

Chapter 1 Spectrometer overview

1.1 Introduction to the instrument

The TY-9000 desktop direct reading spectrometer is a high performance full spectrum direct reading spectrometer developed by our company using atomic emission spectroscopy (AES) technology. The appearance of the instrument is shown in Figure 1-1:



Figure1-1Appearance of the TY-9000 direct reading spectrometer

The TY-9000 Direct Reading Spectrometer is an easy-to-use spark direct reading spectrometer and the measurement principle is shown in Figure 1-2. During the analysis of the instrument, an electric spark is generated between the electrode on the spark stand and the previously prepared metal sample under the action of high pressure. The composite light emitted by the spark passes through the lens and then enters the light chamber through the entrance slit. After the light is split by the grating, the light of different wavelengths is separated at different angles and irradiated onto the CMOS sensor. The CMOS sensor converts the optical signal into an electrical signal and transmits it to the computer through the measurement system. After processing by the computer, the analysis result is calculated, and the content of each element in the metal sample is displayed through the display, and the result can be summarized or print.

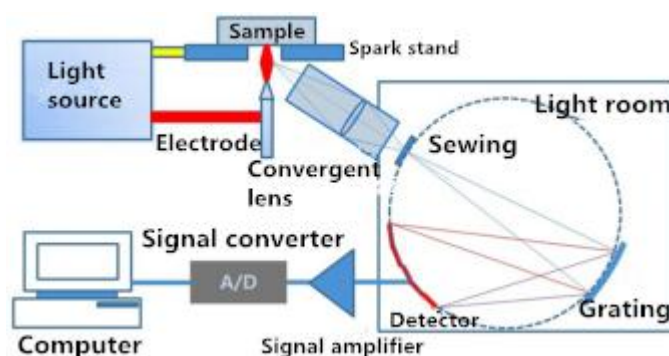


Figure 1-2 Working principle of TY-9000 direct reading spectrometer

The TY-9000 direct reading spectrometer uses CMOS full-spectrum acquisition technology, all-digital pulsed synthesis light source technology and advanced argon self-cleaning UV wave transmission technology to ensure the analytical performance and reliability of the instrument.

The TY-9000 direct reading spectrometer uses CMOS full-spectrum acquisition technology to obtain rich spectral information and easily measure simultaneous multi-element and multi-matrix. Conventional large direct reading spectrometers generally use photomultiplier tubes (PMT) as photo sensors for spectral acquisition and analysis and the focal length is generally longer. Such instruments are often bulky, have high power consumption, and are complicated to use and maintain. At the same time, since a photomultiplier tube can only analyze a specific wavelength, subject to the size of the photomultiplier tube, it is impossible to place too many photomultiplier tubes in a limited light chamber space, so the number of analysis elements is limited. With the maturity of CMOS technology, it has provided a new direction for the development of direct reading spectrometers. The optical system using CMOS as the sensor requires only a small focal length, and the overall size of the instrument can be made small, resulting in less power consumption. A full-spectrum acquisition system consisting of multiple CMOSs can be measured without the number of channels, and the elements covered over the entire spectral range can be measured. At the same time, full spectrum acquisition can obtain more complete spectral line information, and some interference spectrum information besides the analyzed elements can be obtained, so that more algorithms can be used to ensure the analytical performance of the instrument.

The TY-9000 direct reading spectrometer uses a vacuum method to acquire the ultraviolet spectrum. The vacuuming method uses a vacuum pump to extract the air inside the light chamber, maintain a high degree of vacuum, and realize the collection of the ultraviolet spectrum. The light chamber does not need to consume argon gas, and the maintenance cost is low and the use is convenient.

1.2 Instrument parameters

Name	Content
Optical system	
Optical structure	Paschen-Long Gloria full-spectrum vacuum optical system
Light room constant temperature	35 ° C ± 0.5 ° C
Wavelength range	165-580nm (expandable)
focal length	400mm
Grating	2400m1/mm
Detector	Multiple high performance linear CMOS arrays
Average resolution	10pm/pixel
Spark stand	
gas	Argon(99.999%)
Argon flow	When sparked: 3-5L/min Standby: no traffic required
electrode	Tungsten spray electrode
Cleaning	Automatic cleaning function
composition	Thermal deformation self-compensation design
Analysis gap	Sample stage analysis gap:3.4mm
Spark source	

Types of	HEPS high energy pre-combustion technology
Discharge frequency	100-1000HZ
Discharge current	1-400A
advanced technology	Optimization design of discharge parameters
Pre-ignition	High energy pre-combustion technology
processor	High-end ARM, high-speed data synchronization acquisition and processing
Data collection system	
port	Ethernet data transmission based on DW9000A
Working power	220VAC 50/60Hz
other	
Analysis element	Fe, Cu, Al, Ni, Co, Mg, Ti, Zn, Pb, Sn, Ag, Mn, Cr etc
Electricity consumption	Maximum: 750W Standby: 100W
Operating temperature	10-35 °C (temperature \geq 5 °C)
Working humidity	20-85%
size	860mm (length) * 680mm (width) * 438mm (height)
weight	About 100Kg

1.3 Instrument features

The TY-9000 uses multi-chip high-performance CMOS as a photoelectric sensor to achieve 165-580nm (expandable) full-band spectral acquisition, rich spectral information, and can measure more than 20 elements simultaneously. It has the characteristics of small size, low power consumption and low operation and maintenance costs.

The TY-9000 adopts vacuum and constant temperature light chamber. The arc flame generated during sparking is directly introduced into the vacuum light chamber by the lens, which realizes the light path through, eliminates the optical path loss, improves the detection limit, and has accurate measurement results, excellent reproducibility and long-term stability.

The multi-stage isolated vacuum anti-return technology and the TY-9000 adopts vacuum compression and flapper valve to ensure that the vacuum chamber is completely isolated from the vacuum when the vacuum pump is not working. A vacuum filter is added in the middle to ensure that the oil in the vacuum pump does not enter the vacuum chamber, ensuring that the CMOS detector and optical components work in a reliable environment.

The TY-9000 is equipped with a factory calibration curve for common metal substrates. Combined with advanced single spark analysis technology and spectral delay acquisition technology, users can easily use the full spectrum information of the sparking for additional statistical analysis of data, which can reduce operating and maintenance costs. Provide users with stable, fast, accurate and rich high analysis performance. At the same time, TY-9000 is convenient for daily use and maintenance.

1.4 Notes

This instrument is a professional spectrum analysis instrument. Non-professional analysts are not

allowed to use it without authorization. Otherwise, it may cause instrument failure or personal injury.

The computer used in this instrument is a special equipment. It is not allowed to install application software that is not related to the direct reading spectrometer on the computer; it is not allowed to move, modify or delete the files in the TY-9000 analysis software at will.

Do not move or carry it after the instrument has been installed and debugged.

When the instrument is sparked, high-frequency electric spark will be generated at the spark stand. Therefore, when the analysis process is sparked, the hand must not move or take away the analysis sample, nor allow any liquid to spill on the spark stand, otherwise the instrument may be damaged or damaged human body.

The light chamber and spark stand of this instrument are precision optical components and are not allowed to be opened or removed without authorization. If you have any questions, please ask a trained professional or contact our customer service department in time.

The exhaust gas filter tank of this instrument must be cleaned in time. If it is not cleaned for a long time, it will cause air clogging and affect the performance of the analysis.

The instrument needs to work at (10~30) °C and (20~80)% RH humidity. It must be equipped with a sufficient power air conditioner for the instrument analysis environment and a humidifier in the wet area.

This instrument is powered by 220V AC single-phase AC power supply. Please pay attention to the safety of electricity. Improper use may cause electric shock and injury.

The instrument uses high purity argon (argon purity $\geq 99.999\%$) as the analysis gas source, please pay attention to gas safety, a large amount of argon leakage may cause people to suffocate.

Sample processing is required before the instrument analyzes metal samples. Generally, steel samples are ground using a grinding machine or a grinder; for non-ferrous metals such as aluminum and copper, a lathe is used for the spark surface treatment. Please be aware that the use of safety, improper use of grinding machines, grinders and lathes may cause harm to the human body.

1.5 Application areas

TY-9000 direct reading spectrometer can be widely used in the steel and non-ferrous metals industry, the rapid analysis of laboratory metal components, into the factory materials inspection and metal materials analysis in the automotive, aerospace, petrochemical, electric power, machinery manufacturing and foundry industries.

Chapter 2 Spectrometer composition

The TY-9000 direct reading spectrometer consists of a light source, a spark stand, an optical system, a pneumatic circuit module, and a vacuum system.

2.1 Housing

See Figure 1-1

2.2 spark stand

The spark stand mainly provides an environment for sample spark, and the spark stand is composed of a spark stand, a sample holder and a pole gauge. The spark stand is used to support the sample; the sample holder is used to fix the sample; the pole gauge is used to adjust the distance between the spark electrode and the sample; in normal use, the pole gauge must be fixed on the sample holder to fix the sample.

2.3 Light source

TY-9000 adopts high stability programmable pulse digital light source, which can provide different analysis waveforms according to different substrates and different elements, and obtain accurate and reliable analysis results.

2.4 Gas circuit module

The gas supply system uses an integrated gas circuit module and is divided into two channels of flow. The main flow is used to purge the front end of the lens at a flow rate of 5 L/min, which protects the lens from contamination and creates a good environment for sparking. Auxiliary flow was used for electrode self-purging with a flow rate of 1.5 L/min. The two argon flow creates an excellent environment for sparking.

Chapter 3 Spectrometer installation

3.1 Installation requirements and conditions

3.1.1 Environmental and location requirements

The spectrometer should be placed in a dedicated work space. There should be no harmful, flammable or corrosive gases nearby. Do not put it together with chemical analysis. The laboratory generally needs at least 10 square meters of space. The spectrometer should be placed in a flat, stable position with no vibration; there should be a suitable distance between the back of the spectrometer and the wall for ease of installation and maintenance (at least 0.8 m from the wall).

Working temperature: (10~30) °C, indoor air conditioning should be installed, room temperature fluctuation should be as small as possible

Relative humidity: (20~80)%, for humid areas, a dehumidifier is required.



CAVEAT

- TY-9000 direct reading spectrometer adopts constant temperature control, and the ambient temperature is stable within the range of (10~30) °C. If the above requirements are exceeded, the measurement accuracy of the spectrometer may be affected;
 - The laboratory needs a good ventilation environment.
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3.1.2 Power and ground requirements

3.1.2.1 Power requirements

A single phase power supply with (220 ± 20) VAC, 50 Hz, protective grounding is required. The PE grounding of the power supply must be reliable to ensure proper operation of the instrument and to avoid human body electric shock. If the PE is not guaranteed to be reliably grounded, provide a dedicated ground wire for the instrument. If there is frequent power outage, an uninterruptible power supply (UPS) needs to be prepared.

3.1.2.2 Grounding resistance requirements

The value of the grounding resistance can limit the value of the grounding current. If the grounding resistance is small, the grounding voltage value of the grounding device will be small. That is to say, the value of the grounding resistance has indicated the grounding performance of the device. The grounding resistance is generally measured by an ammeter, a voltmeter, a bridge method, a grounding resistance meter, and the like. Currently measured by grounding resistance meter and this method is simple and convenient. The universal grounding resistance measuring instrument is of the ZC-8 and ZC-29 type. Before grounding the resistance test, first unscrew the ground lead.

Generally speaking, the grounding depth should not be less than 2 meters. Install grounding in special places. If the depth is less than 2 meters, place 5 kg around the grounding salt, 10 kg of wood carbon and add water to reduce the grounding resistance. If at least 2 and 2 grounds are used, the distance between each pole should not be less than 2.0 m to reduce the grounding resistance. In highly corrosive soils, copper or galvanized grounding electrodes should be used. And the grounding should not be buried in the garbage and ash layer. It should not be painted on the ground and the ground to avoid excessive grounding resistance.

3.1.3 Regulator requirements

To ensure the normal use of the instrument, please equip the instrument with a single-phase 220V AC parametric voltage regulator (1~2) KVA(depending on the load).

If you use an intermediate frequency furnace and a high frequency furnace, you need to prepare a 3KV magnetic saturation power supply. It is recommended to use JS-G-3KVA AC Voltage Stabilizer. If it is not equipped, the unstable voltage and frequency generated by the electric furnace will damage the components. This results in reduced instrument precision and reduced service life.

3.1.4 Argon requirements

Argon purity $\geq 99.999\%$;

Argon gas flow rate: standby flow rate is 0, about 3-5L/min when sparked;

Argon inlet pressure: 0.5MPa

3.1.5 Standard sample requirements

Prepare a standard internal control sample for your product and use it for calibration of the analytical program. Our company can be entrusted to purchase or prepare by itself and it needs to pass the chemical analysis of the local inspection department when preparing itself.

3.1.6 Computer and printer requirements

Prepare a computer with a current general configuration (both laptop and desktop), requires more than 1GB of memory, more than 1.8 GHz CPU dual core, and configures the Win7/win10 operating system for TY-9000 direct reading spectrometer analysis software.



NOTE

- Provide a stable and reliable power supply for the PC. Otherwise, sudden power failure may cause data corruption in the computer operating system files or software, which may result in the software not working properly.
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Also, prepare a laser, inkjet, or dot matrix printer for printing of the analysis data reports.

3.2 Assembly

3.2.1 Gas connection

Step 1 Take out the pressure reducing valve and install it on the outlet of the argon valve, as shown in Figure 3-1:



Figure 3-1 The connection between the pressure reducing valve and the argon cylinder should be tightened with a wrench

Step 2 Connect the $\Phi 6\text{mm}$ special fluorine tube to the terminal ferrule joint of the pressure reducing valve, as shown in Figures 3-2 and 3-3:



Figure 3-2 Fluorine tube of the card holder

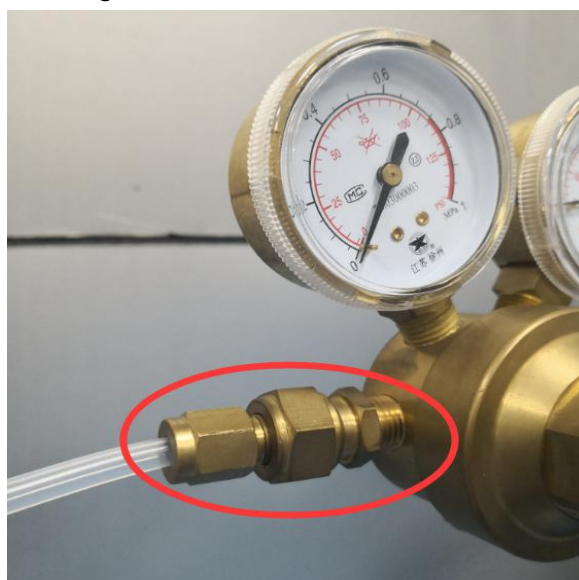


Figure 3-3 Outlet end of the pressure reducing valve

Step 3 Connect the other end of the tube to the argon inlet of the instrument, as shown in Figure 3-4:



Figure 3-4 Argon inlet behind the machine

Step 4: Adjust the pressure of the pressure reducing valve to 0.5 MPa clockwise. The table on the right is the total amount of argon gas in the argon cylinder, as shown in Figure 3-5:



Figure 3-5 Adjusting the traffic size



NOTE

- When the total amount of argon gas cylinder reaches 1Mpa, argon gas should be replaced in time;
- When connecting or disassembling the argon tube fitting on the instrument, use two wrenches, one to fix the connector on the instrument and the other to operate the argon tube connection.

3.2.2 Gas cylinder connection

Step 1 Connect the two gas cylinder caps and connects the gas collection tubes at one end, as shown in Figure 3-6:



Figure 3-6 Note the direction of the arrow on the cover

Step 2 Install a filter cartridge in one bottle and a hard tube on the other bottle and add one-fifth of the water to it, as shown in Figures 3-7 and 3-8:

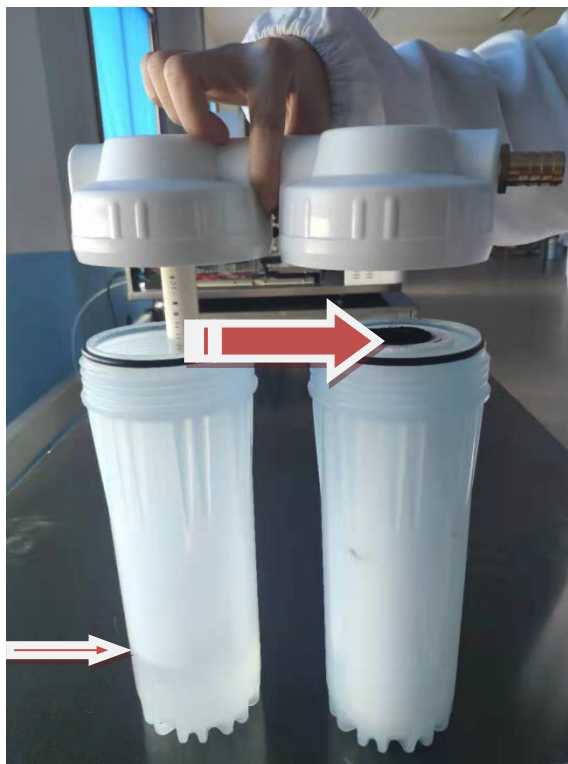


Figure 3-7 Note the direction of the arrow and the water level line



Figure 3-8 Place the filter in the right bottle

Step 3 Pull open the front cover of the machine, as shown in Figure 3-9:

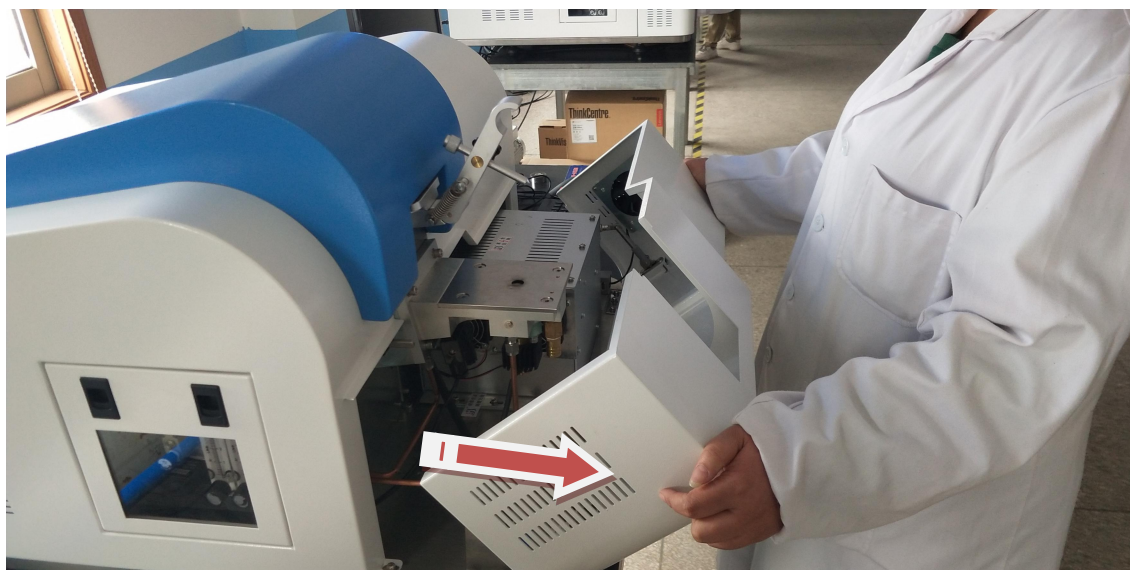


Figure 3-9 Front door of the machine

Step 4 Connect the two ends of the gas collecting hose to the exhaust port of the gas collecting bottle and the spark stand, and use the hoop to lock the hose at the interface, as shown in Figure 3-10:



Figure 3-10 Two ends of the gas collection hose

3.2.3 Vacuum pump connection

Step 1 Find the relevant accessories, as shown in Figure 3-11:



Figure 3-11 Vacuum related accessories

Step 2 Connect the flapper valve to the vacuum hole on the back of the machine with a seal ring in the middle, note the direction of the flapper valve arrow, as shown in Figure 3-12:

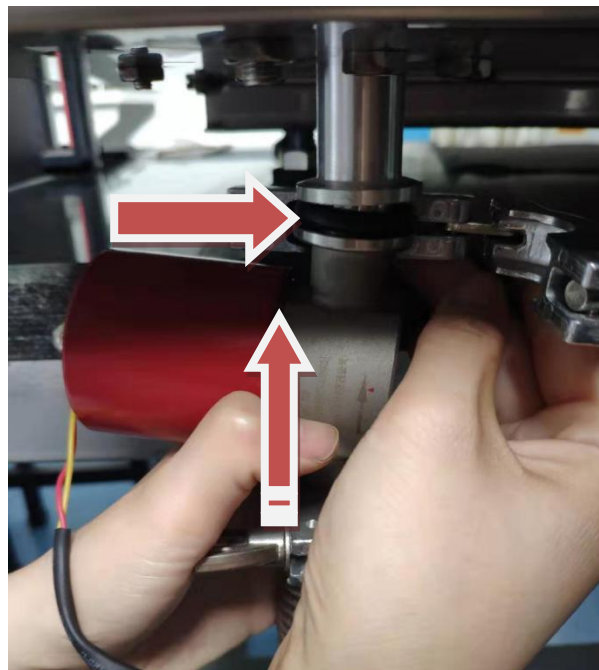


Figure 3-12 Note the seal and arrow direction at the joint



NOTE

- The arrow of the flapper valve is upward;
- Place the seal ring properly, otherwise it will cause air leakage, which is not conducive to vacuum.

Step 3 The other end of the flapper valve is connected to the bellows and a seal is required in the middle, as shown in Figures 3-13 and 3-14:

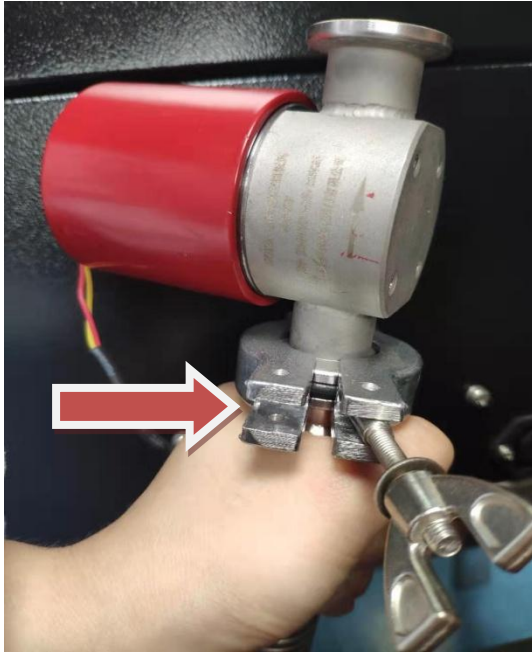


Figure 3-13 Note the middle seal



Figure 3-14 Complete connection

Step 4 The other end of the bellows is connected to the small opening of the filter bottle, which also requires a sealing ring, as shown in Figure 3-15:



Figure 3-15 Note the middle seal

Step 5 The other end of the filter bottle is connected to the vacuum pump. A larger seal is required, as shown in Figure 3-16:

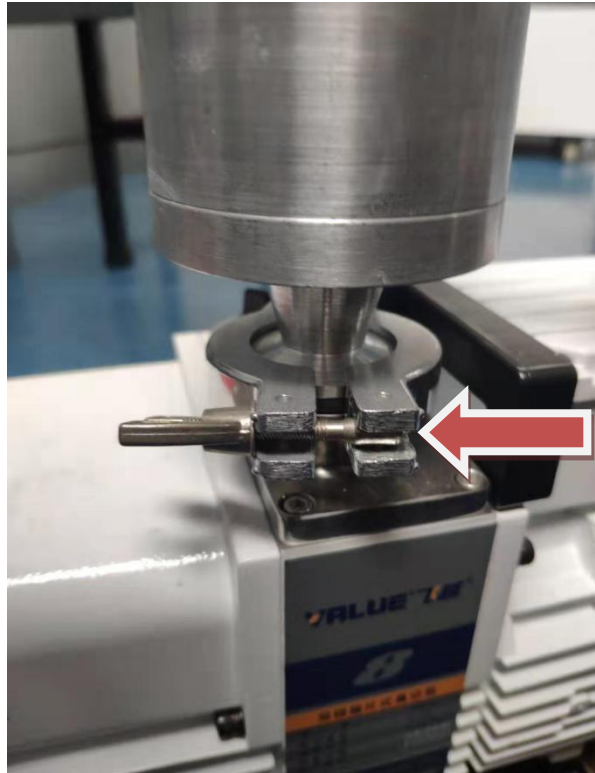


Figure 3-16 Larger seal

3.2.4 Electrical connection and setting

3.2.4.1 Computer connection and settings

Step 1 First connect the power cable to the computer correctly, as shown in Figure 3-17:

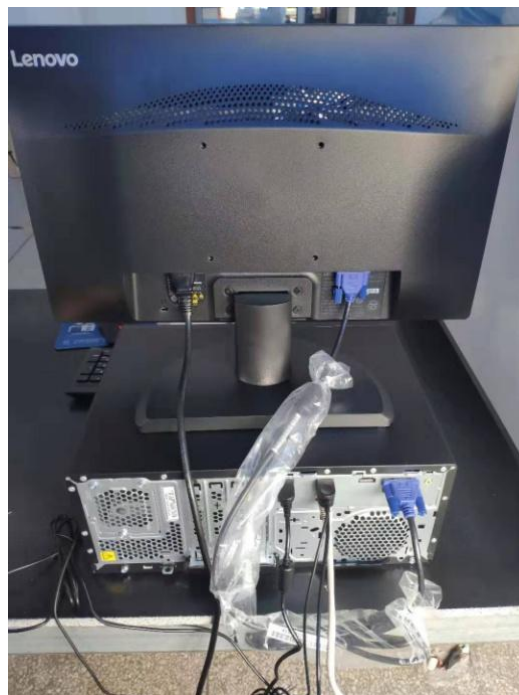


Figure 3-17 Computer and host connection

Step 2 Turn on the computer, find the computer IP address settings, right-click and select “Properties”, as shown in Figure 3-18:

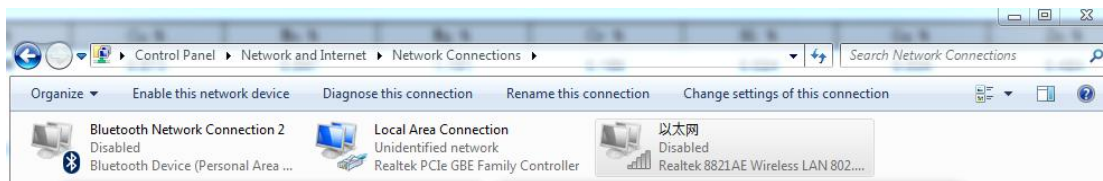


Figure 3-18 Computer Network Properties

Step 3 Click Attributes and change Protocol Version 4 to the parameters shown in Figure 3-19:

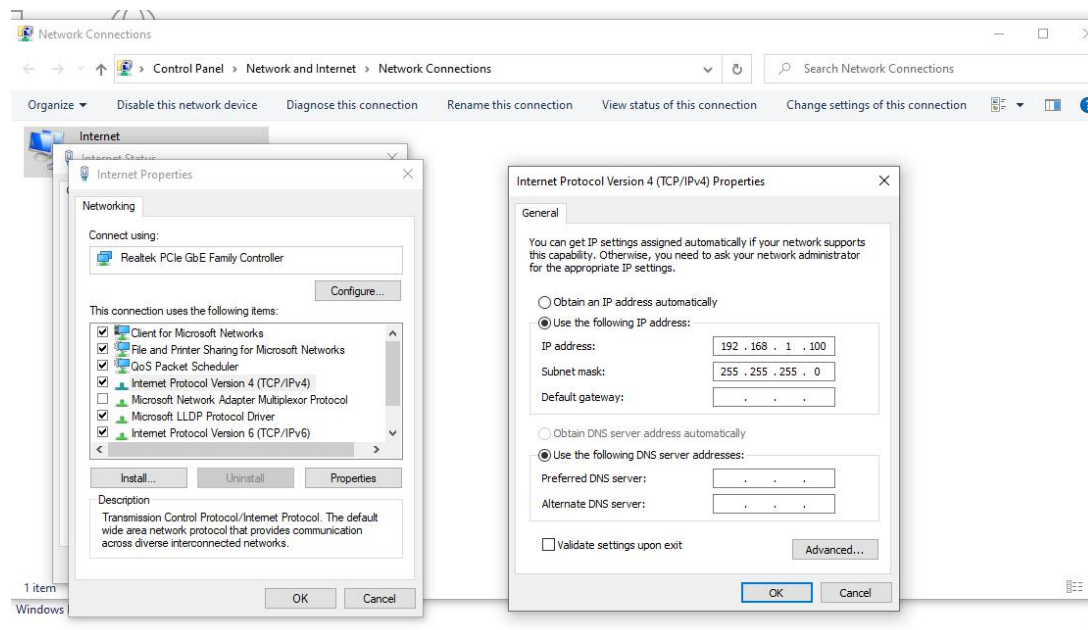


Figure 3-19 Protocol version 4

Step 4 Locate the Windows Defender Firewall "Enable and Disable" and set the firewall to off, as shown in Figures 3-20 and 3-21:

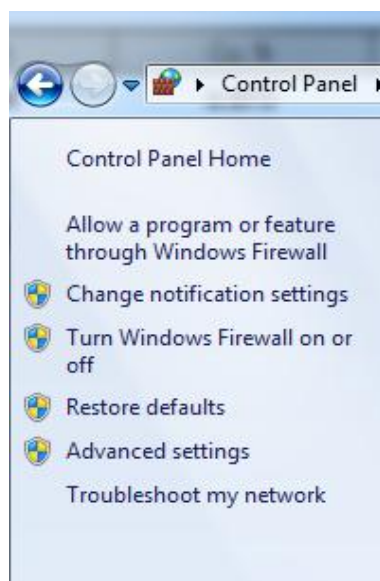


Figure 3-20 Enable and Close

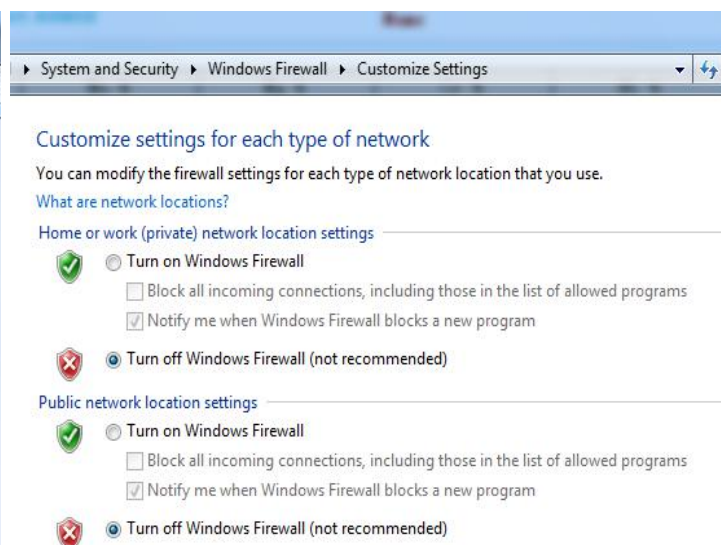


Figure 3-21 Close

3.2.4.2 Machine connection settings

Step 1 Connect the wire on the vacuum pump to the back of the machine and turn on the vacuum pump, as shown in Figure 3-22:

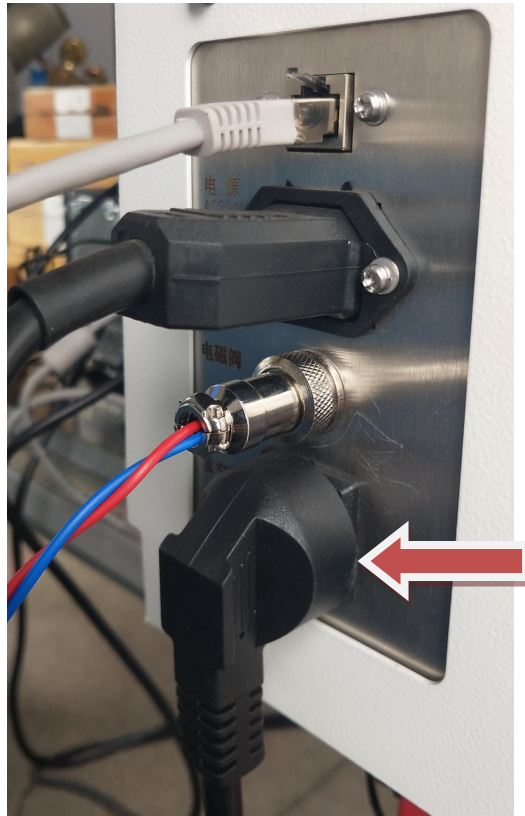


Figure 3-22 The middle socket

Step 2 Connect the wire on the flapper valve to the back of the machine, as shown in Figure 3-23:

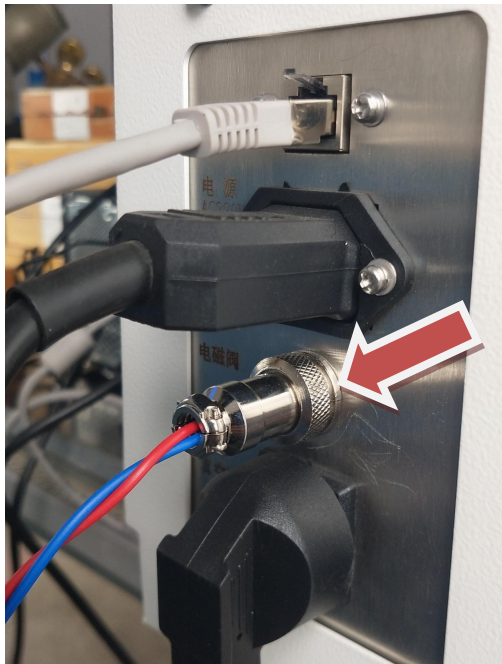


Figure 3-23 Line socket of the flapper valve

Step 3 Connect the power cable of the vacuum pump and the power cable of the main unit to the power supply, as shown in Figure 3-24:

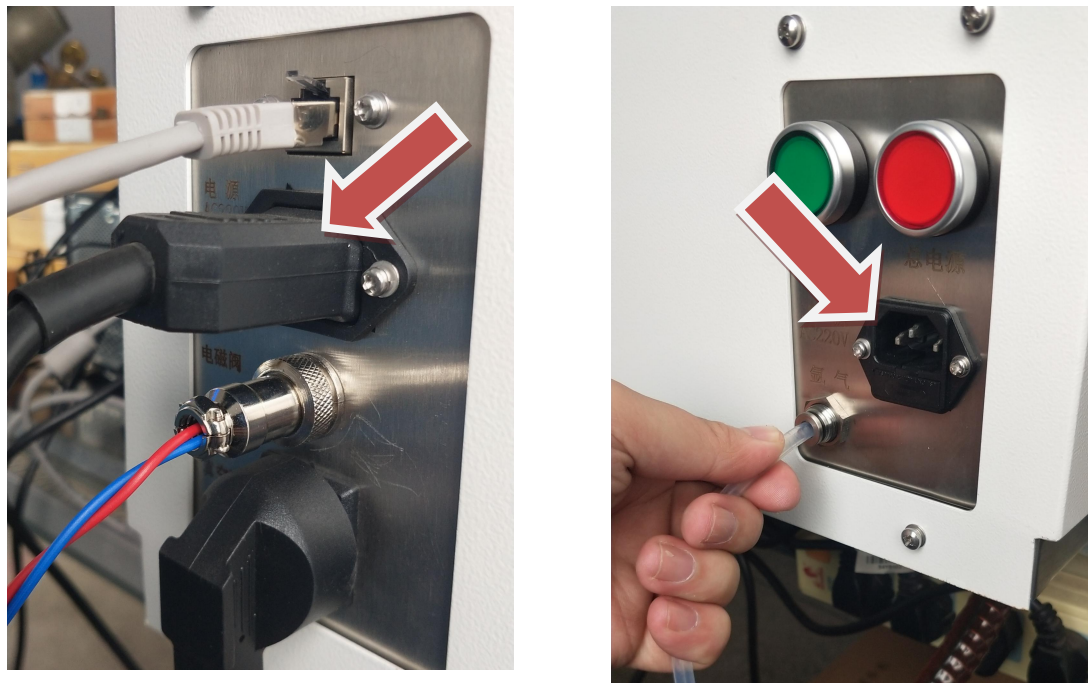


Figure 3-24 Vacuum pump and power cord

3.3 Instrument trial run and sample preparation

3.3.1 Instrument commissioning

Before commissioning the TY-9000 direct reading spectrometer, please confirm:

The AC parameter regulator is connected normally;

Confirm that the instrument has not been accidentally damaged due to transportation or other reasons;

Confirm that there is a PC;

Confirm that the relative humidity of the environment is between (20~80)%;

Confirm that the ambient temperature is between (10~30) °C;

Confirm that the purity of argon used is 99.999%;

Confirm that the filter bottle is installed

Make sure that the power socket or power strip used by the instrument is large enough, the flow capacity is not less than 10A, and the L line (hot wire) in the power strip, the N line (zero line) conforms to the normal left N right L, the safety ground wire and the ground is well connected. It is recommended that the instrument be directly connected to a dedicated ground wire (less than 4 ohms) if conditions permit.

3.3.2 Sample preparation

When preparing the sample, determine the sample processing equipment (according to the analysis materials): pallet grinding machine (sand paper), as shown in Figure 3-25, rotary grinder (grinding wheel or brown steel jade), lathe (Non-ferrous metal), sampling equipment (ingot mold)



Figure 3-25 Tray grinding machine

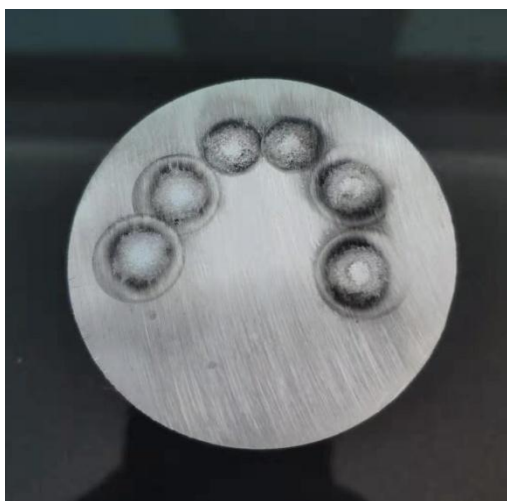
3.3.2.1 Example of a conventional sample spark point



Alloy steel sample



Cast iron sample



Aluminum sample



Copper sample

3.3.2.2 Air chill

Before the sample preparation, some samples (such as cast iron, high silicon aluminum alloy) need to be "air chill" before they can be polished with a grinding machine. "Air chill" refers to the state of the fracture of the iron piece. "White iron" is formed under the condition of rapid cooling of molten iron, that is, the hot molten iron becomes solid iron in the shortest possible time. Iron is called "white iron". "White iron" is crispy but hard. Most of the carbon and sulfur are in the state of iron carbide and iron sulfide. In a chilly situation, the chemical composition of liquid iron is relatively uniform. The chemical composition of the molten iron is too late to aggregate, forming simple carbon and sulfur particles, but evenly distributed in the medium, suitable for photoelectric direct reading spectrometer. The so-called "air-chill" is a process of pouring molten iron and the formation of "white iron". It is often difficult to completely "air chill" a sample after casting. Usually, the closer to the surface, the higher the degree of "air chill". We have to be aware of is:

- (1) "Quenching" refers to the short time when molten iron solidifies into a solid. Because the thermal conductivity of steel is much better than that of refractory materials, steel molds are used. The copper plate for the bottom plate is the best. If there are conditions, it is better to use copper plates. The effect is better, and do not use a cylindrical mold. The "wine cellar" type mold is used. The diameter of the bottom of the standard sample is: $\phi 35\text{mm}$ and the thickness is 12mm, so the degree of "white mouth" will be higher, as shown in Figure 3-26. ;
- (2) The sample needs to be successfully cast at one time. Otherwise, cracks will be left at the multiple pouring interface. When the sample is polished, it is easy to break and damage the sample preparation personnel;
- (3) Because the texture of the "air chill" sample is extremely hard, when grinding the sample, sand cloth, sandpaper, sand table or grinding wheel with larger grain size, harder texture and better adhesion should be used;
- (4) After the "air chill" sample can't be cut, the polished cut surface analysis is difficult because the sample is difficult to completely "white-mouth", so after the sample is cooled, it should be directly polished and analyzed.



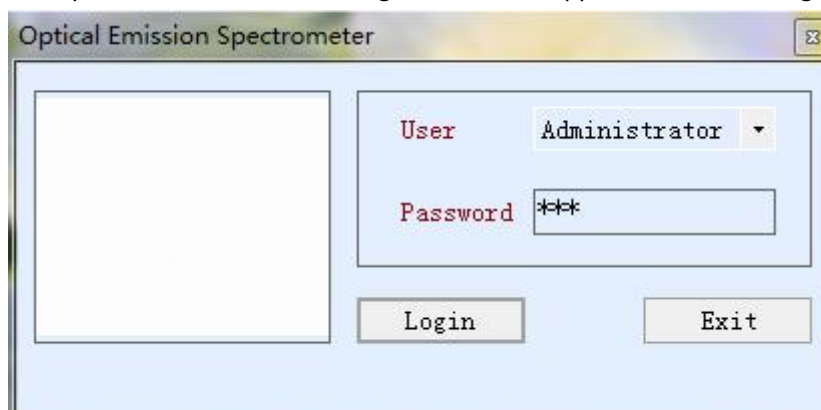
Figure 3-26 Sample Abrasives

Chapter 4 Operation of the spectrometer

4.1 Analysis Software

4.1.1 Introduction to the Software Interface

After clicking the software and entering the software through the operator password 123456 or the administrator password 123, the following interface will appear, as shown in Figure 4-1:



The main interface is divided into analysis result display, menu bar, operation bar, information display bar and status bar, as shown in Figure 4-2:

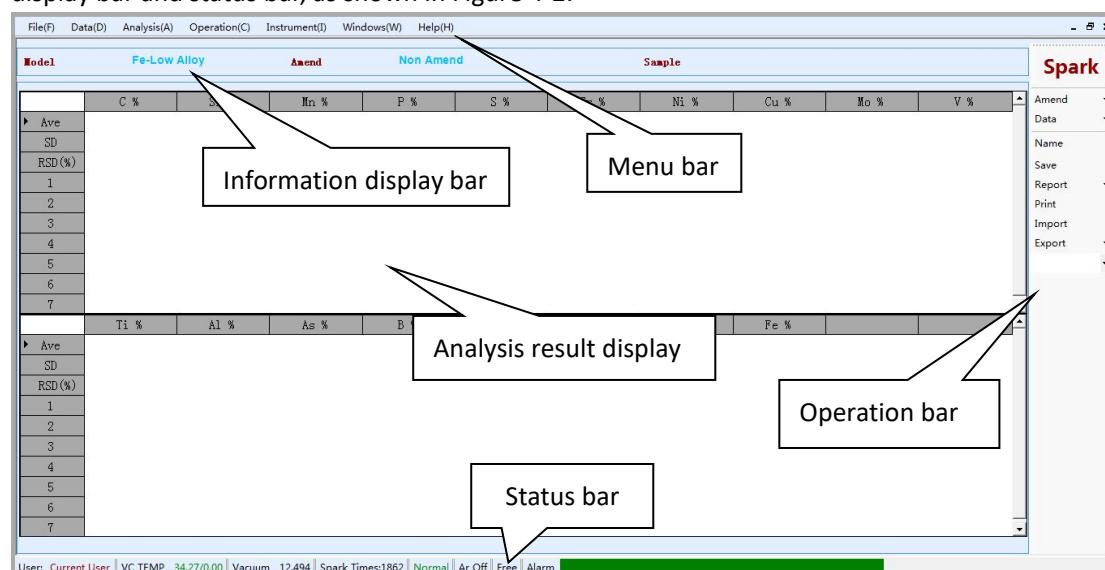


Figure 4-2 Main menu and main interface

Analysis results show: used to display the content of the analysis elements, each line shows 10 elements, the extra elements are displayed in the second column, up to three columns of elements, each time the display shows 11 columns, the number of columns exceeds the drop The scroll bar shows that the SD and RSD values are automatically displayed when the number of analyses exceeds 2 times.

Menu Bar: Displays respectively files, data, performance, actions, instruments, forms and help. The following describes the role of each submenu bar:

4.1.1.1 File

“Sample management”: you can check the content standards of related samples;

“Brand number management”: Query sample number;

"User Management": You can modify the login password of the administrator or operator;

"Exit the software": You can close the software.

4.1.1.2 Data

"Query Analysis Data": Query the saved data. The saved data must edit the sample name for the data. Otherwise, it cannot confirm what data. The query data can be queried by date and sample name, and the queried data can be printed in batches.

"Report Information Setting": Set the report format of the printed data, and set the printed items, such as the name of the unit to be sampled.

4.1.1.3 Analysis

"Analysis Window": Analyze the interface displayed by the element;

"Load Analysis Model": select the appropriate analysis curve when analyzing different materials, such as: iron matrix and aluminum matrix; iron matrix can be divided into alloy steel, stainless steel, cast iron, etc., aluminum alloy can be divided into ordinary aluminum alloy casting aluminum alloy, etc. . Select the appropriate analysis curve based on the material you analyzed at the time.

"Load current Analysis Model": The current analysis curve is recalled, and the refresh function is applied. After the current analysis curve is recalled, the content of the element displayed on the previous interface will be cleared.

"Type Standardization": Use to select the standard sample selected for this calibration analysis sample. It is divided into "new" and "view". The new one is to establish a new control sample. When the sample control is corrected, it is necessary to spark the control sample 2-3 times and the data with good repeatability is saved. Generally, the relative standard deviation is required RSD is less than 3, and "view" refers to viewing the correction factor of all control samples.

"Group Standardization": When the parameters of the instrument are offset, the instrument needs to be calibrated. At this time, the instrument should be calibrated by the high and low standards. It can be divided into "new" and "view". The new one is to spark the standardized samples. Each sample needs to be sparked 2-3 times, and the data with good repeatability is selected. Generally, the relative standard deviation RSD is less than 3.

"Spectrum Calibration": When the instrument changes with the change of temperature and vacuum, the optical path of the device needs to be corrected. At this time, a factory sample is sparked, after 3-5 times, after clicking the calibration, all the optical paths are corrected, and then click save to take effect for this correction.

"Element Display Settings": Displays the order of the elements in the analysis interface and the number of digits that display the decimal point.

4.1.1.4 Operation

"Open Argon Flushing": Open the argon gas solenoid valve and test whether argon gas passes through the instrument. It can be observed by the flow meter. Generally, the main argon gas is 5L/min, and the auxiliary argon gas is 1.5L/min.

"Close Argon Flushing": close the argon solenoid valve.

"Vacuum pump to analysis Mode": shows the setting status of the vacuum pump.

"Vacuum pump standby Mode": shows the setting status of the vacuum pump.

4.1.1.5 Instruments

This menu needs to be logged in as an administrator to log in. It is mainly used to set the hardware of the instrument.

4.1.1.6 Form

Use to display the style of the form.

4.1.1.7 Help

Use to display copyright, analysis shortcuts and instructions for use.

Operation bar: mainly used to set the data processing mode before and after analysis:

“Spark”: is to spark the sample of this analysis;

“Content correction”: When analyzing the sample, call the control sample. This control sample needs to be sparked and valid. When clicking “group Standardization”, select the required control sample to correct the sample to be sparked. Generally, the same material is required. The sample is controlled to be corrected, and when the appropriate sample is selected, the selected sample name will be displayed;

“Sample Name”: the name of the sample to be sparked this time;

“Storage Data”: Save the data generated in this spark in the database. When saving, you need to fill in the name of the sample for later viewing and printing;

“Generate Report”: is the way to export the WPS spreadsheet, which is divided into export average and all analysis data;

“Print data”: print the current data in the form of an average value;

“Import Spectrum”: re-import the spectral spark data exported in the previous stage to the analysis interface for display;

“Export Spectrum”: Export the results of this analysis, which can be exported in different formats, so that this analysis data can be imported into the analysis interface in the future;

Information display column: In this column, “analysis curve” shows the analysis curve selected for this sparking sample; “Content correction” shows whether the sample control is enabled for this sparking; “Sample name” shows the current sparking sample name;

Status bar: “Light room temperature” shows the temperature of the instrument's light chamber, which generally varies within the range of $34\pm0.5^{\circ}\text{C}$; “vacuum degree” indicates the vacuum state of the instrument, generally $<20\text{Pa}$; “full flow” means that argon gas has been turned on. The input pressure detected by the pressure switch on the air circuit module is 0.5MPa . If the pressure is insufficient, the argon gas is not turned on or the output pressure of the argon gas is less than 0.5MPa . The “alarm state” indicates the online state and light source communication status of the instrument, green indicates normal, if it is red, it indicates that the spark light switch is not turned on or the instrument and the computer are not connected. You can double-click here and an error message will appear.

4.1.2 Input standard sample

Step 1 Click “Sample Management” in the “File” menu of the analysis software menu, as shown in Figure 4-3:

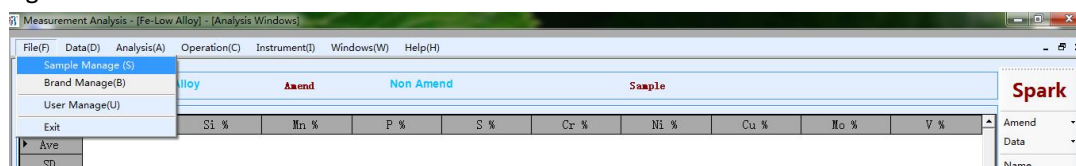


Figure 4-3 Sample Management

Step 2 Find the corresponding classification, such as "alloy steel" right click, select "add sample", as shown in Figure 4-4:

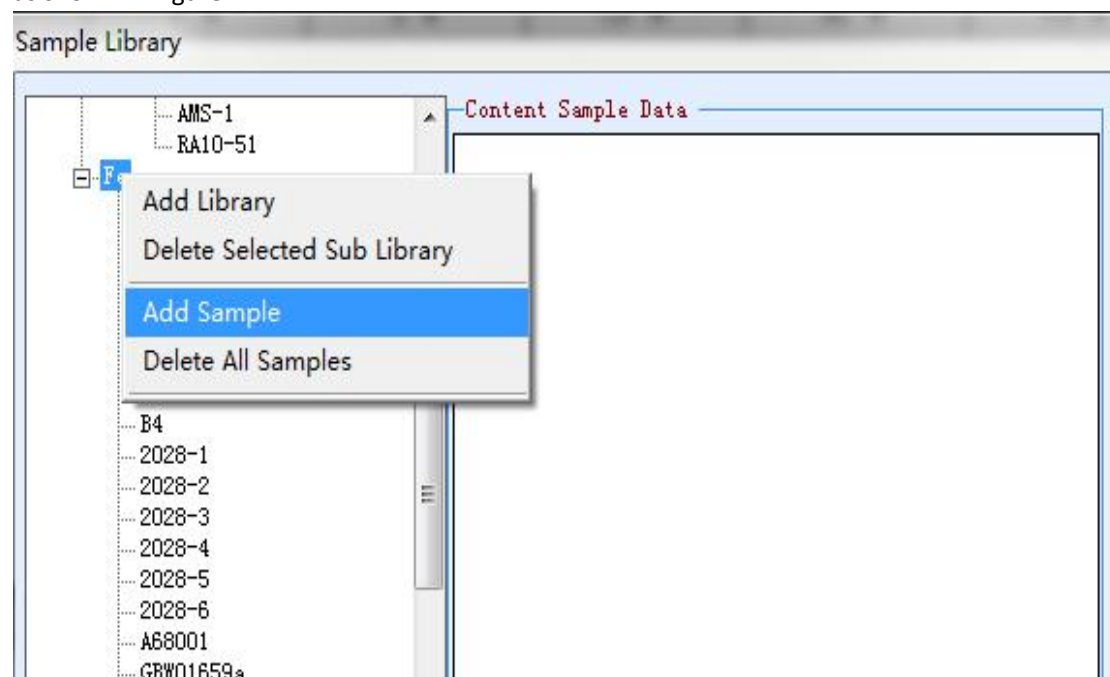


Figure 4-4 Adding a sample

Step 3 Enter the corresponding sample name and content, then click "save", as shown in Figure 4-5:

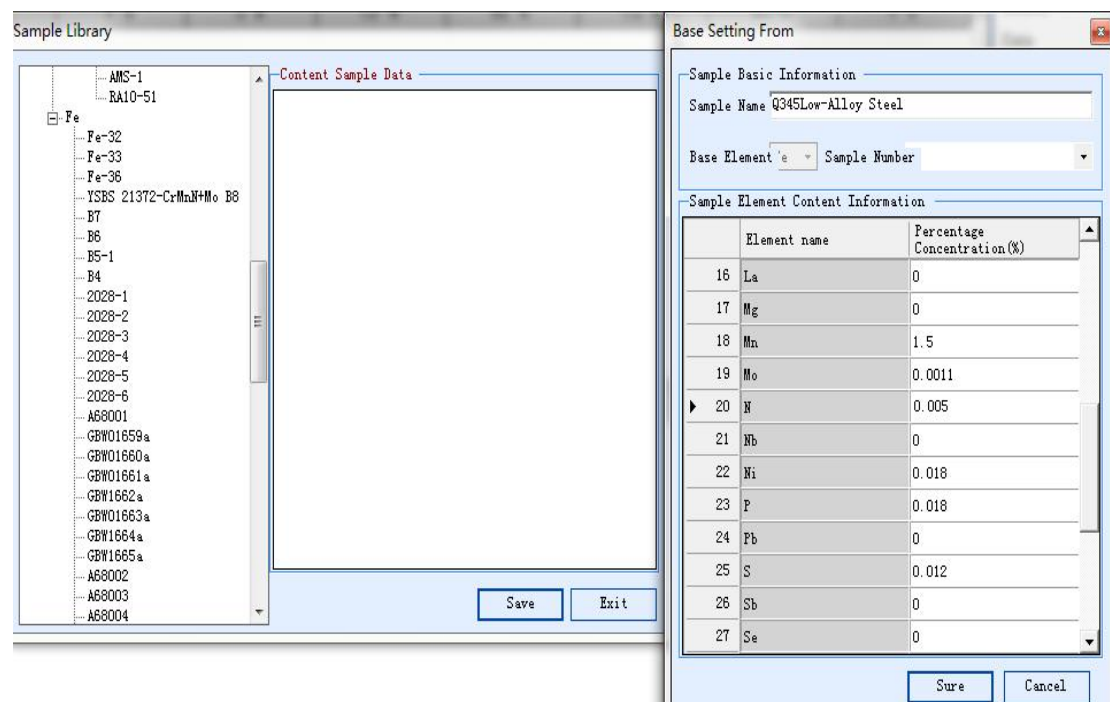


Figure 4-5 Input sample

Step 4 Check the content table and confirm again. Click “Save” and “OK”, as shown in Figure 4-6:

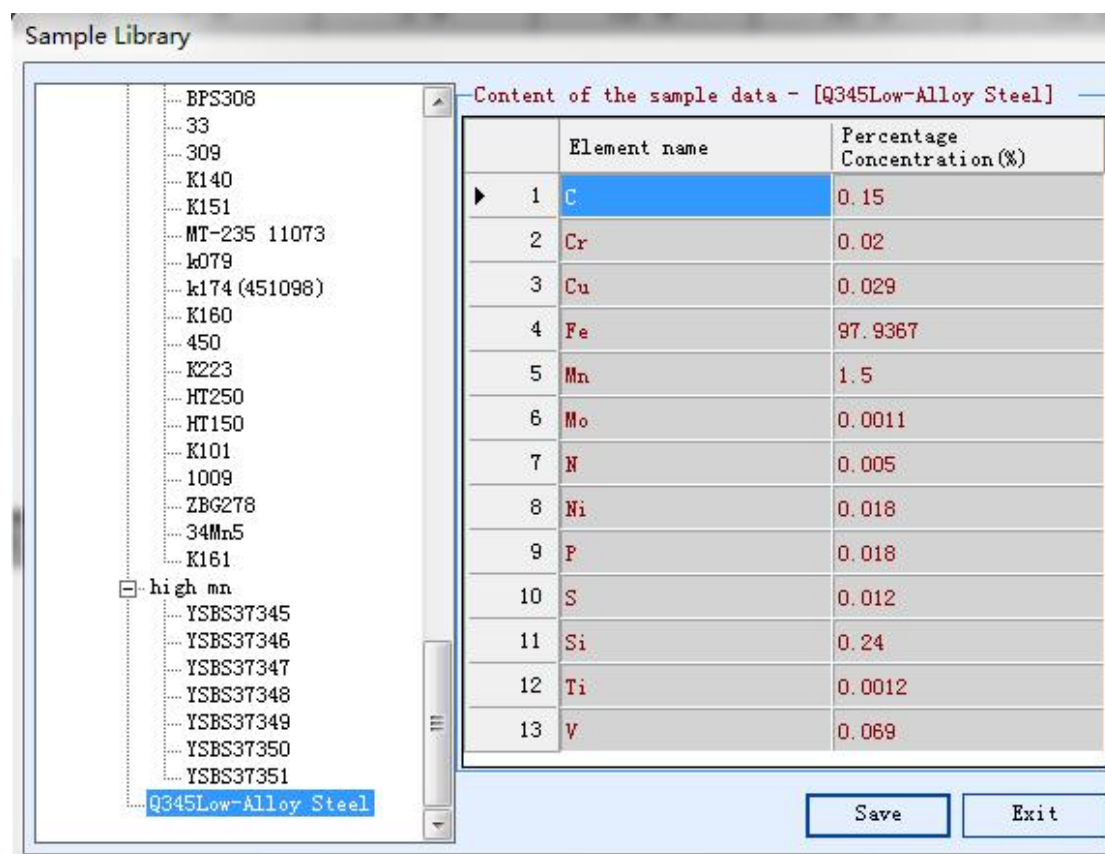


Figure 4-6 Determine the content again

4.2 Preparation

4.2.1 Status of the instrument

Step 1 Check the temperature (33.5 °C - 34.5 °C) and vacuum (7--20) of the instrument status bar, the instrument status is normal, as shown in Figure 4-7:

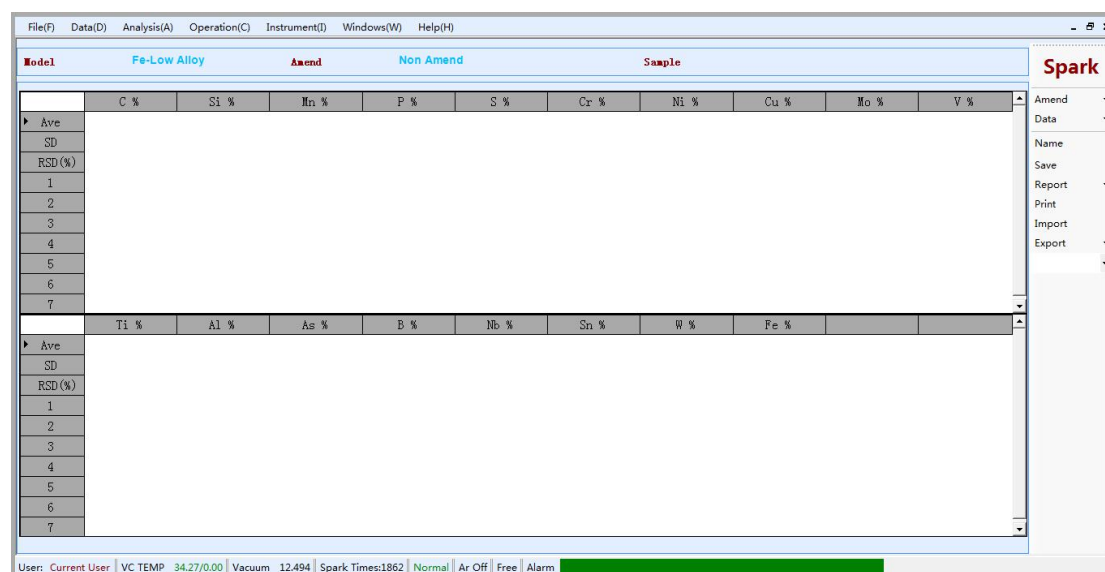


Figure 4-7 TEM and Vacuum

Step 2 Click “Analysis”- “Load Analysis Model” in menu bar of the software, as shown in Figure 4-8:

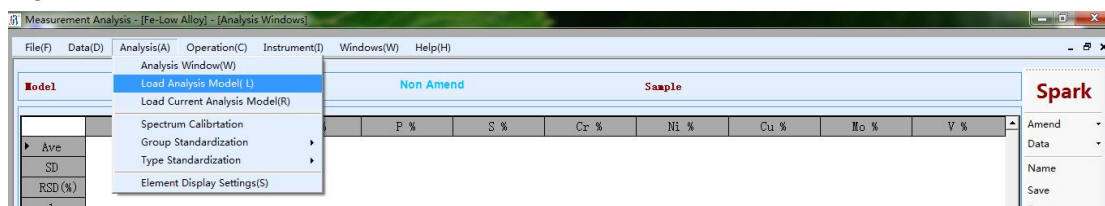


Figure 4-8 Curve call

Step 3 Select the desired curve and click “OK”, as shown in Figure 4-9:

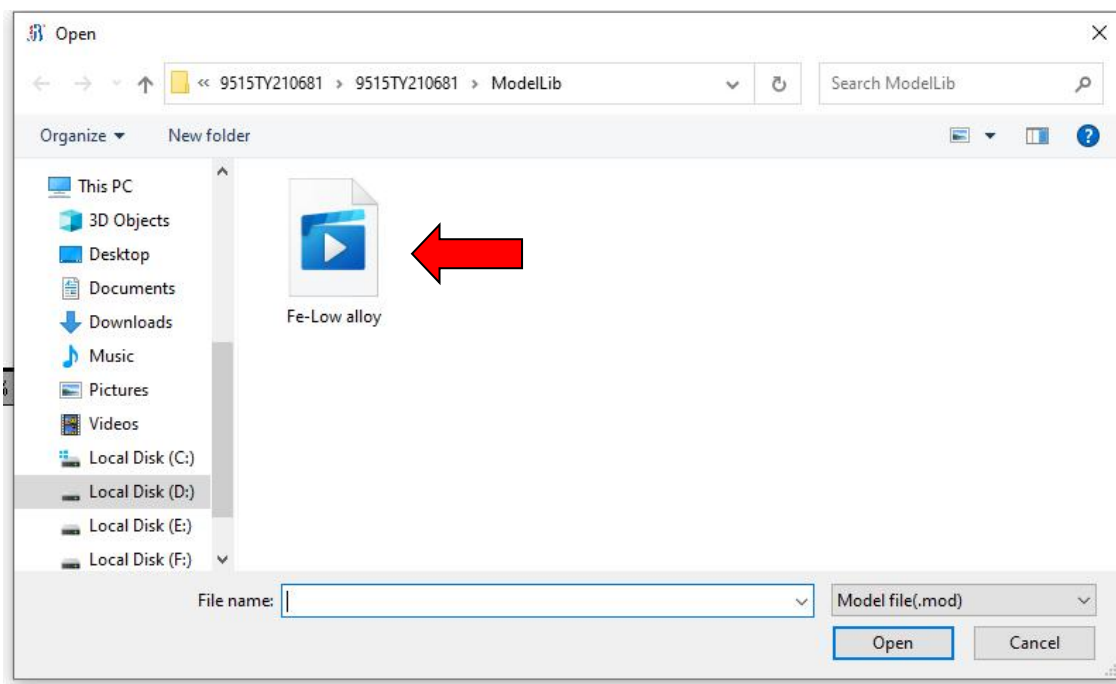


Figure 4-9 Working curve

Step 4 Open the argon main valve, adjust the flow rate to 0.5, and turn on the main power button (red button) and the light source button (green button) in turn, as shown in Figure 4-10:



Figure 4-10 Argon pressure gauge

4.2.2 Sparking of waste samples

Step 1 Place a waste sample and spark it, and adjust the size of the flow meter (1.5 on the left side and 5.5 on the right side) to see if there are any bubbles in the waste bottle, as shown in Figures 4-11 and 4-12:



Figure 4-11 Placement of the sample

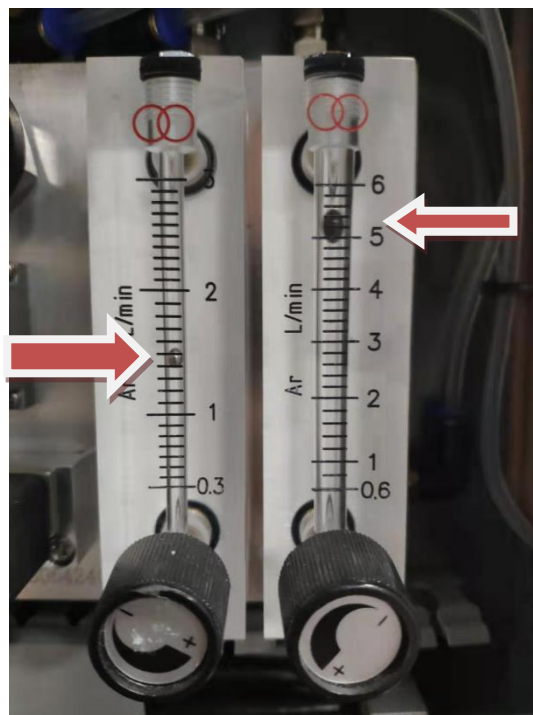


Figure 4-12 Flow meter adjustment

Step 2 Observe the sparking point, the steel sample is the center pitting point, the surrounding black circle; the cast iron sample center pitting, surrounded by a circle of white, the higher the silicon content, the larger the white circle, the lower the carbon content, the darker the point; As show in the figure (more than 5 times)



Iron sample



steel sample

NOTE:

Sparking the waste sample: Exhaust the excess air inside the pipe to stabilize the machine, help the data to stabilize, and then start daily operations.

4.3 Spectral correction

During the use of the instrument, as time goes by and the thermal expansion and contraction of the material, the spectral position will change slightly. The user needs to perform line matching correction according to his own situation. When the indoor temperature change is obvious or the downtime is long, when the general temperature fluctuation exceeds $\pm 5^{\circ}\text{C}$, the data drift is large when the instrument performs the sample control analysis after the startup, and the correction process is first performed. If the room temperature is constant, you can make a correction for about three months (or longer). In addition, if the intensity of the spectrum calibration is less than 1000, you need to wipe the lens (see **6.2 Lens Cleaning**), and then perform spectrum calibration again. The spectrum calibration of TY-9000 is done automatically, and the user only needs to spark the line to correct the sample. Spectrum calibration needs to be performed under administrator privileges. The specific steps are as follows:

Step 1 Click “Analysis”-“Spectrum Calibration” in menu bar of the software, as shown in Figure 4-13:

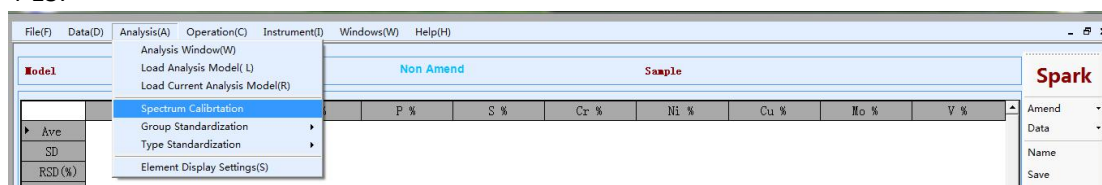


Figure 4-13 Spectrum Calibration

Step 2 Enter the spectrum calibration interface, follow the prompts to find the corresponding sample, and spark the sample three times, as shown in Figure 4-14:

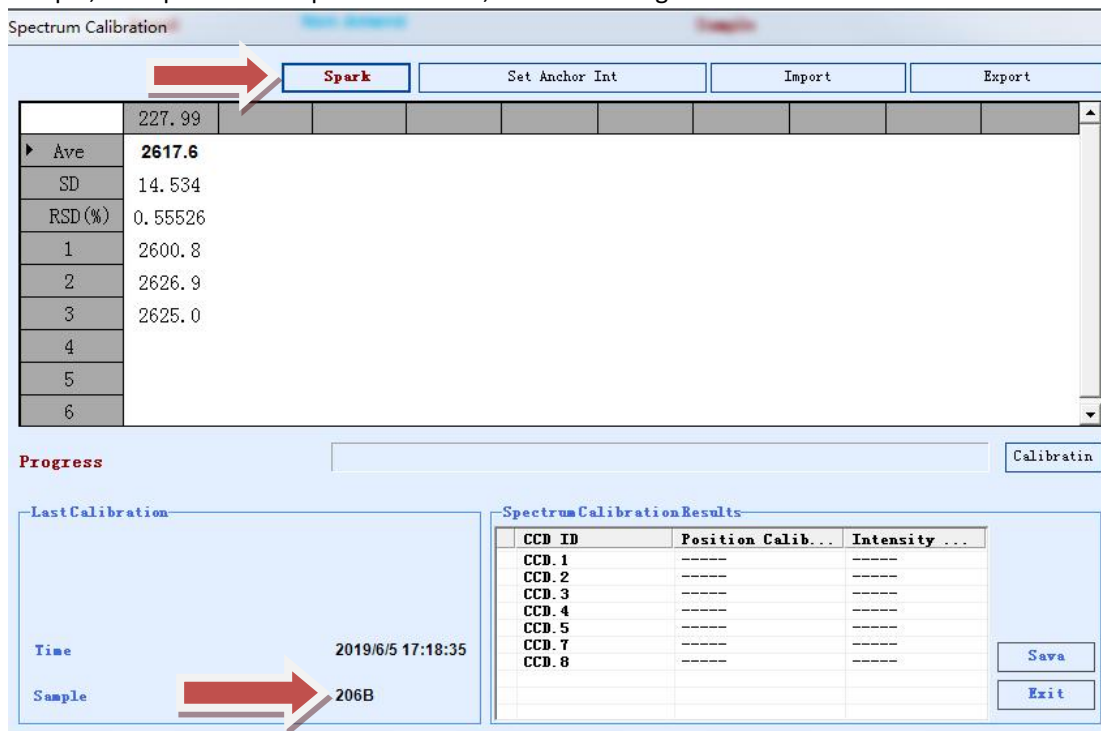


Figure 4-14 sparking the corresponding sample

Step 3 Observe the RSD column in the analysis result. If it is less than 3, click to “Calibration” and “save”. If the RSD is greater than 3, you need to re-spark the sample, right-click to delete a large difference data, and then observe the RSD to ensure that the RSD is less than 3. Then click “Calibration” and “Save”. **Make sure there are three sets of data at the end and the RSD is less**

than 3, as shown in Figure 4-15:

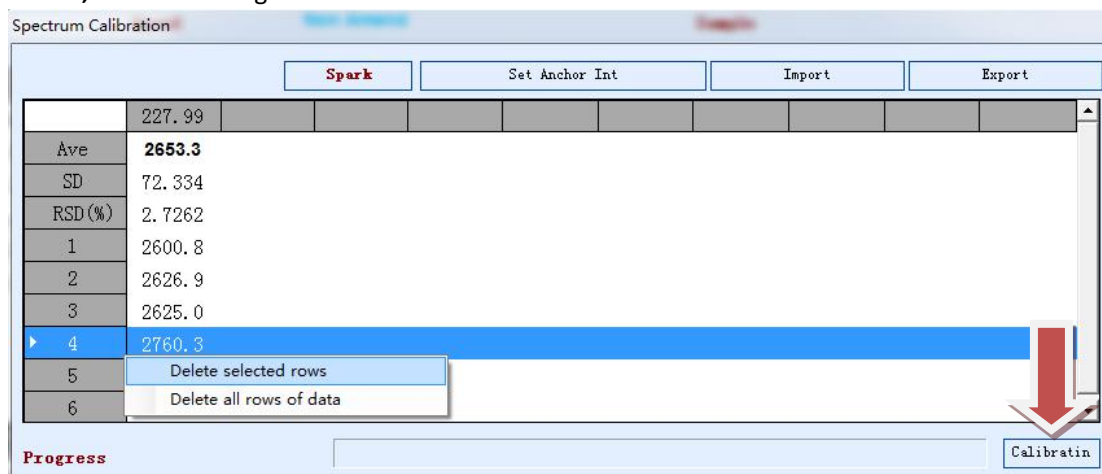


Figure 4-15 Guaranteed that the RSD of the three data is less than 3

4.4 Light intensity standardization

Since the working conditions of the instrument are relatively stable state composed of various factors, the change of the working environment of the instrument (temperature and humidity change), the purity of the replacement argon gas, the pressure of the argon gas (the flow rate), a series of external factors, such as the difference in the grinding surface of the sample and the operating habits of the operator, may cause the instrument working curve to drift. The results show that the test results of the same sample are different at different times, so the instrument should be standardized at any time according to the use; Some factors that change slowly over time, such as lens contamination, aging of electronic systems, and energy attenuation of optical systems, can cause slow drifts in the working curve.

At this time, standardization operation is required. It is to correct the spectral intensity of all the analysis models under one category by high and low standards, which can effectively improve the accuracy of the measurement. In short, the drift of these working curves can be corrected by standardized means, so that it remains relatively stable for a period of time is enough to meet the needs of the work. The user conducts it regularly according to his or her actual situation. It is generally recommended to do it once a week.

4.4.1 Standard operation

Step 1 Click "Analysis"->"Group Standardization"->"New" in menu bar of the software, as shown in Figure 4-16:

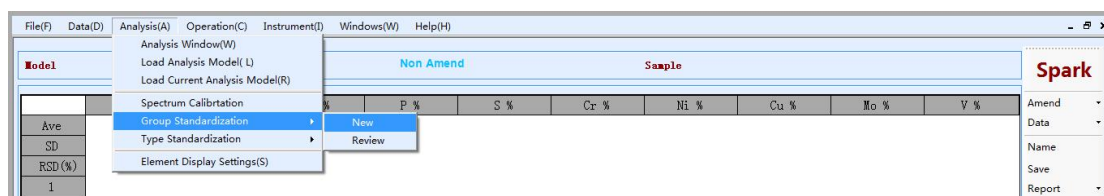


Figure 4-16 Group Standardization

Step 2 Find the sample in the upper left corner, spark every sample twice and then observe the RSD. If the RSD of the channel above 500 is less than 3, click the next sample to repeat the above operation. If the RSD of the channel above 500 is greater than 3, you need to spark the sample again, delete a relatively large data, and finally ensure that the RSD of channels above 500 is less than 3, as shown in the following figure:

Base Setting From

Spark Parameter Spark Data

Sample

J70201
J70206B

	C19309_1	C19309_2	C38608_1	Si25069_1	Si25161_1	Si28815_1	Si39055_1	Mn19212_1	Mn25937_1	Mn26381_1
Ave	5006.6	2276.3	343.2	4338.7	1227.0	731.5	162.4	1875.8	12435.7	1334.3
SD	4089.7	1851.8	252.21	189.16	848.04	762.57	142.81	828.14	2117.4	425.05
RSD (%)	81.687	81.35	73.496	4.3597	69.114	104.24	87.944	44.148	17.026	31.854
1	7369.7	3348.5	494.4	4256.5	735.9	291.2	85.4	2350.5	13615.5	1589.4
2	7365.8	3342.3	483.1	4204.6	738.8	291.3	74.6	2357.4	13700.3	1569.9
3	284.2	138.1	52.0	4555.1	2206.2	1612.1	327.2	919.6	9991.3	843.7
4										
5										

	Mn29001_1	Mn29393_1	Mn29492_1	Mn40307_1	Mn40344_1	P17749_1	P17828_1	Si8073_1	Si8203_1	Cr26771_1
Ave	454.0	6706.1	8920.0	3317.4	1582.4	1042.5	476.3	135.9	235.2	4839.9
SD	145.24	1497.1	2027.2	198.44	198.49	64.544	162.57	26.29	55.127	7119.7
RSD (%)	31.988	22.324	22.727	5.9818	12.544	6.1916	34.132	19.339	23.44	147.11
1	540.4	7531.4	10102.8	3378.3	1679.1	1011.6	573.2	125.0	271.2	728.2
2	535.4	7608.8	10077.9	3478.3	1714.0	999.1	567.1	116.9	262.6	730.4
3	286.4	4978.0	6579.2	3095.7	1354.1	1116.6	288.6	165.9	171.7	13061.1
4										

Analysis(A) Operation(C) Instrument(I) Windows(W) Help(H)

Base Setting From

Spark Parameter Spark Data

Sample

J70201
J70206B

	C19309_1	C19309_2	C38608_1	Si25069_1	Si25161_1	Si28815_1	Si39055_1	Mn19212_1	Mn25937_1	Mn26381_1
Ave	5006.6	2276.3	343.2	4338.7	1227.0	731.5	162.4	1875.8	12435.7	1334.3
SD	4089.7	1851.8	252.21	189.16	848.04	762.57	142.81	828.14	2117.4	425.05
RSD (%)	81.687	81.35	73.496	4.3597	69.114	104.24	87.944	44.148	17.026	31.854
1	7369.7	3348.5	494.4	4256.5	735.9	291.2	85.4	2350.5	13615.5	1589.4
2	7365.8	3342.3	483.1	4204.6	738.8	291.3	74.6	2357.4	13700.3	1569.9
3	284.2	138.1	52.0	4555.1	2206.2	1612.1	327.2	919.6	9991.3	843.7
4	Delete selected rows									
5	Delete all rows of data									

	Mn29001_1	Mn29393_1	Mn29492_1	Mn40307_1	Mn40344_1	P17749_1	P17828_1	Si8073_1	Si8203_1	Cr26771_1
Ave	454.0	6706.1	8920.0	3317.4	1582.4	1042.5	476.3	135.9	235.2	4839.9
SD	145.24	1497.1	2027.2	198.44	198.49	64.544	162.57	26.29	55.127	7119.7
RSD (%)	31.988	22.324	22.727	5.9818	12.544	6.1916	34.132	19.339	23.44	147.11
1	540.4	7531.4	10102.8	3378.3	1679.1	1011.6	573.2	125.0	271.2	728.2
2	535.4	7608.8	10077.9	3478.3	1714.0	999.1	567.1	116.9	262.6	730.4
3	286.4	4978.0	6579.2	3095.7	1354.1	1116.6	288.6	165.9	171.7	13061.1
4										

Base Setting From

Spark Parameter Spark Data

Sample

J70201
J70206B

	C19309_1	C19309_2	C38608_1	Si25069_1	Si25161_1	Si28815_1	Si39055_1	Mn19212_1	Mn25937_1	Mn26381_1
Ave	7367.8	3345.4	488.7	4230.6	737.4	291.3	80.0	2353.9	13657.9	1579.7
SD	2.6959	4.3498	7.9917	36.647	2.0498	0.12255	7.6815	4.9169	59.907	13.811
RSD (%)	0.03659	0.13003	1.6352	0.86624	0.27798	0.042078	9.6023	0.20888	0.43862	0.87428
1	7369.7	3348.5	494.4	4256.5	735.9	291.2	85.4	2350.5	13615.5	1589.4
2	7365.8	3342.3	483.1	4204.6	738.8	291.3	74.6	2357.4	13700.3	1569.9
3										
4										
5										

	Mn29001_1	Mn29393_1	Mn29492_1	Mn40307_1	Mn40344_1	P17749_1	P17828_1	Si8073_1	Si8203_1	Cr26771_1
Ave	537.9	7570.1	10090.4	3428.3	1696.6	1005.4	570.1	120.9	266.9	729.3
SD	3.5852	54.675	17.593	70.721	24.675	8.8777	4.3081	5.6967	6.0749	1.5484
RSD (%)	0.66654	0.72225	0.17436	2.0629	1.4544	0.88303	0.75564	4.7102	2.276	0.21231
1	540.4	7531.4	10102.8	3378.3	1679.1	1011.6	573.2	125.0	271.2	728.2
2	535.4	7608.8	10077.9	3478.3	1714.0	999.1	567.1	116.9	262.6	730.4
3										

Step 3 When both the high and low standard samples on the left are sparked and meet the conditions, click “Next Step” and “Save”, as shown in Figure 4-17:

New light intensity standardization coefficient - 1/2 - [Stimulate High And Low Sample]

	C19309_1	C19309_2	C38608_1	Si25069_1	Si25161_1	Si28815_1	Si39055_1	Mn19212_1	Mn25937_1	Mn26381_1
Ave	671.3	291.9	90.4	5099.3	3025.8	1790.7	193.4	282.8	6578.7	294.7
SD	6.3958	2.2461	3.3764	90.899	53.952	23.589	6.9218	8.6421	85.324	5.0689
RSD (%)	0.95276	0.7696	3.7338	1.7826	1.7831	1.3174	3.5782	3.0554	1.297	1.7202
1	675.8	290.3	92.8	5163.6	3063.9	1774.0	198.3	289.0	6639.1	298.2
2	666.8	293.4	88.0	5035.0	2987.6	1807.4	188.6	276.7	6518.4	291.1
3										
4										
5										

	Mn29001_1	Mn29393_1	Mn29492_1	Mn40307_1	Mn40344_1	P17749_1	P17828_1	S18073_1	S18203_1	Cr26771_1
Ave	54.0	1477.6	3522.0	1090.5	427.9	393.6	145.9	905.4	589.9	7120.8
SD	0.11746	28.588	68.89	9.106	6.872	1.3716	2.4159	48.764	27.392	314.99
RSD (%)	0.21761	1.9347	1.956	0.83499	1.6059	0.34844	1.6558	5.3858	4.6434	4.4234
1	54.1	1457.4	3570.7	1084.1	432.8	392.7	147.6	870.9	570.5	7343.6
2	53.9	1497.9	3473.3	1097.0	423.1	394.6	144.2	939.9	609.3	6898.1
3										
4										

Next Step Cancel

Figure 4-17 Group Standardization

4.4.2 Manual normalization coefficient correction

After completing the above steps, a high and low standard is randomly sparked. If the test result is not satisfactory and you do not want to pass the group Standardization, you can also change the data result by modifying the coefficient.

Step 1 When the high-standard element (general content is greater than 0.1) is higher than the measured value, and the desired result is lowered, the reference light intensity value is modified to be smaller, then the concentration value becomes lower as the correction amount becomes smaller, and vice versa. When the value is low, the reference light intensity value is modified a little larger, and the concentration will become higher accordingly, as shown in Figure 4-18:

Measurement Analysis - [Fe-Low alloy] - [Analysis Windows]

File(F)Data(D)Analysis(A)Operation(C)Instrument(I)Windows(W)Help(H)

Model	Fe-Low alloy	Amend	Non Amend	Sample						
	C %	Si %	Mn %	P %	S %	Ca %	Cr %	Ni %	Cu %	Mo %
Ave	0.045	3.841	4.477	<0.001	0.195	0.002	0.823	0.167	0.119	34.570
SD	0	0	0	0	0	0	0	0	0	0
RSD (%)	0	0	0	0	0	0	0	0	0	0
1	0.045	3.841	4.477	<0.001	0.195	0.002	0.823	0.167	0.119	34.570
2										
3										
4										
5										
6										
7										
8										
9										

	V %	Ti %	Al %	As %	B %	Nb %	Sn %	N %	Pb %	Fe %
Ave	0.009	1.137	0.344	0.068	0.024	0.189	0.088	0.025	9.029	43.003
SD	0	0	0	0	0	0	0	0	0	0
RSD (%)	0	0	0	0	0	0	0	0	0	0
1	0.009	1.137	0.344	0.068	0.024	0.189	0.088	0.025	9.029	43.003
2										
3										
4										
5										
6										
7										
8										
9										

Spark

Amend

Data

Name

Save

Report

Print

Multiple Spark

Import

Export

Figure 4-18 where the content of C is high

Step 2 Click "Analysis"- "Light standardization"- "Review" in the menu bar of the software, as shown in Figure 4-19:

Measurement Analysis - [Fe-Low alloy] - [Analysis Windows]

File(F)Data(D)Analysis(A)Operation(C)Instrument(I)Windows(W)Help(H)

Model

Spectrum Calibration

Group Standardization

Type Standardization

Element Display Settings(S)

Dark Current(D)

Lamp Exposure(E)

Amend

Non Amend

Sample

	Mn %	P %	S %	Ca %	Cr %	Ni %	Cu %	Mo %
Ave		<0.001	0.195	0.002	0.823	0.167	0.119	34.570
SD		0	0	0	0	0	0	0
RSD (%)		0	0	0	0	0	0	0
1	4.477	<0.001	0.195	0.002	0.823	0.167	0.119	34.570
2								
3								
4								

	V %	Ti %	Al %	As %	B %	Nb %	Sn %	N %	Pb %	Fe %
Ave										
SD										
RSD (%)										
1										
2										
3										
4										

Spark

Amend

Data

Name

Save

Report

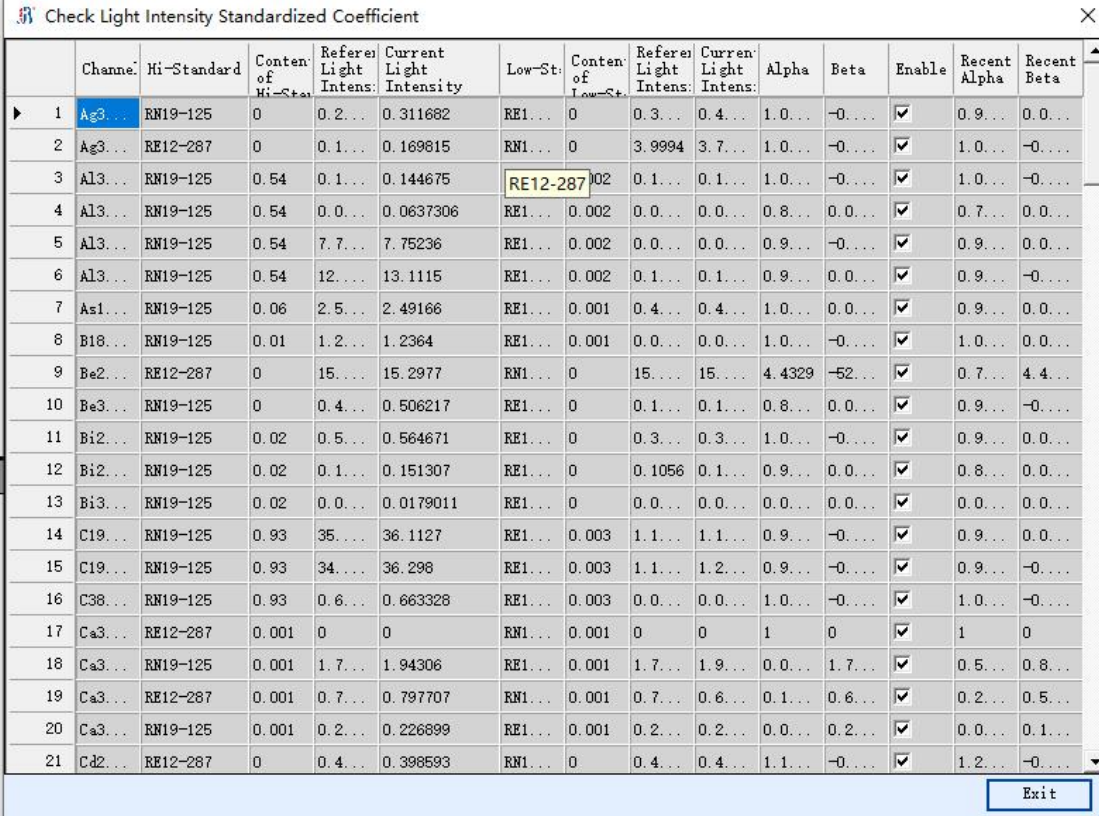
Print

Multiple Spark

Import

Figure 4-19 View of light intensity standardization

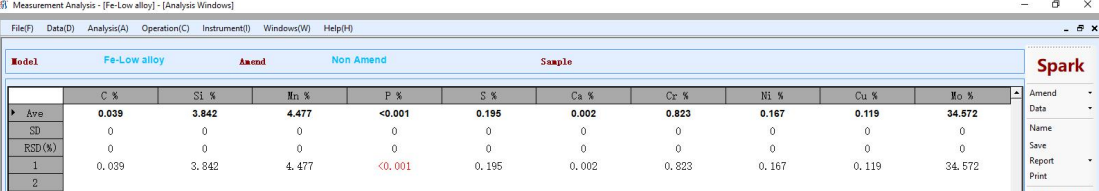
Step 3 Change the reference light intensity 33973.2 of the C element to 32973.2 (about 5% each time), and click “Save”, as shown in Figure 4-20:



	Channel	Hi-Standard	Content of Hi-Standard	Reference Light Intensity	Current Light Intensity	Low-St.	Content of Low-St.	Reference Light Intensity	Current Light Intensity	Alpha	Beta	Enable	Recent Alpha	Recent Beta
1	Ag3...	RN19-125	0	0.2...	0.311682	RE1...	0	0.3...	0.4...	1.0...	-0...	<input checked="" type="checkbox"/>	0.9...	0.0...
2	Ag3...	RE12-287	0	0.1...	0.169815	RN1...	0	3.9994	3.7...	1.0...	-0...	<input checked="" type="checkbox"/>	1.0...	-0...
3	Al3...	RN19-125	0.54	0.1...	0.144675	RE12-287	0.02	0.1...	0.1...	1.0...	-0...	<input checked="" type="checkbox"/>	1.0...	-0...
4	Al3...	RN19-125	0.54	0.0...	0.0637306	RE1...	0.002	0.0...	0.0...	0.8...	0.0...	<input checked="" type="checkbox"/>	0.7...	0.0...
5	Al3...	RN19-125	0.54	7.7...	7.75236	RE1...	0.002	0.0...	0.0...	0.9...	-0...	<input checked="" type="checkbox"/>	0.9...	0.0...
6	Al3...	RN19-125	0.54	12....	13.1115	RE1...	0.002	0.1...	0.1...	0.9...	0.0...	<input checked="" type="checkbox"/>	0.9...	-0...
7	As1...	RN19-125	0.06	2.5...	2.49166	RE1...	0.001	0.4...	0.4...	1.0...	0.0...	<input checked="" type="checkbox"/>	0.9...	0.0...
8	B18...	RN19-125	0.01	1.2...	1.2364	RE1...	0.001	0.0...	0.0...	1.0...	-0...	<input checked="" type="checkbox"/>	1.0...	0.0...
9	Be2...	RE12-287	0	15....	15.2977	RN1...	0	15....	15....	4.4329	-52...	<input checked="" type="checkbox"/>	0.7...	4.4...
10	Be3...	RN19-125	0	0.4...	0.506217	RE1...	0	0.1...	0.1...	0.8...	0.0...	<input checked="" type="checkbox"/>	0.9...	-0...
11	Bi2...	RN19-125	0.02	0.5...	0.564671	RE1...	0	0.3...	0.3...	1.0...	-0...	<input checked="" type="checkbox"/>	0.9...	0.0...
12	Bi2...	RN19-125	0.02	0.1...	0.151307	RE1...	0	0.1056	0.1...	0.9...	0.0...	<input checked="" type="checkbox"/>	0.8...	0.0...
13	Bi3...	RN19-125	0.02	0.0...	0.0179011	RE1...	0	0.0...	0.0...	0.0...	0.0...	<input checked="" type="checkbox"/>	0.0...	0.0...
14	C19...	RN19-125	0.93	35....	36.1127	RE1...	0.003	1.1...	1.1...	0.9...	-0...	<input checked="" type="checkbox"/>	0.9...	0.0...
15	C19...	RN19-125	0.93	34....	36.298	RE1...	0.003	1.1...	1.2...	0.9...	-0...	<input checked="" type="checkbox"/>	0.9...	-0...
16	C38...	RN19-125	0.93	0.6...	0.663328	RE1...	0.003	0.0...	0.0...	1.0...	-0...	<input checked="" type="checkbox"/>	1.0...	-0...
17	Ca3...	RE12-287	0.001	0	0	RN1...	0.001	0	0	1	0	<input checked="" type="checkbox"/>	1	0
18	Ca3...	RN19-125	0.001	1.7...	1.94306	RE1...	0.001	1.7...	1.9...	0.0...	1.7...	<input checked="" type="checkbox"/>	0.5...	0.8...
19	Ca3...	RE12-287	0.001	0.7...	0.797707	RN1...	0.001	0.7...	0.6...	0.1...	0.6...	<input checked="" type="checkbox"/>	0.2...	0.5...
20	Ca3...	RN19-125	0.001	0.2...	0.226899	RE1...	0.001	0.2...	0.2...	0.0...	0.2...	<input checked="" type="checkbox"/>	0.0...	0.1...
21	Cd2...	RE12-287	0	0.4...	0.398593	RN1...	0	0.4...	0.4...	1.1...	-0...	<input checked="" type="checkbox"/>	1.2...	-0...

Figure 4-20 Modifying the reference light intensity

Step 4 Modify the corresponding reference light intensity, the content will change, as shown in Figure 4-21:



	C %	Si %	Mn %	P %	S %	Ca %	Cr %	Ni %	Cu %	Mo %
Ave	0.039	3.842	4.477	<0.001	0.195	0.002	0.823	0.167	0.119	34.572
SD	0	0	0	0	0	0	0	0	0	0
RSD (%)	0	0	0	0	0	0	0	0	0	0
1	0.039	3.842	4.477	<0.001	0.195	0.002	0.823	0.167	0.119	34.572
2										

Figure 4-21 Observing the content of C element

Similarly, when the low-standard element (content less than 0.1) is lower, it is hoped that the result will increase, then the reference light intensity value will be modified a little larger, then the concentration value will become higher as the correction amount becomes larger, and vice versa. When the value is high, the reference light intensity value is modified to be smaller, and the concentration will be lower accordingly.



NOTE

- When the value is corrected, it is opposite to the above result;
- The corrected coefficient is a permanent repair and must be based on the comparison of the indicated content of the standard sample with the standard content table;
- Light intensity standardization must be performed before correction;
- The correction method is most effective only when there is interference or the

sparkling parameter is not suitable for the analysis of the element. Therefore, the artificial correction of the permanent curve is a supplement to the standardization of the instrument;

- Persistence curve corrections are sometimes repeated until the analysis results are accurate.

4.5 Type Standardization

If the channel analysis range of an analysis program is large or there is interference (such as superimposed interference, matrix effect, etc.), there is still a bias in the control sample analysis after standardization, and type standardization is required. Type standardization effectively calibrates the effects of various disturbances on the results of the analysis. It is especially suitable for multi-sample analysis of metals and their alloys with consistent sample content or the same grade.

Step 1 Click “Analysis”- “Type Standardization”- “New” in menu bar of the software, as shown in Figure 4-22:

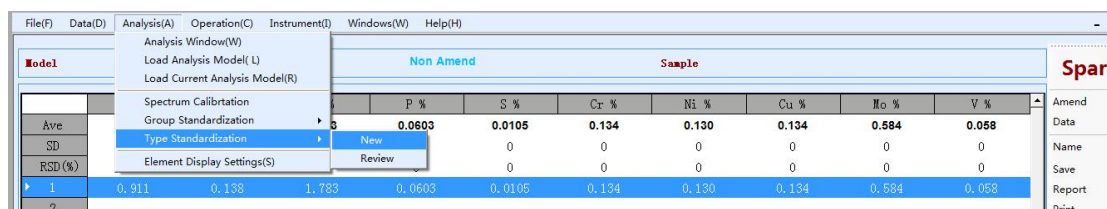


Figure 4-22 Type Standardization

Step 2 After clicking “New” again, enter the sample name and click “OK”, as shown in Figure 4-23:

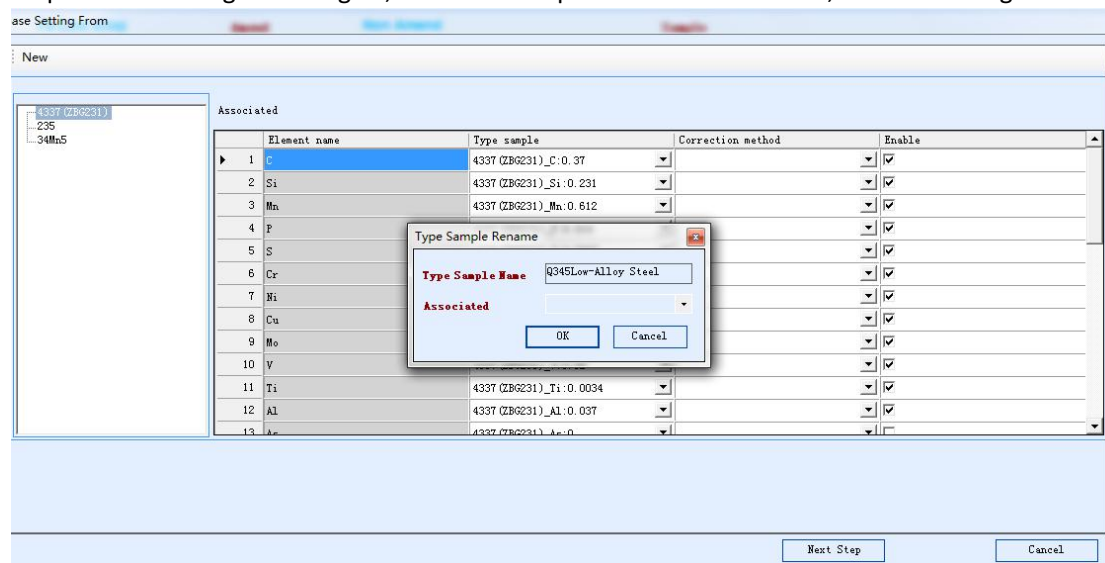


Figure 4-23 Entering the sample name

Step 3 Right-click on the sample and select “Add”, as shown in Figure 4-24:

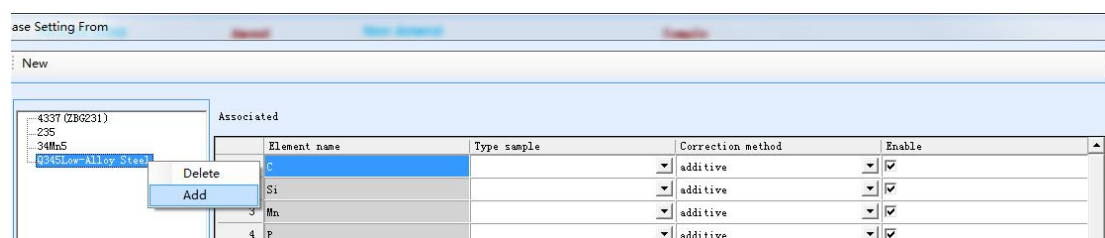


Figure 4-24 Adding a sample

Step 4 Find the sample in the sample library, tick it, right-click " Check Select Node", and then click "Sure" and "Next Step" as shown in Figure 4-25:

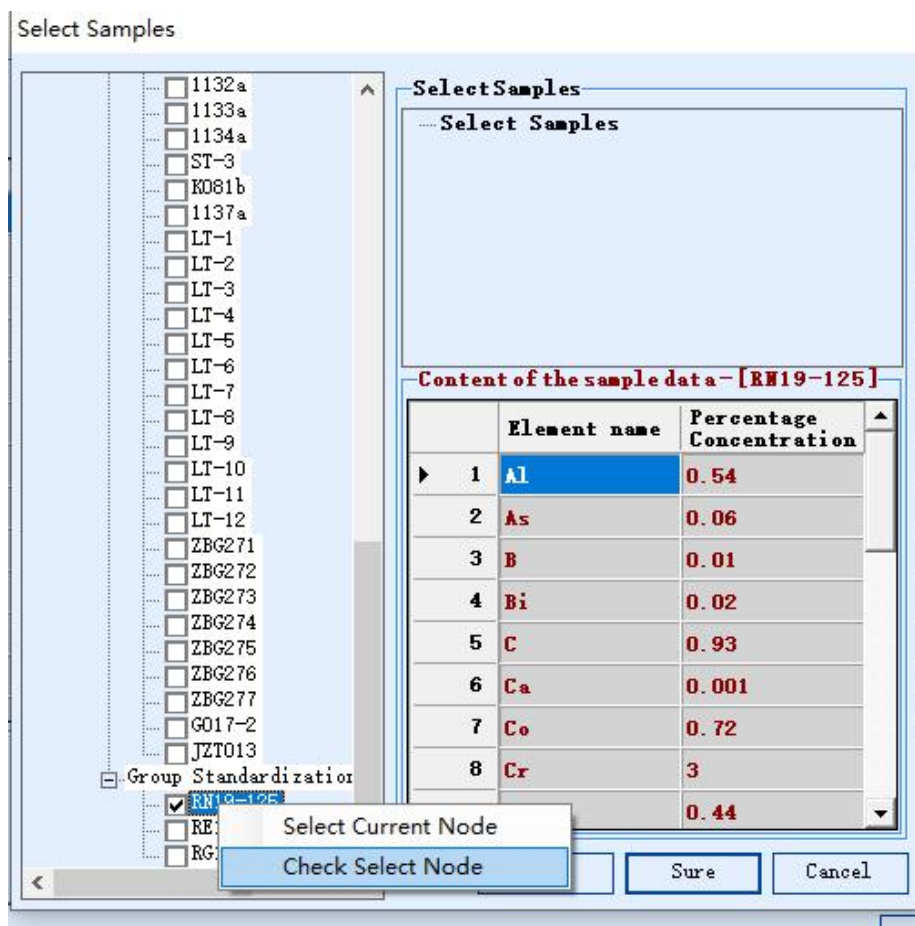


Figure 4-25 Select node

Step 5 Enter the sparking page. According to the sample information listed on the left, place the selected sample on the spark stand. Click "Spark" to analyze the sample, as shown in Figure 4-26:

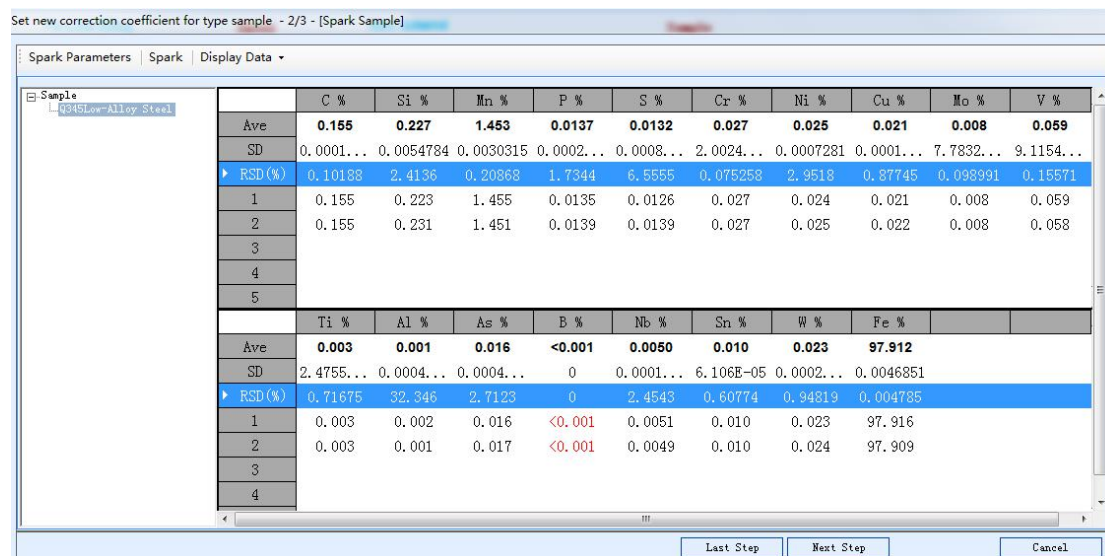


Figure 4-26 Sparking the sample

As with the Group Standardization, after seeing RSD twice, **ensure that the RSD of the main elements is less than 3, you can spark the third or more**, and finally click “Next” and confirm “Save”.

4.6 Actual operation

4.6.1 Daily preparation

This step is detailed in **4.2 Preparations**

4.6.2 Classification of categories

Step 1 Click “Amend”- “Type Standardization” In the upper right corner, as shown in Figure 4-27:

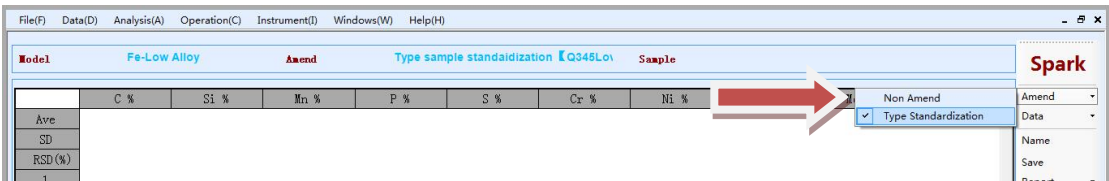


Figure 4-27 Type Standardization

Step 2 Select the required control sample and click “Select”, as shown in Figure 4-28:

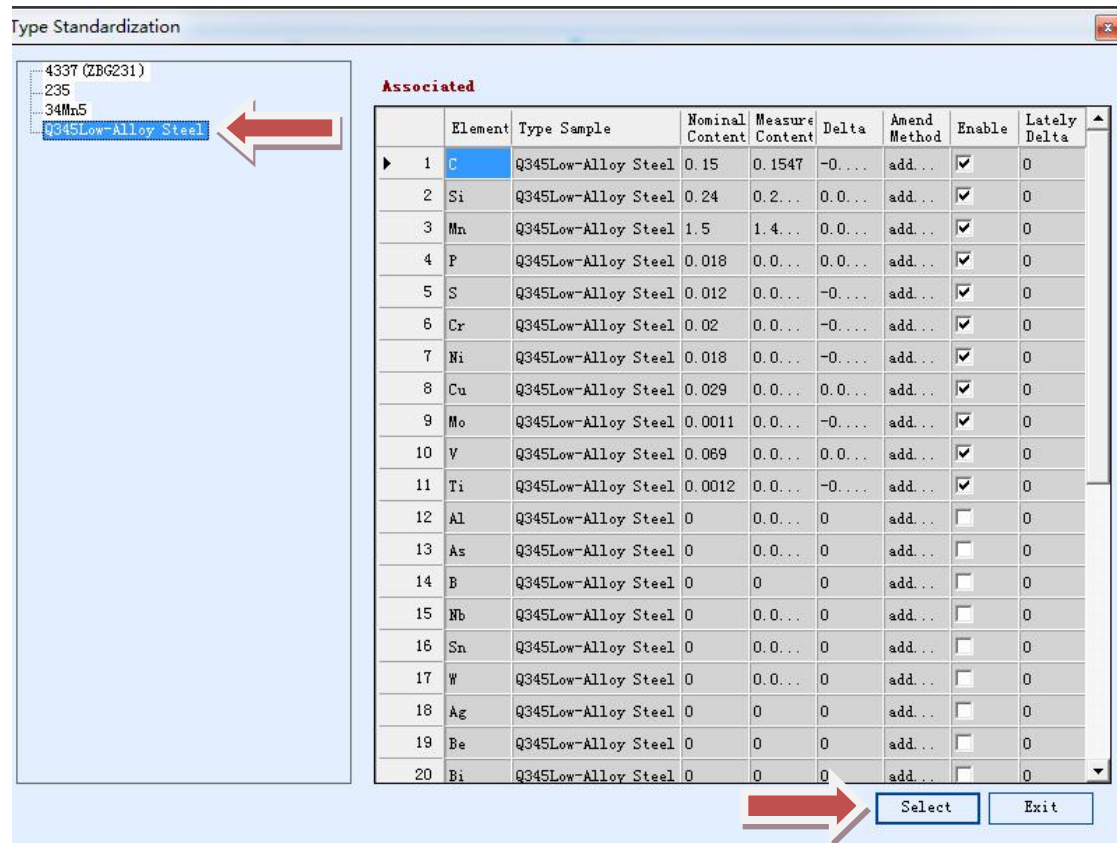


Figure 4-28 Selecting the sample

Step 3 At this point, the name of the sample control just appears, and the corresponding control sample is sparked, as shown in Figure 4-29.

Model

Fe-Low Alloy

Amend

Type sample standardization

Q345Low

Sample

Spark

Amend

Data

Name

Save

Report

Print

Import

Export

	C %	Si %	Mn %	P %	S %	Cr %	Ni %	Cu %	Mo %	V %
Ave	0.149	0.245	1.554	0.0179	0.0117	0.019	0.018	0.029	<0.001	0.068
SD	0	0	0	0	0	0	0	0	0	0
RSD (%)	0	0	0	0	0	0	0	0	0	0
1	0.149	0.245	1.554	0.0179	0.0117	0.019	0.018	0.029	<0.001	0.068
2										
3										
4										
5										
6										
7										
	Ti %	Al %	As %	B %	Nb %	Sn %	W %	Fe %		
Ave	0.001	<0.001	0.017	<0.001	0.0054	0.010	0.024	97.800		
SD	0	0	0	0	0	0	0	0		
RSD (%)	0	0	0	0	0	0	0	0		
1	0.001	<0.001	0.017	<0.001	0.0054	0.010	0.024	97.800		
2										

Figure 4-29 Data after sparking

Step 4 Find the corresponding content in the sample management, as shown in Figure 4-30.

File(F)

Data(D)

Analysis(A)

Operation(C)

Instrument(I)

Windows(W)

Help(H)

Model

Fe-Low Alloy

Amend

Type sample standardization

Q345Low

Sample

	C %	Si %	Mn %	P %	S %	Cr %	Ni %	Cu %	Mo %	V %	Non Amend
Ave	0.149	0.245	1.554	0.0179	0.0117	0.019	0.018	0.029	<0.001	0.068	Type Standardization
SD	0	0	0	0	0	0	0	0	0	0	
RSD (%)	0	0	0	0	0	0	0	0	0	0	
1	0.149	0.245	1.554	0.0179	0.0117	0.019	0.018	0.029	<0.001	0.068	
2											
3											
4											
5											
6											
7											
	Ti %	Al %	As %	B %	Nb %	Sn %	W %	Fe %			
Ave	0.001	<0.001	0.017	<0.001	0.0054	0.010	0.024	97.800			
SD	0	0	0	0	0	0	0	0			
RSD (%)	0	0	0	0	0	0	0	0			
1	0.001	<0.001	0.017	<0.001	0.0054	0.010	0.024	97.800			
2											
3											
4											
5											
6											
7											

Content of the sample data - [Q345Low-Alloy Steel]

Element name	Percentage Concentration (%)
1 C	0.15
2 Cr	0.02
3 Cu	0.029
4 Fe	97.9367
5 Mn	1.5
6 Mo	0.0011
7 W	0.005
8 Ni	0.018
9 P	0.018
10 S	0.012
11 Si	0.24
12 Ti	0.0012
13 V	0.068

Save

Exit

Q345Low-Alloy Steel

940

301

calibration

345

304

316

321

062918

Spark

Amend

Data

Name

Save

Report

Print

Import

Import

Export

Figure 4-30 Sample content

If the difference is not big, you can directly detect similar products. If the difference is large, click "Amend" - "Non Amend", as shown in Figure 4-31:

File(F) Data(D) Analysis(A) Operation(C) Instrument(I) Windows(W) Help(H) 8

Model	Fe-Low Alloy	Amend	Type sample standardization	Q345Low	Sample					
Ave	0.149	0.245	1.554	0.0179	0.0117	0.019	0.018	0.029	<input checked="" type="checkbox"/> Non Amend	Amend
SD	0	0	0	0	0	0	0	0	<input type="checkbox"/> Type Standardization	Data
RSD (%)	0	0	0	0	0	0	0	0		Name
1	0.149	0.245	1.554	0.0179	0.0117	0.019	0.018	0.029	<0.001	Save
2									0.068	Report
3										Print

Spark

Figure 4-31 Content correction

Step 5 Click “Analysis”- “Type Standardization”-“New” in menu bar of the software, as shown in Figure 4-32:

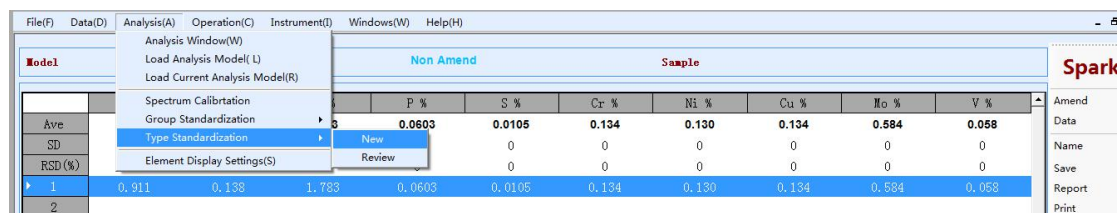


Figure 4-32 group Standardization

Step 6 Click required control sample and click “Select”, as shown in Figure 4-33.

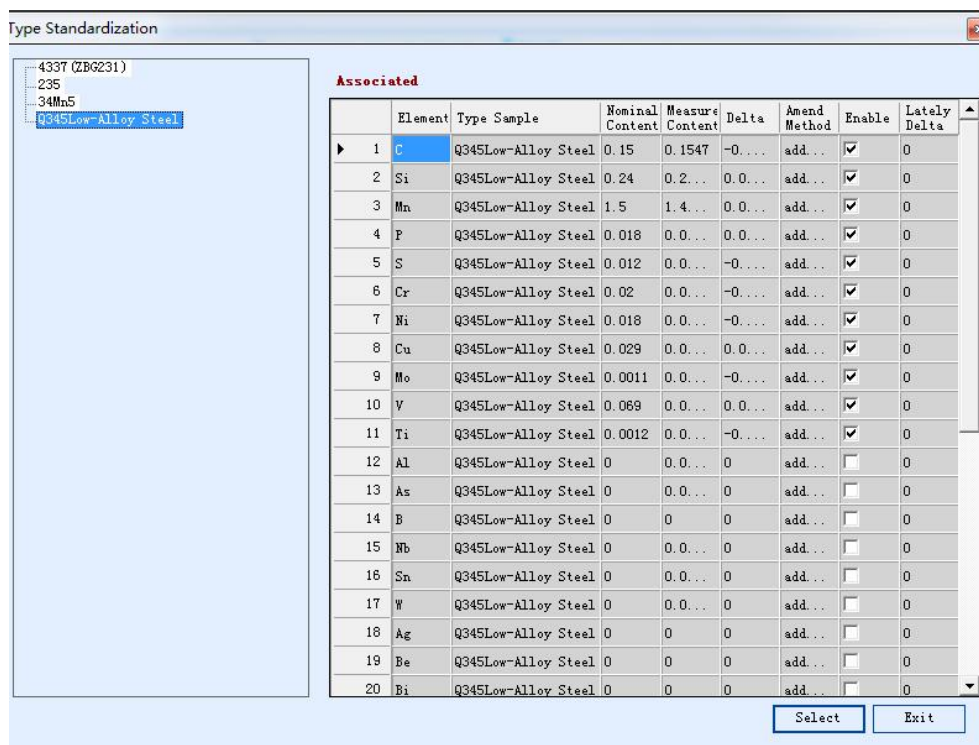


Figure 4-33 Select the required control sample

Step 7 Spark the corresponding control samples twice to ensure that the RSD of the main elements is less than 3. Click “Next Step”, as shown in Figure 4-34:

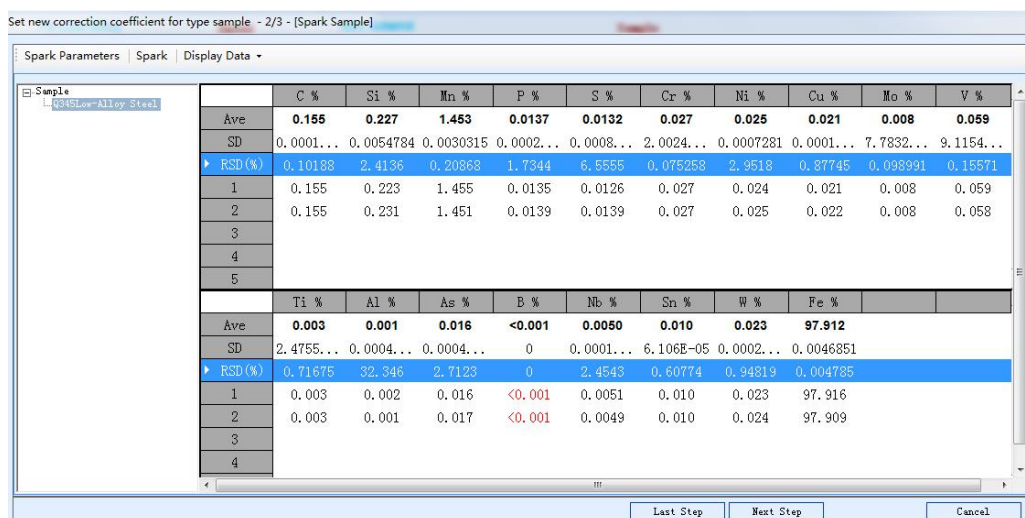


Figure 4-34 Sparking the sample

Re-spark the corresponding control sample again, compare the content table, if the difference is not big, you can test the similar products. If the difference is still big, you need to proceed to the next step.

4.6.3 Continue to correct

Step 1 Same as 4.4.1 standard operation

Step 2 Step 5 to Step 7 with the standardization of the 4.6.2 category

Step 3 Check the corresponding content table. If the difference is not big, you can detect similar products. If the difference is still large, you need to proceed to the next step.

4.6.4 Final step correction

Step 1 **with 4.3 Spectrum Calibration**

Step 2 **Same as 4.4.1 standard operation**

Step 3 **Step 5 to Step 7 with the standardization of the 4.6.2 category**



NOTE

- When the line is corrected, the intensity of the light must be greater than 1000. When the temperature is lower than 1000, the lens should be cleaned;
 - Steps in daily work should be performed from top to bottom, sometimes not all completed
-

Chapter 5 Analyze data processing

5.1 Querying the current day data and printing

5.1.1 Simple Data Processing

Step 1 Enter the “sample name” and click “Save”, as shown in Figure 5-1:

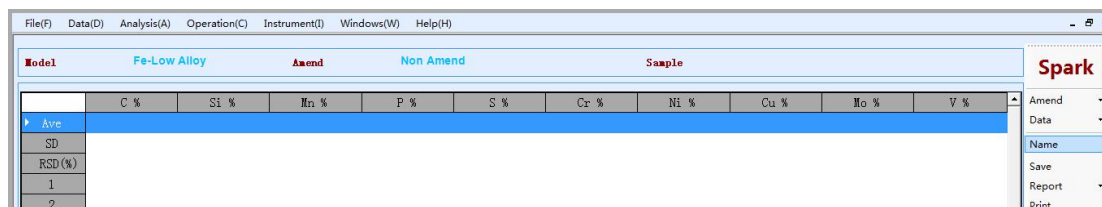


Figure 5-1 Simple data processing

Step 2 Click “Print Data” to display simple data processing.

5.1.2 Report Data Processing

Step 1 Click “Analyze Data” under “Report”, as shown in Figure 5-2:

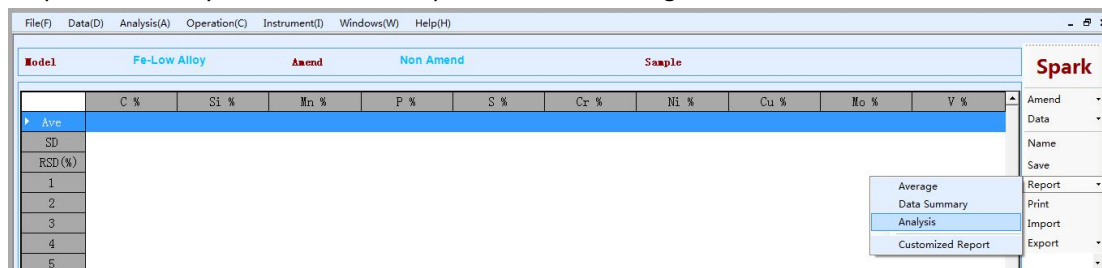


Figure 5-2 Report data

Step 2 Automatically jump to the Excel software to complete the related report printing.

5.2 Querying historical data and printing

Step 1 Locate the “Query Analysis Data” of “Data” in the menu bar, as shown in Figure 5-3:

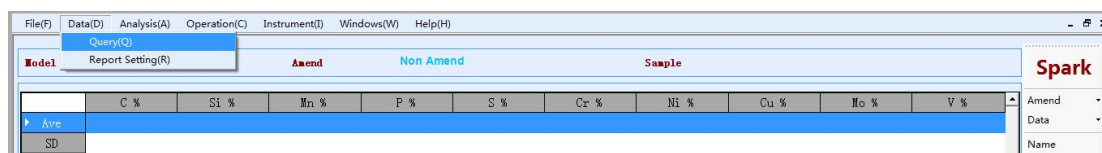


Figure 5-3 Query analysis data

Step 2 Click “Advanced Query” to query the historical data according to the time, or print it, as shown in Figure 5-4:

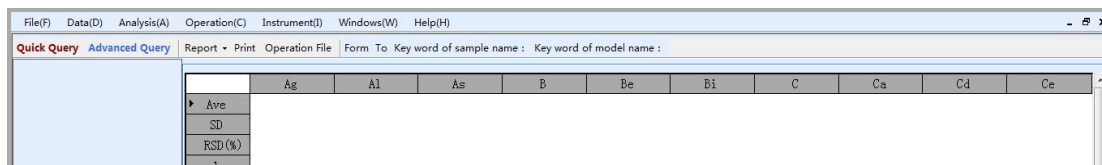


Figure 5-4 Advanced query

Chapter 6 Daily maintenance

6.1 Device Maintenance Period

Number	Maintenance project	Maintenance cycle
1	Electrode cleaning	Before each sparking
2	Sparking stand maintenance	(3-7) days or 300 sparking (requires the light source to be turned off)
3	Lens maintenance	6 months or 600 sparking (requires the light source to be turned off, Spectrum Calibration required after completion)
4	Gas cylinder maintenance	(1-2) months or 2,500 sparking
5	Vacuum pump maintenance	About 2000 working hours

- (1) When the instrument is in standby mode or not used for a long time, a sample should be placed on the spark stand to prevent the spark stand from entering the debris;
- (2) When turning off the instrument, first turn off the green key and then turn off the red key. When turning on the instrument, first turn on the red key and then turn on the green key;
- (3) If you need to use the instrument every day, you can only turn off the green button and the argon main valve when you are not using the instrument temporarily, keep the red button open;
- (4) If the instrument does not need to work for a long time (more than 5 days), and finally close the argon main valve and the total power supply, please turn on the instrument three hours in advance when using it;
- (5) There should be no trachoma or small holes in the preparation of the sample, the surface must be flat, and the spark pores can be completely covered. The surface of the sample should not be touched by hand, so as not to affect the data results;
- (6) When the argon gas in the standard 40L argon cylinder is only 2Mpa, the argon gas should be replaced in time to avoid contamination of the argon cylinder.
- (7) After each sample is sparked, the electrode is cleaned with an electrode brush.

6.2 Spark stand cleaning

Step 1 Turn off the light source button and the main power button, and unscrew the four hexagon socket screws on the spark table, as shown in Figure 6-1:



Figure 6-1 Loosening the set screw

Step 2 Remove the sparking panel and pay attention to the sealing ring on the panel and wipe it clean, as shown in Figure 6-2:

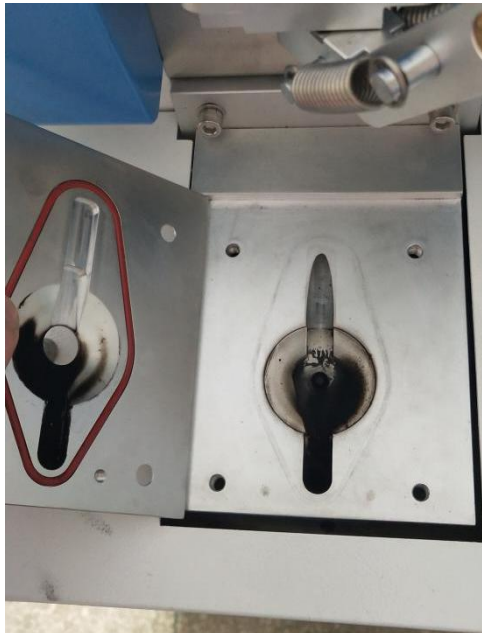


Figure 6-2 Removing the sparking panel and cleaning it

Step 3 Use paper to block the opening of the excitation table and clean the excitation table, as shown in Figure 6-3:



Figure 6-3 Cleaning the spark stand

Step 4 Remove the used waste paper, cover the spark stand, pay attention to the position of the seal and fix the four screws, such as 6-4:



Figure 6-4 Installing the spark stand

6.3 Lens cleaning

The lens is the only way the light emitted by the sample is sparked into the spectrometer and must be kept clean. However, the long-term use of the lens is contaminated, and a brownish-colored substance adheres to the outer surface. The longer the time, the thicker the

deposit. The metal powder generated by the sparking also adheres to the outer surface of the lens, reducing the transmittance of light, and lowering the absolute light intensity of all elements, especially the far ultraviolet elements C, P, and S are more obvious. The slope of the working curve of the element can be lowered, the sensitivity of the analysis is also lowered, and the analysis error is increased. Therefore, it is necessary to clean up the system regularly, and how much time to clean up. It depends on how many tasks are analyzed. It is best to clean up once every 60-100 days.

Step 1 Turn off the light source and the main power button to open the front door of the machine, as shown in Figure 6-5:

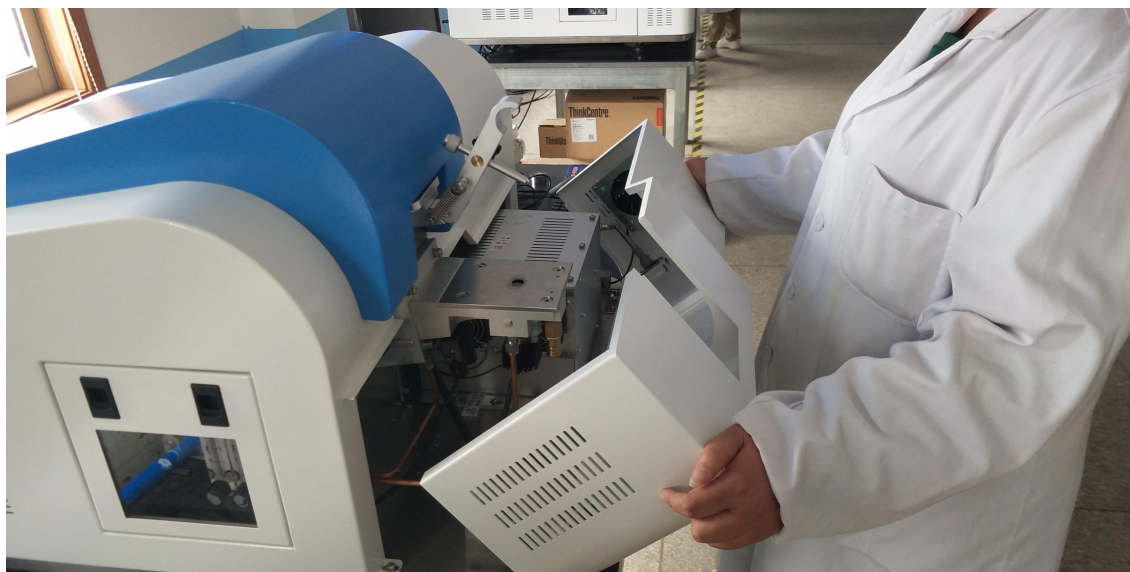


Figure 6-5 Opening the front door of the instrument

Step 2 Turn the 90° down to close the ball valve. At this time, you must go to the corresponding position to completely close it, as shown in Figure 6-6.



Figure 6-6 Rotating the ball valve

Step 3 Slide the lens down and slowly pull out the lens. Pay attention to the lens direction, as shown in Figures 6-7 and 6-8:



Figure 6-7 Removing the lens Figure

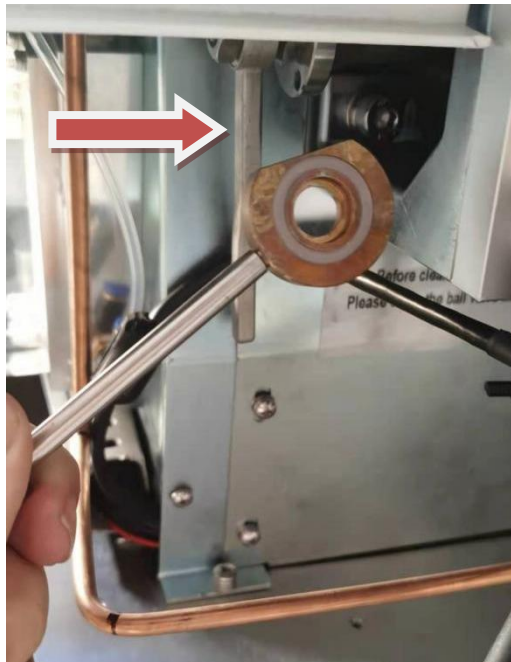


Figure6-8 Paying attention to the lens direction

Step 4 Use a cotton swab to dipped a little anhydrous ethanol (purity above 90%). After a slight damp, gently wipe the front and back sides of the lens, as shown in Figure 6-9:



Figure 6-9 Wipe the lens

Step 5 After the cleaning is complete, install the lens in the correct direction, as shown in Figure 6-10:

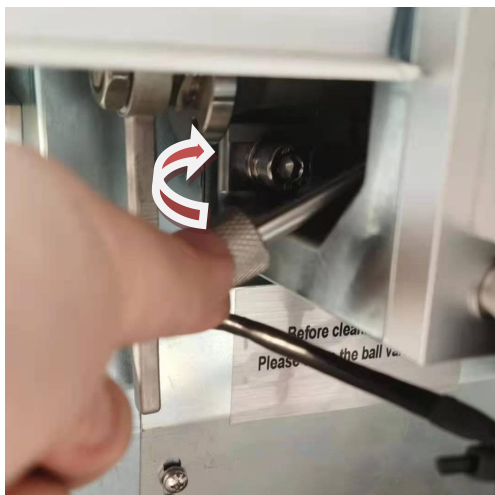


Figure 6-10 After cleaning, install the lens in the correct direction.

Step 6 Open the ball valve to the correct position, as shown in Figure 6-11:



Figure 6-11 Opening the ball valve upwards



CAVEAT

- Do not use too much absolute ethanol to wipe the lens to avoid dissolving the fixed glue around the lens;
 - The lens is made of quartz. Do not use hard objects (must not use metal to clamp cotton) to avoid scratching the lens surface;
 - When cleaning the lens, the ball valve switch must be closed (pull the handle 90 °) to prevent dust from sucking into the vacuum chamber, causing the optical path to be contaminated and affecting the optical device, resulting in a significant drop in instrumental analysis accuracy;
 - After the lens is wiped, "Spectrum Calibration" must be performed. See **4.3 Spectrum Calibration** for details.
-

6.4 Gas cylinder cleaning

Step 1 Open the bottle with water. If the water in the bottle is not clean or dark, it is recommended to change it to keep the bottle one-quarter of pure water.

Step 2 Open another gas cylinder. If the filter is dirty (the entire filter is black), clean it and reinstall it.

6.5 Check spark gap

Step 1 Turn off the light source button and the main power button to open the front door of the machine, as shown in Figure 6-12.

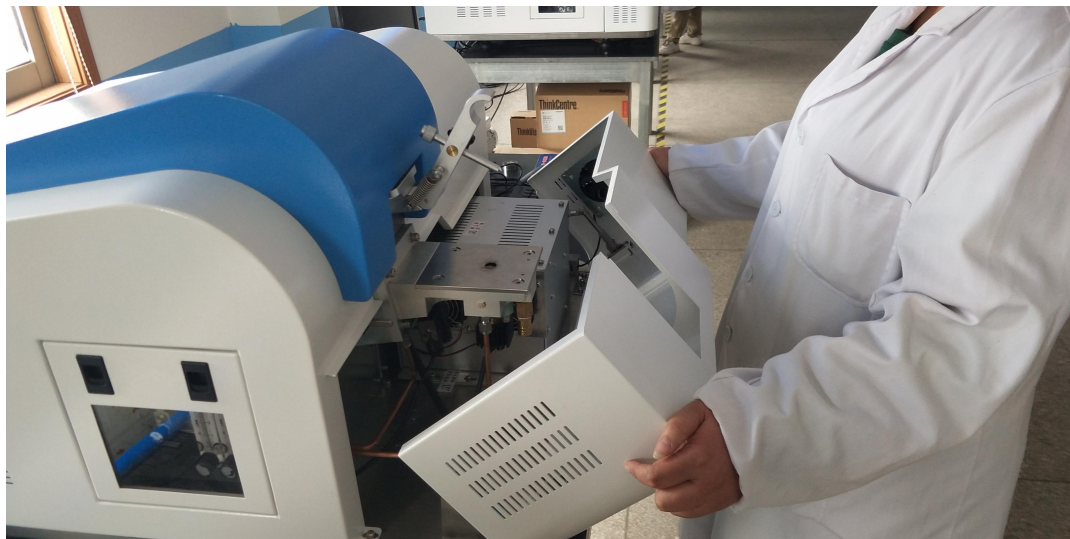


Figure 6-12 Opening the front door of the instrument

Step 2 Use a flat-blade screwdriver to unscrew the screw at the adjustment hole in the figure, and then use the M3 hex wrench to loosen the screw that fixes the tungsten electrode from the adjustment hole, as shown in Figure 6-13:

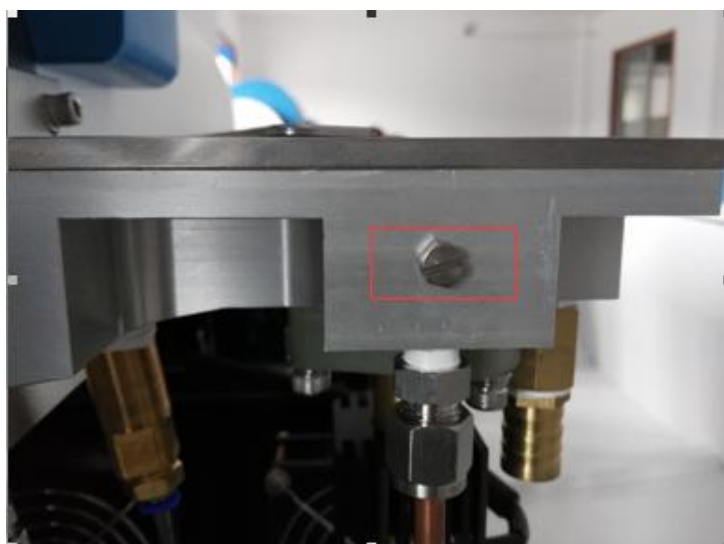


Figure 6-13 Adjustment hole

Step 3 Cover the sparking hole (the other end of the pressure bar) with a 3.4mm pitch gauge, loosen the electrode fixing screw on the left side of the spark stand, and then press the electrode with the spacing gauge until the spacing gauge is close to the surface of the spark stand. The protruding portion of the pitch gauge should be completely placed into the hole on the spark

stand, and then the electrode fixing screw can be tightened, as shown in Figure 6-14:

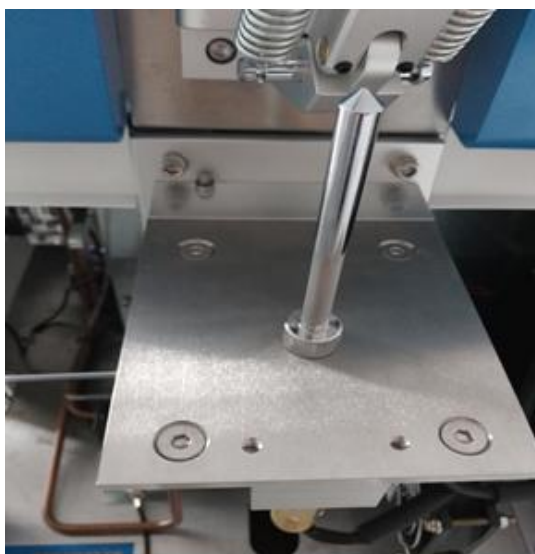


Figure 6-14 Adjusting the position

Step 4 Install the screw of the adjustment hole and reinstall the pressure bar.

6.6 Vacuum pump maintenance

Please use clean and suitable oil, preferably Shell 46# or 68#, to ensure the performance and life of the pump. Check the position of the oil according to your different operating conditions. During operation, the oil level of the pump must always be visible between the maximum and minimum values. If the oil level is lower than the minimum mark, refuel, if the oil level is higher than the maximum mark, drain the oil. Usually the oil is clear and transparent. If the oil turns black or the oil contains a lot of liquid, organic solvent or corrosive gas, please change the oil in time. It is recommended to change the oil every 2,000 working hours.

Step 1 Turn off the main power of the machine and disassemble the filter bottle, as shown in Figure 6-15:



Figure 6-15 is now open when the vacuum pump is in the state

Step 2 Remove the drain plug and drain the used oil into a suitable container. When the oil flow stops, screw the drain plug back, as shown in Figure 6-16:



Figure 6-16 Oil drain plug

Step 3 Briefly turn on the pump (maximum 10 seconds) and close, remove the drain plug again and drain the remaining oil, which will remove the residual oil in the pump chamber;

Step 4 Take out the oil filler plug and inject fresh oil, as shown in Figure 6-17:



Figure 6-17 Oil filler plug

Chapter 7 Common troubleshooting

7.1 Data instability

The temperature should be heated stably for more than three hours;

Check if argon is up to standard;

Check if the voltage is stable;

Whether the sample grinding sample meets the standard;

The sparking point cannot be repeated;

Ensure that there is no light leakage when the sample is sparked;

Whether the pollutants in the spark stand need to be cleaned;

Did not clean the lens for a long time;

Determine the accuracy of the spectrum calibration, the group standardization and the type standardization.

7.2 Unable to open the software

Make sure to use the correct analysis program;

Check the error message and reload the analysis software environment;

If the software fails to boot due to data loss, you can use the backup software.(Common is sudden breaking conductance cause curve model damage);

Whether to open the software repeatedly;

Make sure your computer's IP address is set up properly.

7.3 The instrument generates static electricity

Whether the ground wire connected to the instrument is normal;

The ground wire in the socket is normal.

7.4 Interference problem

Whether it is a grounding wire;

Cover the gap of the light source part and the low groove of the light source part with tin foil paper.

7.5 An abnormal sound is emitted when the instrument is sparked

Open the front door of the instrument and check if the hose is connected.

Open the spark stand cover and check if the seal is normal.

7.6 The software operation interface displays an abnormality.

7.6.1 "The instrument is not connected" alarm prompt

Check if the network cable of the instrument is normal;

Check the network icon in the lower right corner of the computer as an exclamation point;

Check that the computer IP address is set correctly.

7.6.2 "Device Abnormal: Spark Timeout" Alarm Prompt

Make sure that the interfaces of the light source are connected properly.

Turn off the instrument's total power for one minute and turn the instrument back on.

7.7 Instrument Status Bar Display Abnormal (Red Progress Bar)

Including the temperature of the optical room exceeds the standard, the temperature control board environment is abnormal, the sample clamp is not placed well, the light source 24V auxiliary power fails, the Ethernet chip soft reset, the argon pressure is insufficient, the temperature control board reference voltage is abnormal, the FPGA memory read and write is abnormal, the CPU and the temperature are abnormal. The control board communication is

abnormal, the communication between the CPU and the light source module is abnormal, the fatigue lamp is abnormal, the fatigue lamp feedback is abnormal, etc., and the problem needs to be checked according to the actual situation, or the relevant personnel can help solve the problem.