setup

Cycle test

Service information

N0.1 level: Manual/calibration setup

Manual/ion source status/filament

N0.1 level: Manual

Manual/valve status/turbo pump status

Manual/ion source/ion gauge

Manual/ion source status/high voltage

7. Response time: Set the filter response time const, the unit if 0.1s, you can regulate by   Keys, it is from 0.0s to 5.0s, and the default value is 1.0s.

8. Cycle test: Stop& start cycle test, and the No.1 password level can control corresponding parameters.

8.1 Cycle test status: open or close the cycle test by   keys.

8.2 Vent: open or close the venting time, with   keys can adjust the time,

8.3 Test time: update the cycle test time.

9. Manual: you can control system components and inner parameter by manual.

9.1 System calibration settings: set the main inner parameters by   and 

keys. All the parameters are as follows:

Accelerate voltage (V)-------ion source voltage

Repelled voltage (V)-------ion source repelled voltage

Focus voltage (V)------ion source focus voltage

Emitted current (mA) ------filament emitted current

Inlet port vacuum compensation------adjusted in program

Calibration gain------signal calibration parameter

System vacuum gain------fore line vacuum calibration parameter

Inlet port vacuum gain------inlet port vacuum calibration parameter

Ion gauge gain------high vacuum calibration parameter

Temperature sensor gain------environment temperature calibration parameter

The first amplifier calibration------adjust by program

The second amplifier calibration------ adjust by program

Vacuum exchange------the inlet port pressure value

Zero compensation------system zero compensation

Temperature compensation------environment temperature measure compensation

Zero reference------is only for KYKY testing

Note: Thereinto, the three voltage of ion source determine the helium peak, vacuum exchange value decide the roughing pressure of inlet port, the initialization is 10 Pa.

9.2 Turbo pump status: it is no used now, don't enter this menu.

9.3 Valve status: No.3 password level can control the four of valves, including roughing valve, test valve, vent valve and standard leak valve by manual, this function is available only for maintenance man.

9.4 Ion source status: No.2 password level can control ion source status by manual:

Filament: the special man of No.2 password level can change the filament number by   Keys.

Ion source gauge: only one who has the No.3 password level has the right to control the ion source gauge by manual.

High voltage: it is like to ion source gauge method.

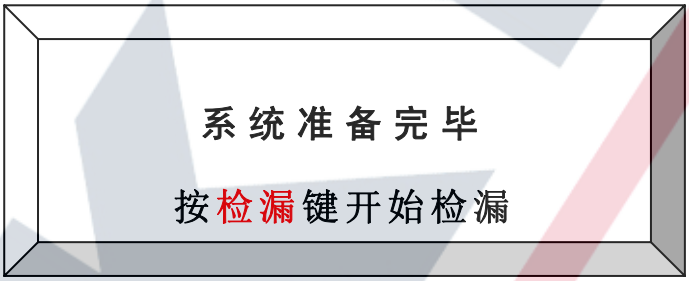
9.5 Service information: the simply specification of KYKY.

Note: Chinese character 291K HLD has other menu, such as gross leak test menu, in this menu, you can set the inlet port pressure up to 2000Pa.

DETECTION PROCESS

1. Connect the supply power and switch on, LCD displays "**291K 型氦质谱检漏仪**" character. After 10 minutes, during this stage, HLD will prepare the system vacuum, ion source burning and zero etc.

2. The HLD is ready if the LCD display “系统准备完毕” and “按检漏键开始检漏” character with 4 times beep.



3. Check the inlet port if it is ok, then you can push 检漏 key to test, during testing, you can adjust some parameters, such as opening the standard leak valve, auto calibration, peaking the helium signal by manual and soon on.

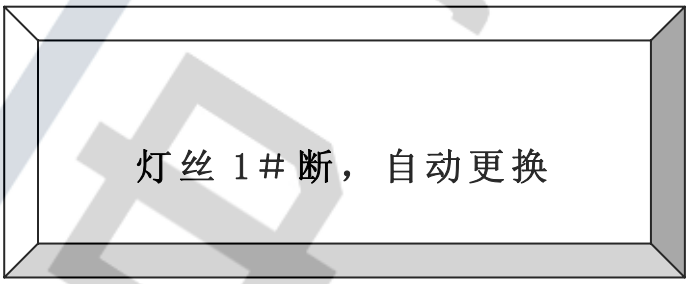
4. Push the 放气 key to vent the inlet port, and mount the work on it, then push 检漏 key to test.

Note: you can stop roughing during roughing the work by 放气 key.

5. After finishing the work, you can exit the system wit 退出 key, at the end, turn the power off.

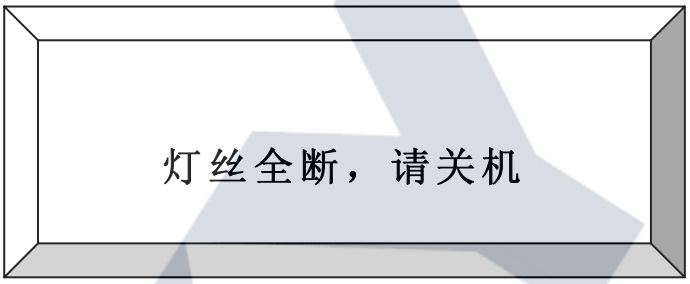
SUPLEMMENT

1. If the LCD displays “灯丝 1（或 2）#断，自动切换”, it means that one of two filaments is error, may be burned or other fault, system will switch on the other filament automatically.

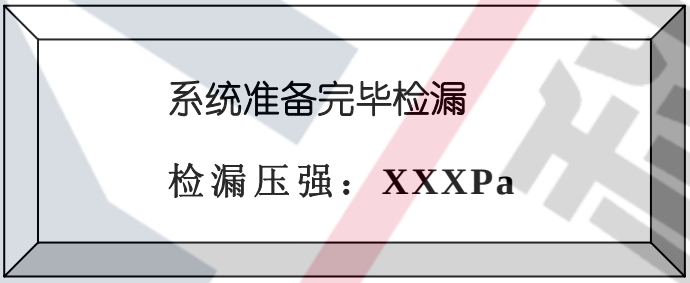


2. If it displays ”灯丝全断，请关机”, it indicates all the filament are fault, push the 确认

key to validate, then system will turn off the high voltage, valves and turbo pump, you must cut off the supply power to check.



3. If the inlet port explores atmosphere suddenly or the vacuum pressure is higher, it can lead ion source current higher, in order to protect the filament against burning, system will cut off the power of filament, and close the roughing valve, at this time, LCD displays “真空保护” , it means system take the vacuum protection, then you need to check the work, when the fault is resolved, system can turn on the filament again, and LCD displays as following message.



4. When you change the printer paper, you need to take off the printer by loosing the screws, and put new paper in printer then install it again.

ZQJ-291 Helium Leak Detector

Maintenance manual

KYKY Technology Development Ltd.

Catalog

User's Notice

1. Strictly abide by all operating rules of 《291K user's manual》 and notice below:
   - Forbidden inlet port exposure atmosphere when the HLD isn't in the vent stage;
   - According to normal rules when Shut off , avoid straightly to decrease electric strike
   - Be care for lay down lightly when using exterior standard leak to calibrate, avoid to collide .Notice: Open the leak to decrease the stabilized time of signal when using the standard leak.
2. Avoid to collide the LCD、leak LED and printer.
3. Be sure the temperature of the surrounding between 5℃～35℃, humidity≤85%, and the normal cleaning surrounding .
4. Check the stage of the HLD timely, and put up necessarily maintenance. The detail method see Maintenance ;

Maintenance

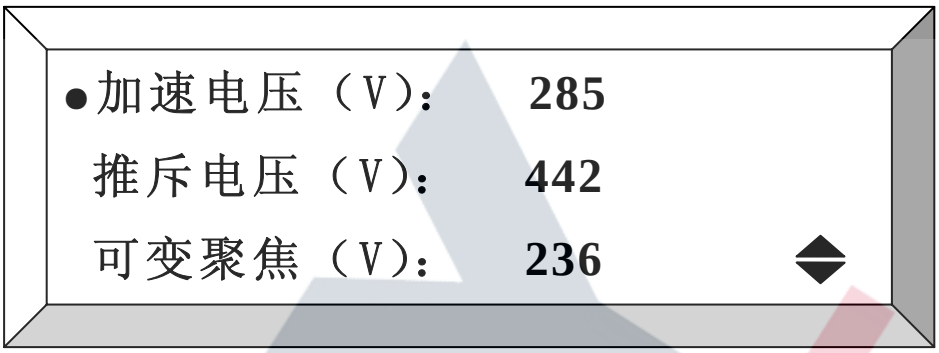
1. Daily-check
   - Press 漏孔 key to open the inter standard leak, or use the external standard leak, observe the difference between the measured value and the calibrated value ,calibrated when it be necessary. Notice: you must consider the temperature's influence for the external standard leak.
   - Enter the Main menu "control by hand" calibrated set for system, check all parameters.
     1) Whether the value of the parameter be abnormal? Too big or too small?
     2) Whether the "calibrated gain" value are suitable? If it exceed 4.50, 如 it means the signal not enough, need to adjust the stage of the ion source , refresh the strength of the ion source, the detail method see " adjust peak";
2. Adjust peak

   Usually, the two following stage need to adjust helium peak:

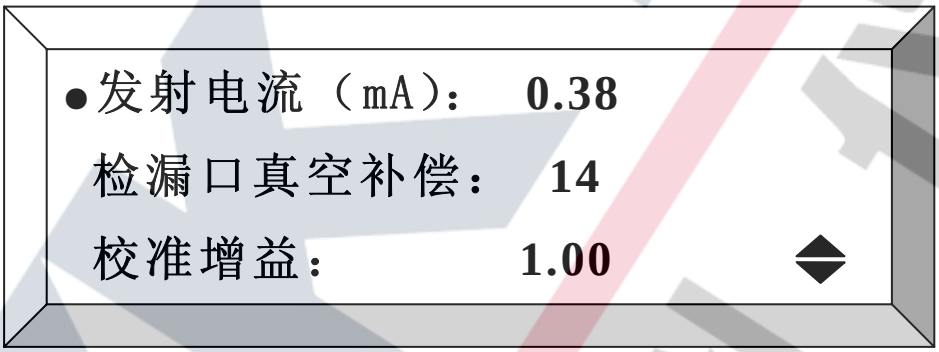
   1) The voltage of the ion source work point badly deflected, entirely no helium peak. If start at first or after impulse by strength electronic disturb.
   2) The voltage of the ion source work point a little deflected, "the calibrated gain" value over the 4.50, maintenance people think it be necessarily to adjust helium peak.

   Adjust helium peak has two method, hand adjust and auto adjust. In the above, the first stage need to hand adjust , and the second stage need both the two method .

   - *hand peak:*
     (1) Press 漏孔 key to open the interior standard leak, or use the external standard leak. The arm makes the signal of helium into the HLD. (HLD, that is, helium leak detector)
     (2) Press 选项 key and enter the main menu, "hand adjust" calibrated set for system, there are three parameters:



(3) Press ▼ arrow key and move the cursor down until to second page. :



Set the "emission current "value is 0.38, then come back the first page , the method see the user's manual.

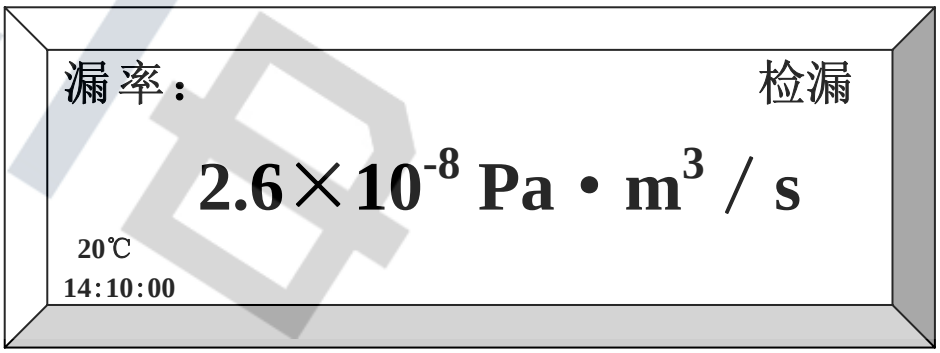
(4) Set the ion source voltage volt, the process is following : Increase the accelerate volt and observe the LED display of the leak. If continuously increased the accelerate volt and find the leak rate decrease, adjust decreased until to find the maximum value. Then adjust the "repel voltage" is same with above to find the maximum value.

(5) Exit the menu, press 漏孔 key to close the interior leak , check the helium signal , if the helium signal decreased, it means the helium signal . otherwise it is not the peak of helium. When used the exterior leak, directly closed the leak.

(6) Press 校准 key then after calibrated, can normal leak.

- *Auto adjust peak.*

(1) In the test stage



press 校准 key, let the HLD into calibrated progress.

(2) After the zero progress, the message in the right above of the LED become "calibrated", press 校准 key, the HLD enter auto adjust peak. The message of the right above LED become " peak"

(3) The HLD calibrated after 10 minutes when the auto peak are completed.

(4) The HLD refreshed the normal stage after calibrated.

3. Observe the oil level of RVP

Check sight glass. If oil level is low add fresh mechanical pump oil until the level is between the marks in the sight glass, when the pump is not running.

4. Change oil of RVP

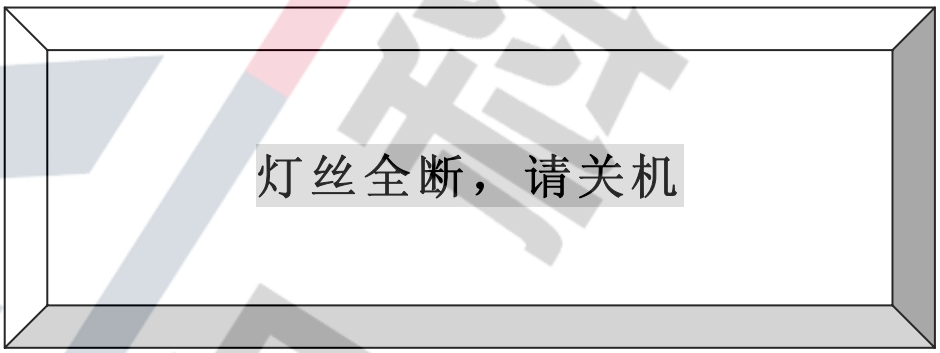
Use these instructions for the RVP oil change. It is necessary to change the RVP oil every six months or if unable to pump below 5 Pa because of oil contamination.

Proceed as follows:

1. Drain the mechanical pump oil, as follows:
   a. Place drain pan under drain plug, then turn on RVP
   b. Remove the drain plug
   c .Place palm of hand over mechanical pump air outlet hole. This will force oil out of the pump
   d. When oil has been completely removed, shut off the RVP
2. Reinstall drain plug and add one cup of fresh oil through fill plug
3. Repeat steps 2 and 3 above until oil runs clean
4. With drain plug reinstalled, refill pump with fresh clean oil. Fill until oil level is in middle of sight glass when pump is running. Reinstall fill plug.
5. With test port plugged, turn on mechanical pump.

5. Maintenance of Ion Source and MS tube

If the LED emerge "all the filaments are broken, please shut off". Measure the



resistance value of the two filaments, need to change the filaments. Ensure the HLD power is shut off, and drop the power plug.

1). Depart the right and back panel, you can see the turbo pump and MS

2). Loosen the bar clasp and vent both the turbo pump and MS

3). Loose plug of ion source power and preamplifier power, and cutting-out plug in the preamplifier.

4). Remove spectrometer tube from the manifold.

5). Remove three mounting screws and take off magnet assembly

6). Remove four screws on each side of spectrometer tube body and slip out both pole pieces. Discard O-rings.

7). Remove four screws and take down the total ion monitor, ion source and preamplifier.

8). Using fine emery cloth, remove heavy deposits from all surfaces of baffle, ground slit plate, until bare metal surfaces are exposed. (NOTE: Do not use crocus cloth, as it leaves a residue.)

9). Rinse spectrometer tube body, pole pieces, ground slit plate, and total ion monitor in a Freon-type solvent (DuPont Freon TF or equivalent).

10). If foreign matter or stubborn stains remain, rub them with a Plastic scouring pad such as "Bear-Tex" or "Scotch-Brite™" (very fine grade)

11). Rinse again in Freon-Type solvent.

12). Use warm air to dry all parts

13). Reassemble pole pieces (using new O-rings), and magnet assembly. Pole pieces are interchangeable.

1). Install ground slit plate. (When installing ground slit plate be sure that the prongs are facing up. Align slits at 90° with sidewalls of spectrometer tube and /or concentrically align circular hole in plate with smaller guide hole in bottom of ion source cavity.) See Fig.4-1

15). Wipe new o-ting and mating surfaces with clean lint-free cloth and place new ion source in cavity. Locating pin should be approximately in center of guide hole. Be sure pin and 8 arc parallel to the sidewall of the spectrometer tube (Fig.4-2) Tighten hold-down flange evenly and firmly.(A straight edge held against pins 1 and 8 of both octal arrays is a convenient way to assure parallelism .)

16). Install Preamplifier using new O-rings. Tighten clamps evenly and securely

17). Install total ion monitor. (See Fig2-4)

18). Install spectrometer tube in manifold, using flange and O-ring.

19). To evacuate spectrometer tube, act operating switch to the "0" position and leave the Leak Detector is in the Rough stage. .

6. Valve Block Cleaning

1. DISASSEMBLY (Discard all O-rings if new ones are available).

a. Relieve the electromagnetic valve plug.

b. Remove the two corrugated pipes which linked the mechanical pump and the turbo pump.

c. Remove the thermocouple gauge, vent valve and the test port.

d .Remove the test valve spool. Notice: Don't lose the four balls of the spool.

e. Remove the rough valve as the same way.

f. Remove the four screws which linked the assembly valve body and the framework, take away it from the framework.

7. Cleaning Valve Block

Wash all parts, except thermocouple gauge, in Freon (or Acetone and Gasoline) to remove all foreign matter and residual Apiezon grease. Dry thoroughly in cleanliness circumstance.

NOTICE
Don't clean the O-ring with the acetone !

Reassembling Valve Block

a. Check the assembly valve body whether it is be cleaned and the sealing face cannot have radial scratches.

b. Moisten all new O-rings with Apiezon vacuum grease until they are shiny.

c. Mount the assembly valve body in the framework. Fix the test valve, rough valve according to the disassembly order. First fix the spool then fix the valve cap body, and last fix the coil and the enclosure. Insert the power plug.

NOTICE
The four screws which linked the valve cap and the assembly valve body must be over spring and screws down evenly.

d. Assemble thermocouple gauge, vent valve and test port.

e. Linked the corrugated pipe and fix the framework panel.

8. Self-leak test

Accuracy, reliability and stability of my mass spectrometer leak detector depend upon the leak-free integrity of its own vacuum system. Inherent helium background and its effect on sensitivity demands elimination of all detectable leak. If performance degrades during operation or after some part of the vacuum system is opened for switch, a methodical leak check will eliminate the possibility of a leak as the cause

1). The leak detector has tuned and calibrated. （See 3.3.2 and 3.3.3）

2). Install the test port plug, and the test valve is opened.

3). When spraying suspected leak locations, always apply helium sparingly, starting at the highest points first. Once found the large leak, ought to mend immediately and then check the suspect places.

9. Other maintenance

If the HLD emerge the other troubles, pleased contacted the service of the KYKY.

Trouble and Settle

1. RVP don't go round when start:

Open the switch is on and the RVP don't work leak to " the overtime of the low vacuum "

Cause: poor connect of the RVP or the switch is off.

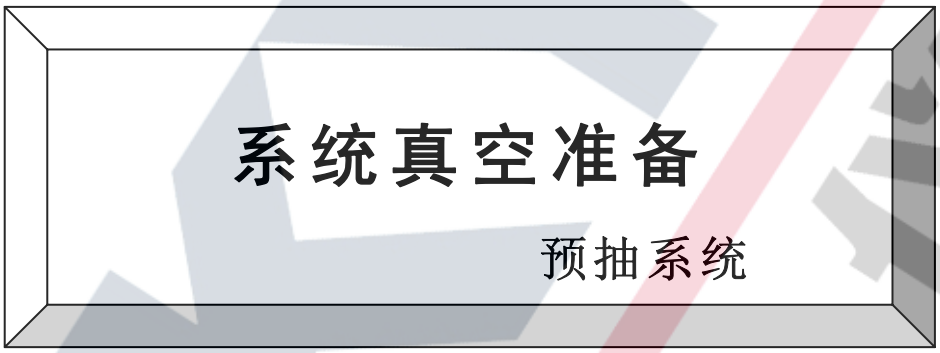
Settle：a. Check that blower is plugged in and operating

b. Check for poor connection in wiring to the fan

c. Check for shorted or overloaded power circuit and correct

2. Display trouble message:" low pressure overtime

Phenomena :the LED display "**系统真空准备**" little word "预抽系统" about 15minuts , the messages "低真空超时" is appeared.

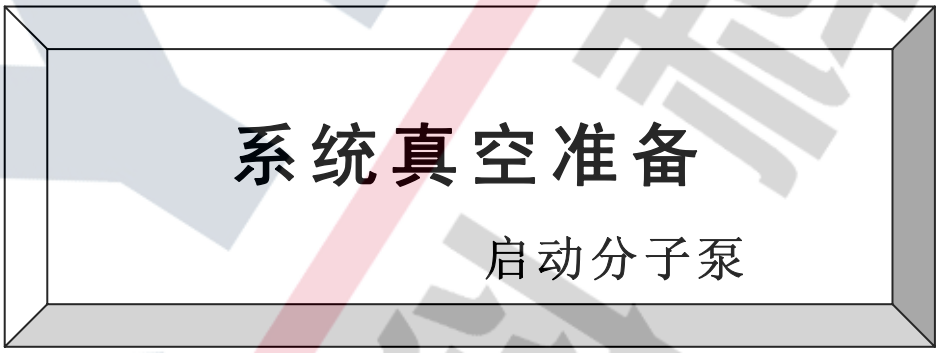


Cause: the system is leak or the foreline thermocouple gauge is damaged.

Settle: Change the thermocouple gauge or connect the service of KYKY.

3. Pump don't start

Phenomena : the LED display "启动分子泵", but the pump don't start.



Cause：a, The device 4N33（03） of the controller of pump is damaged.

b. The fuse of the controller is burned.

Settle: a. Change the device 4N33

b. Change the fuse.

4. Display trouble message: "pump overtime

Phenomena: The LED message displayed " 启动分子泵", and the time is over3 minutes, the pump speed don't normal, the LED display" 分子泵超时";

Cause: a . The device 4N35(01) is damaged of the pump controller.

b. The controller is troubling .

c. The system has leak.

Settle: a. Change the 4N35;

b. Connect the service of KYKY.

5. Display trouble message: "high pressure overtime"

Phenomena: the LED display "分子泵正常"、"请稍等",and the time is over

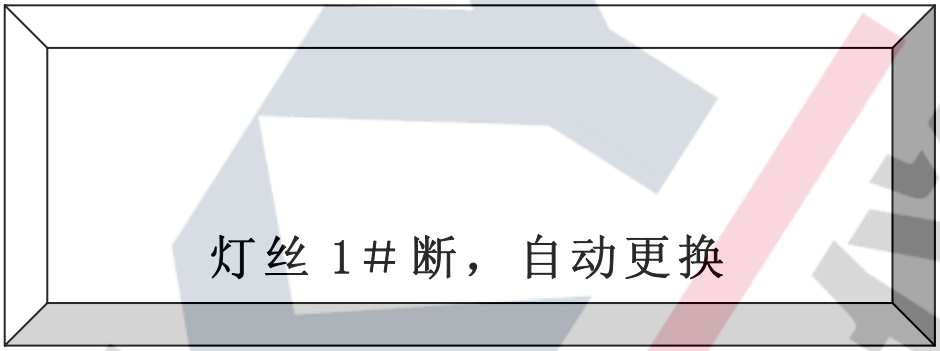
15minutes, the display “高真空超时”;

Cause: the HLD vacuum system has little leak or the HLD has not start for long time.

Settle: connect the service of KYKY.

6. Filament break

Phenomena: a. during the start and leak process, the LED display “灯丝 1（或 2）



#断，自动更换”;

b. The LED display “灯丝 1（或 2）#断，自动更换” then display “灯丝全断，请关机”;

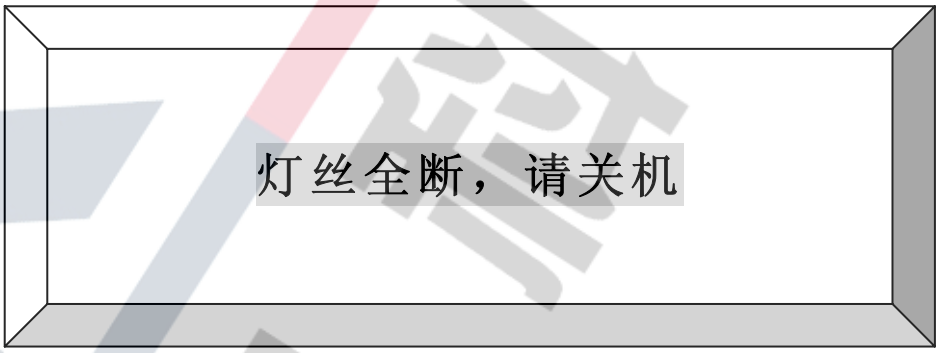
Cause : one or two filaments of the ion source burned, or the 2731(U36) is damaged.

Settle: a. the HLD auto change other filament and normal, don’t do anything.

b. Check ion source. If the two filaments burned, change ion source. The method see Daily maintenance “ion source maintenance”; otherwise change the 2731(U36) of the switch power box.

7. Display trouble message: ”NO He Peak”

Phenomena: the LED display “没有氦峰” when the auto peak isn’t succeed.



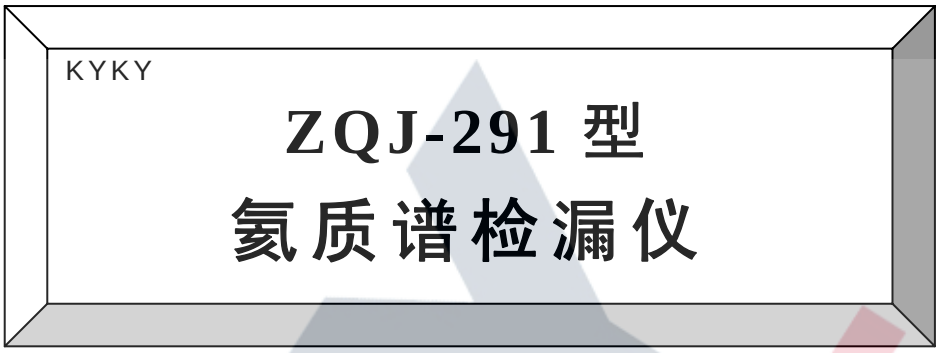
Cause: a, the stage of ion source has big change when the HLD don’t start long time.

b. the strength disturb lead to interior parameter been changed, enter the menu to check them .

Settle: a. press 选项 key enter menu, adjust helium peak by manual, the detail method to see Daily Maintenance “adjust peak ” 中的 “*adjust peak by manual*”;

(1) Shut off the HLD

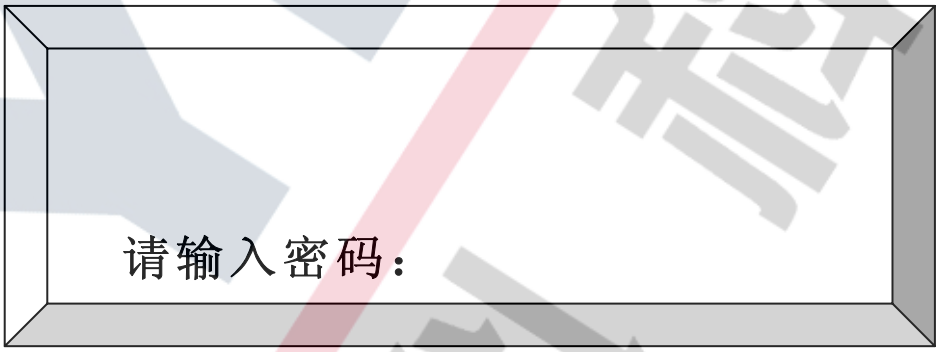
(2)Restart the HLD and press 选项



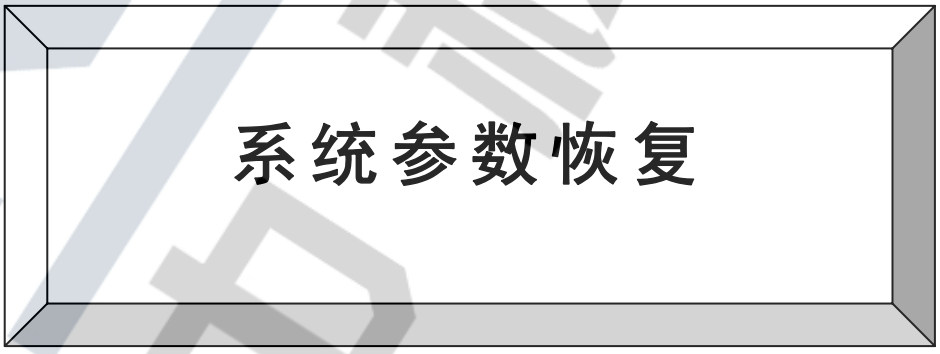
key

(3)The Led display “恢复系统参数” “确认/退出”, Press 确认 key;

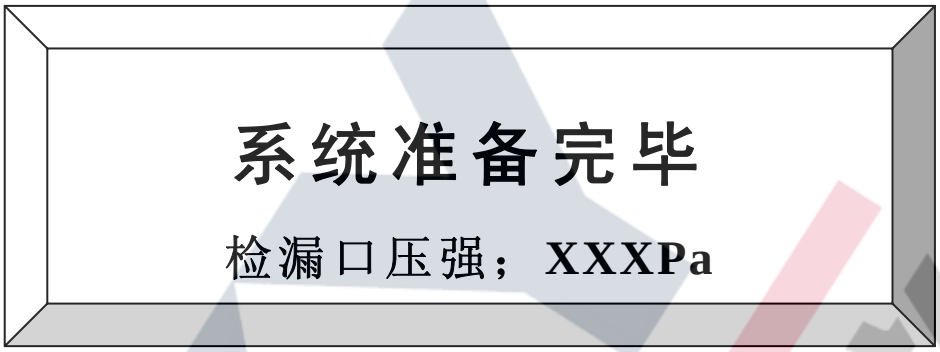
(4)The LED display “请输入密码:”, enter the third passport , the LED



display “系统参数恢复”;



(5)The LED display“系统准备完毕”、“检漏口压强；XXXPa”, press 检漏 key



(6)Enter leak progress , press 漏孔 key to open interior calibrated leak or input the exterior leak.

(7)press 选项 key enter menu, manual adjust helium peak, the detailed method see Daily maintenance “调整氦峰” “*手动调峰*”;

(8) According to System parameter table ,set the system parameters.

(9) Notice, if reset the value of calibrated leak

(10) Set the passport and recorded it.

(8) Display message “signal too small”

Phenomena: The LED display “信号过小”when the calibrated is over.

Cause：the signal less than the normal

Settle: Check the system parameter“校准增益”, if the signal is not too big, the HLD can use normally. If the signal is too big, and the calibrated gain over4.50, it can adjust peak, the detail method see Daily Maintenance “adjust helium”;

(9) Display trouble message: ”temperature too high”

Phenomena : the LED display “温度过高”or“温度过低”when during test leak.

Cause：the temperature is too high or too small.

Settle: adjust temperature bulb. ,

System parameter table

Name	Reference value	Function
Accelerate	240V～350V	Acc. Of ion source
Repel	330V～530V	Rep. of ion source
Focus	160V～315V	Foc. Of ion source
Emission	0.18～1.0 mA	Emission current
The compensation of the test port Vacuum	14	Parameter
Gain	1.0～4.0	System signal gain
System vacuum gain	1.00	System vacuum gain
The test port pressure gain	1.00	The test port pressure gain
The ion gauge gain	1.00	The ion gauge gain
The gain of temperature	1.0	The gain of temperature
The first amplifier calibrated	0.96	Calibrated 10 imes
The second amplifier calibrated	0.82	Calibrated 100times
Vacuum transfer	10～20Pa	The pressure of the open valve
The big leak transfer	2000Pa	The pressure of the open valve
Zero compensation	20mV	System signal zero
Temperature compensation	0.00℃	Temperature zero compensation

Appendix A: Principle

Principles of Mass Spectrometry

A mass spectrometer sorts gases by their molecular weights (mass number) to determine the quantity of each gas present. With the helium leak detector (HLD), the point of interest is primarily in helium and the mass spectrometer tube is relatively simple. The principle is to ionize the gases in vacuum, accelerate the various ions through a fixed voltage, and then separate the ions by passing them through a magnetic field. A slit, properly placed, allows only helium ions to pass through and be collected. The resulting current is amplified and a leak rate bar graph indicates the presence and amount of helium. See in Fig. A1The track radius is such as:

$$R = \frac{144}{B} \times 10^{-4} \left[\frac{M}{Z} U \right]^{1/2}$$

R------Ion deflexion track radius
B-------Intensity of magnet field
M/Z----Mass-to-charge radio
U-------Accelerate power

In the mass spectrometer tube, R and B are held constant and we are concerned only with singly ionized helium atoms (M=4), and (Z=1) so the only variable to adjust is U. When the voltage is adjusted for collecting helium ions, the machine is said to be “tuned” to helium, and mass (4) will plot as shown in Fig.A2

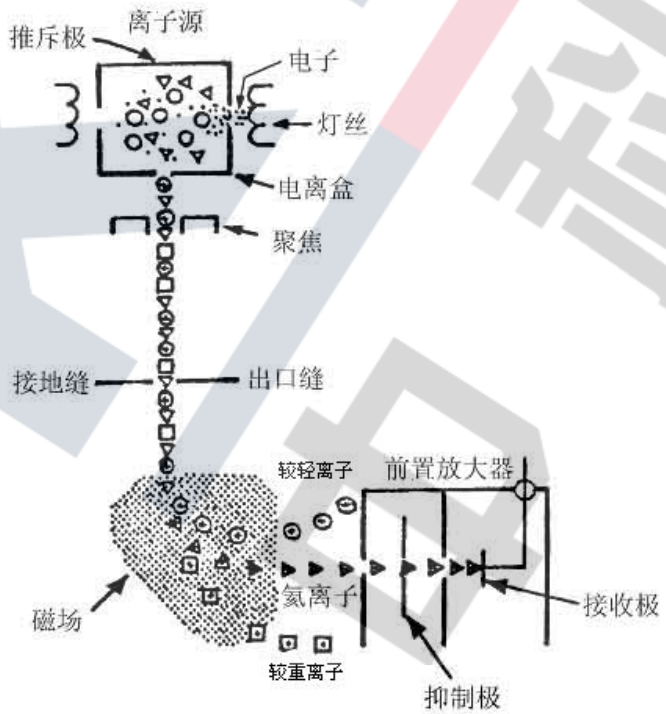


Fig. A-1 The principle of the MS

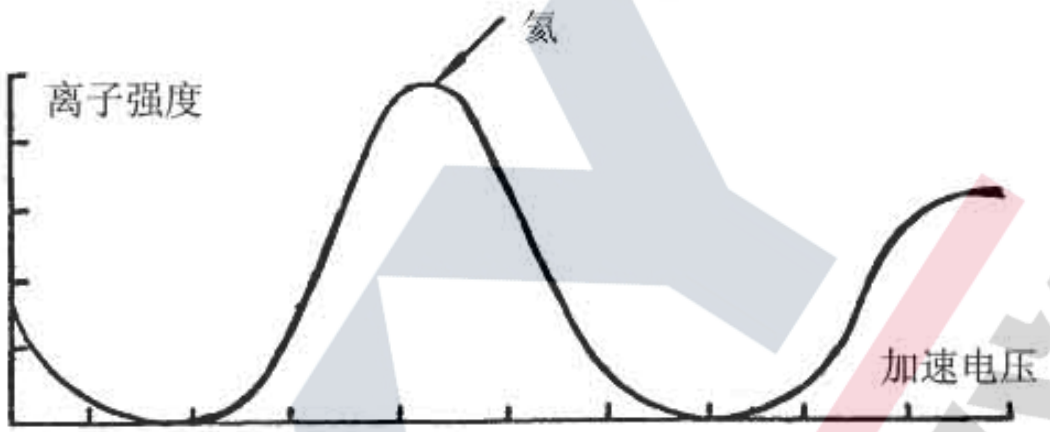


Fig.A-2 Mass Spectrum of HLD

Test Mode

Most leak detection methods depend on the use of a tracer gas passing through the leak and being detected on the other side (for example, visual detection of air bubbles in water). The mass spectrometer leak detector operates with helium as a tracer and is widely used because it combines high sensitivity with production testing capability. The three basic methods in common use are described below.

Test Piece Evacuated

The object to be tested is evacuated by the leak detector roughing pump, then valve into the spectrometer vacuum system. The surface of the test object is then probed with a small jet of helium to locate individual leaks, or surrounded by helium (hooded) for an overall leak check.

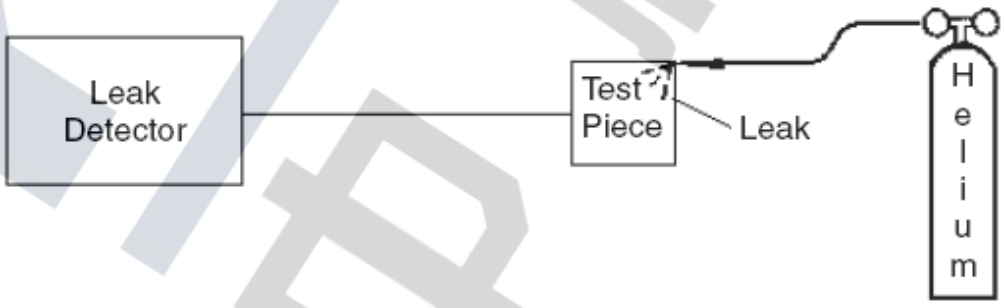


Fig.B-1 Test Piece Evacuated: Tracer Probe Used to Locate Leak

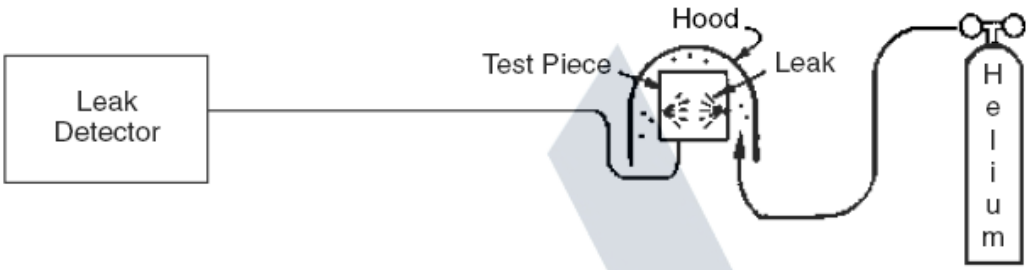


Fig. B-2 Test Piece Evacuated and Hooded with Helium Atmosphere to Determine Overall Leak Rate

Test Piece Pressurized

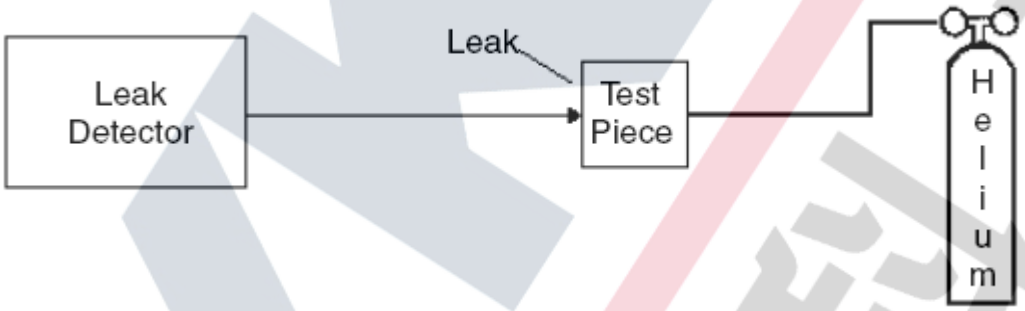


Fig. B-3 Test Piece Pressurized: Detector Probe Used to Locate Leak

A sampling probe is connected to the leak detector. The object to be tested is filled with helium at the desired test pressure and the probe is moved over its surface. Some of the helium escaping from a leak is captured through the probe and enters the leak detector, thus locating the leak.

Sensitivity of this type of testing is limited to about 10^{-8} Pa • m^3/sec, since most of the escaping helium diffuses into the surrounding atmosphere. The sensitivity is also limited by operator technique and variation in ambient helium concentration in the vicinity of the testing.

An alternative to probing is to enclose the object and probe the enclosure for a change in helium content.

Test Piece Already Sealed

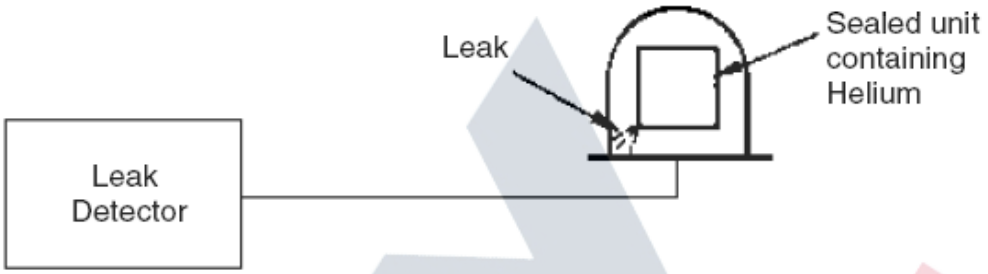


Fig. B-4 Test Piece Sealed with Helium or Mixture of Helium and Other Gases: Bell Jar Used to Determine Overall Leak Rate

Sometimes it is necessary to leak check a completely sealed object. This may be done by placing helium inside the object before sealing (either 100% or mixed with other gas used for backfilling). The object is then placed in a vacuum chamber connected to the leak detector. Helium escaping from the object into the vacuum chamber is detected by the spectrometer tube. Sensitivity depends on the partial pressure of helium in the object.

If the presence of helium in the finished object is undesirable, units already sealed may first be placed in a container that is then pressurized with helium for a specific time at a known pressure. Helium will enter the object through any leaks and may be detected later, as described in the previous paragraph. Gross leaks may sometimes not be detected, since all helium entering through a large leak may be lost prior to testing. Also, spurious signals may be given by helium not entering the object, but entering surface fissures and remaining long enough to be detected.

1-3pressure and leak rate unit

1-3.1 pressure unit

	Pa	Torr	mbar	bar	atm
1Pa	1	0.75×10^{-2}	0.01	10^{-5}	0.99×10^{-5}
1Torr	133	1	1.33	1.33×10^{-3}	1.32×10^{-3}
1mbar	100	0.75	1	10^{-3}	0.99×10^{-3}
1bar	10^{5}	750	1000	1	0.99
1atm	1.013×10^{5}	760	1013	1.013	1

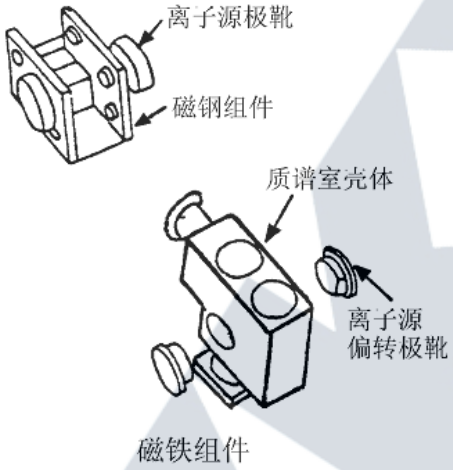
1-3.2 leak rate unit

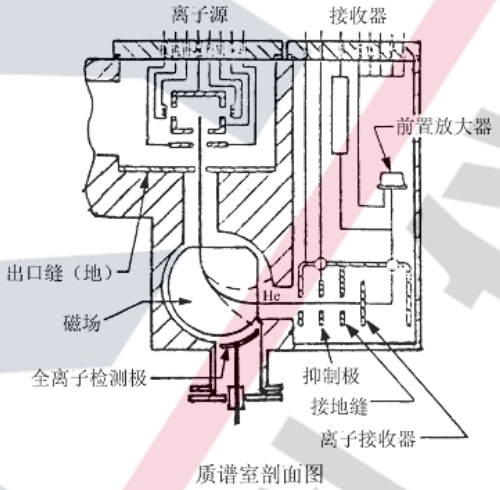
	Pa • m^3/S	Torr • L/S	mbar • L/S	atm • mL/S
1Pa • m^3/S	1	7.5	10	9.9
1Torr • L/S	0.133	1	1.33	1.32
1mbar • L/S	0.1	0.75	1	0.99
1atm • mL/S	0.101	0.76	1.01	1

Appendix B：The configuration of 291

1 MS Tube

MS tube are included ion source, magnetic analyzer and receive， and the magnetic analyzer is 90° deflexed .

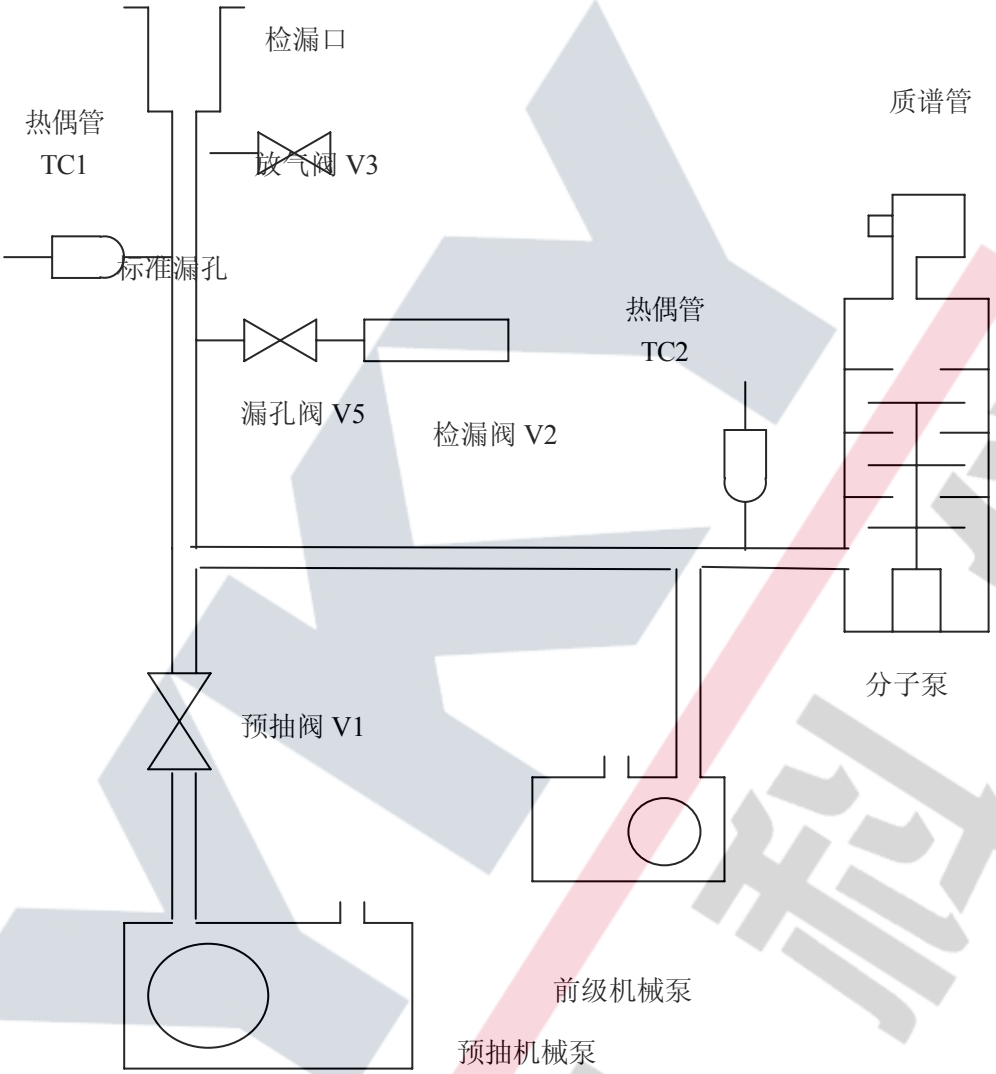




质谱室剖面图

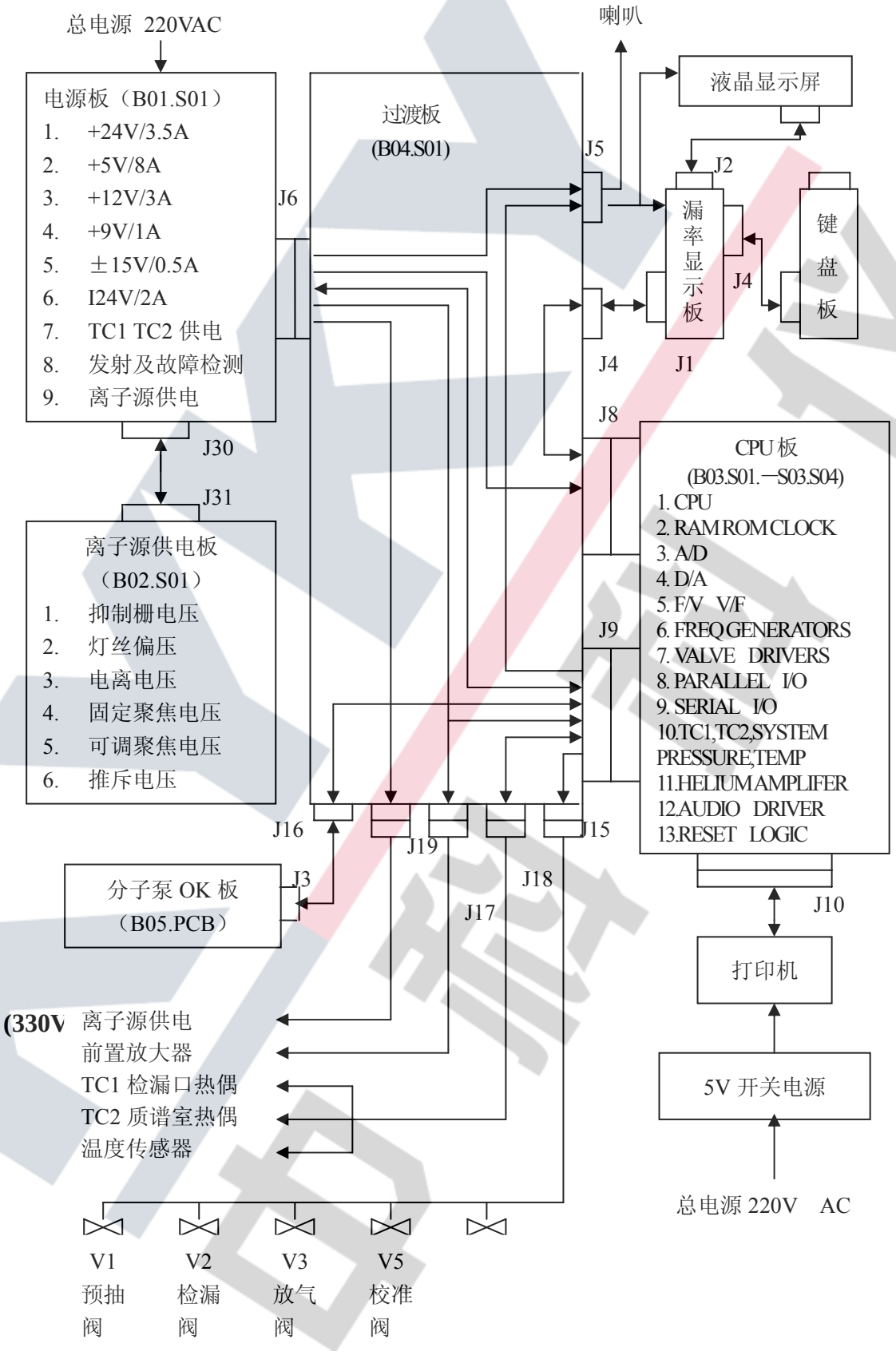
2 vacuum system

The vacuum system is composed of turbo pump、RVP and solenoid valves.


检漏口
热偶管
TC1
放气阀 V3
质谱管
标准漏孔
热偶管
TC2
漏孔阀 V5
检漏阀 V2
分子泵
预抽阀 V1
前级机械泵
预抽机械泵

291　真空系统原理图

Appendix C: The electric system connect of 291



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