DW-EDX3300S

User Manual

Please read operating manual before installation and operation.

Drawell International Technology Limited

Chongqing Drawell Instrument Co., Ltd.

Shanghai Drawell Scientific Instrument Co.,Ltd.

Address: Suite 2705,Building No.12,Shiyou Road No.1, Yuzhong District, Chongqing China.

Homepage: www.drawell.com.cn

Tel: 0086-023-63268643

Email: sales05@drawell.com.cn

Table of Contents

CONTENTS

Chapter I Product Overview

1.1 Introduction

This manual is applicable to the EDX3300S portable single-wavelength excitation energy dispersive fluorescence spectrometer produced by Chongqing Drawell Instrument Co., Ltd.

The EDX3300S single-wavelength spectrometer is primarily used for the detection and analysis of sulfur, chlorine, silicon, and phosphorus elements in finished petroleum products (gasoline, diesel), raw materials, additives, component oils, naphtha, MTBE/FCC additives and other components in the petrochemical industry. XRF refers to fluorescence analysis. This manual uses the EDX3300S as an example.

Note: Due to differences in production batches, there may be some variations in the appearance and color of the instrument. Please refer to the actual product for accuracy.

1.2 Main Uses

The new generation EDX3300S single-wavelength excitation energy dispersive spectrometer allows simultaneous analysis of multiple elements in petroleum and chemical oil testing. It meets the market demand for on-site online analysis of various elemental components from raw material testing, production process control to finished product inspection.

1.3 Performance Advantages

- The introduction of three core technologies, namely, high-power side window Cr target tube, large-area beryllium window FassSDD (75mm^2) silicon drift detector, and miniature digital signal multi-channel processor, significantly reduces test time, improves detection accuracy, and reduces test errors. The instrument demonstrates testing performance similar to standard instruments.
- It complies with the sulfur content detection standards for gasoline and diesel in National V and National VI standards (ASTM D7039 - Standard Test Method for Sulfur in Gasoline and Diesel Fuel by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry).
- The instrument's unique optical path design achieves a minimum detection limit of 0.5 mg/kg, meeting the sulfur content testing requirements of *GB252-2015 General diesel fuels* and the relevant testing requirements of *GB17411-2015*

Marine fuel oils.

- For low-content oil samples, such as 10 mg/kg fuel samples, the repeatability is RSD < 10%.
- Samples are placed in disposable sample cups, and analysis time ranges from 60 seconds to 300 seconds.
- Compact and portable, it can be handheld, meeting customer on-site analysis needs. It requires no consumables, no vacuum pumping, and no sample pretreatment—ready for immediate use. The detection process truly achieves non-destructive testing.
- One-click easy testing. Built-in intensity calibration mode to correct deviations caused by electronic drift on samples.
- Innovative software interface and core for a broader range of applications. It features high sensitivity, short testing time, and easy operation, with minimal restrictions on operators.
- On-site analysis and laboratory testing at any time and anywhere, as desired.
- The entire testing process is safe, fast, reliable, and has low consumables for analysis and testing.
- The portable instrument can be moved for quick testing of samples in inspection vehicles and used for long-term fine testing of samples in laboratories.
- Compact in size, portable, suitable for outdoor work, ideal for rapid on-site inspections at gas stations for gasoline and diesel.
- The software is fully functional, with a simple and intuitive interface, allowing real-time observation of the measured results of the tested samples.
- A variety of testing modes can be configured, and an unlimited number of modes can be freely added, combined with sample analysis and automatic recognition matching functions, achieving effortless testing with a single key press. Built-in intensity calibration methods can correct deviations caused by different states and uneven structural densities of samples in liquid, powder, solid, etc.
- The innovative software interface and core combine FP and EC software, expanding the range of applications. It features high sensitivity, short testing time, and easy operation, with minimal restrictions on operators.
- The integrated constant temperature control system and intelligent air-cooling heat dissipation system provide temperature control and meet testing requirements in different environmental conditions.
- It adopts an embedded Android system, high-resolution LCD touchscreen display, combines digital multi-channel technology, uses SPI data transmission, effectively

enhancing data transmission and processing capabilities. In any environment, test data is easily accessible.

- Multiple safety protection functions: automatic sensing, with a self-check function when the cover is opened, quick response to automatically shut off the tube. The radiation level during operation is far below international safety standards, with no radiation leakage; thickened protective test walls.
- Optional large-capacity 118,000mAh lithium battery for continuous 24-hour operation. Equipped with a wide-voltage AC charger to ensure testing anytime, anywhere.
- Warning indicator system. When powered on, the green indicator light flashes, the high-voltage indicator light turns yellow to prevent misoperation.
- The protective box is made of high-strength military-grade materials, providing excellent shock, pressure, and water resistance.
- The instrument itself has dustproof functionality and can be used continuously in high-temperature and high-humidity environments.

1.4. Unpacking and Inspection

The instrument's sealed packaging box is as follows:

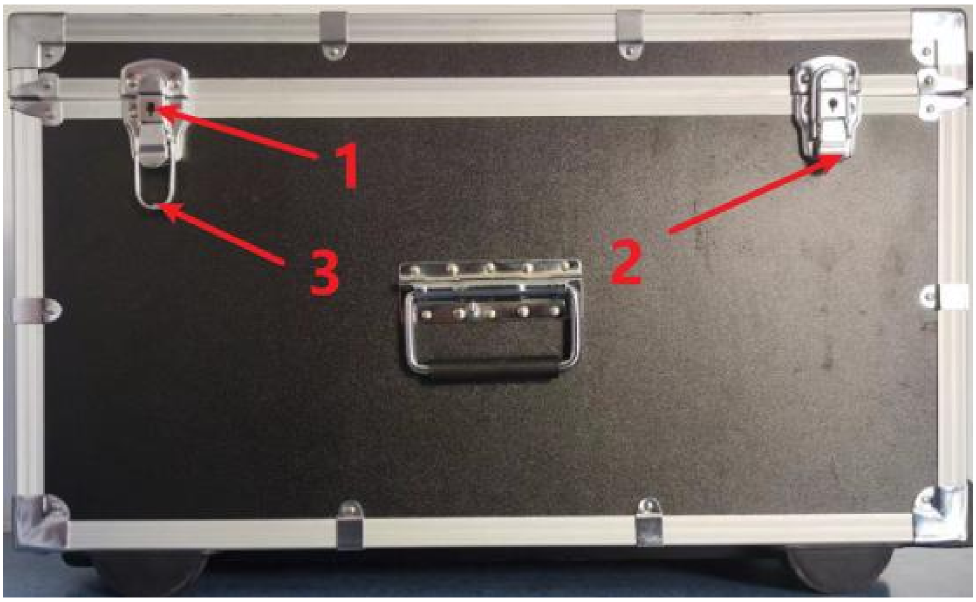


Figure1-1

①Lock hole;②Lock handle;③Hole buckle

Open the safety locks on both sides of the sealed box, lift the lock handle upward, and remove the upper lock buckle, as shown in Figure 1-2:

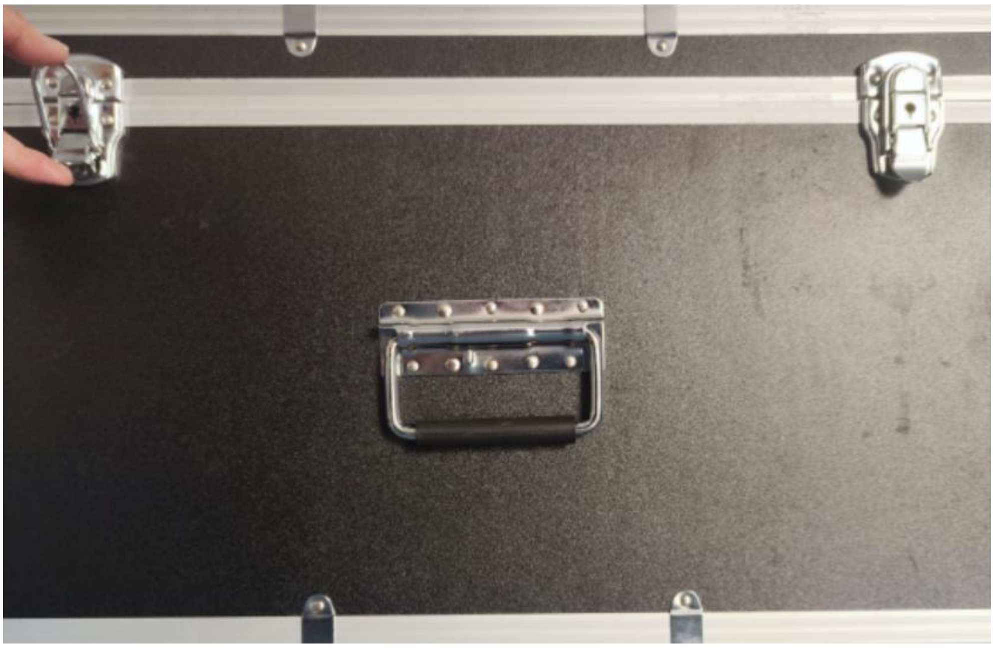


Figure 1-2

After opening the box, you can see the items as shown in Figure 1-4:

① EDX3300S XRF; ② Suction tube; ③ Sample cup; ④ Film;

⑤ Data cable; ⑥ Tools; ⑦ Stainless steel sleeve; ⑧ Adapter;

Figure 1-4

Refer to the actual product packing list. If there are any discrepancies, please contact the nearest Drawell office or authorized service center promptly.

Chapter II Structural Features and Working Principles

2.1 Instrument Appearance

2.1.1 Front View

① Android industrial control screen; ② Power indicator light; ③ USB port; ④ High-voltage indicator light; ⑤ Power button; ⑥ Side exhaust vent (2 sides);⑦Handle; ⑧ Sample chamber cover

Figure 2-1

1) Screen: Embedded screen with specialized X-ray fluorescence analysis software, capable of controlling instrument operations, processing collected information, and displaying output results.
2) Power switch and charging indicator light: After powering on the instrument, the power indicator light flashes green.
3) USB port: USB port for software installation and data copying.
4) Radiation indicator light: When the tube is under high voltage, it produces radiation. At this time, the radiation indicator light is yellow, otherwise dark.
5) Power button: Turns the instrument on or off.
6) Side exhaust vent: Both sides have exhaust vents for heat dissipation.
7) Handle: Portable and mobile.
8) Sample chamber: Cover for testing sample chamber.

2.1.2 Rear View

1) Fan: Used for equipment ventilation and heat dissipation.
2) Power socket: Used for instrument power supply.
3) Mini USB port: Connects to the PC with a Mini USB cable, and after installing the relevant drivers, it can synchronize with the PC.
4) Reserved positions

①Fan; ②Power interface (24V); ③USBport; ④Reserved hole

Figure 2-2

2.1.4 Top View

① Testing window; ② Sample chamber cover; ③ Mesh ring

Figure 2-3

1) Testing window: Location where the sample is placed.

2.2 Working Principle

The EDX (Energy Dispersive Spectrometry) Fluorescence Spectrometer utilizes the principle of fluorescence analysis (XRF).

XRF Principle: When atoms of elements in the sample are irradiated with high-energy X-rays, they emit X-ray spectra with specific characteristics. The wavelength of characteristic spectral lines is only related to the atomic number of the elements and not to the energy of the exciting rays. Therefore, by determining the wavelength of the spectral lines, it is possible to identify the elements present in the sample, enabling qualitative analysis. By measuring the intensity of the spectral lines and comparing it with known standard intensities, the element's content can be determined, allowing for quantitative analysis.

Working Principle of the Instrument: The tube generates primary rays, which penetrate into the optical device's diffracting crystal and interact with the atoms in the crystal lattice. Reflection and scattering occur inside the crystal, separating the rays into different characteristic wavelengths (or energies). These wavelengths excite fluorescence on the test sample, which has characteristics specific to the sample. These electronic signals enter the detector and become voltage signals. After amplification and data collection, the signals are sent to the computer for processing, yielding the required test data.

2.3 System Composition

The instrument is primarily composed of three major systems: the excitation system, optical path system, and detection system.

2.3.1 Excitation System

The excitation system is primarily used to generate rays and includes the high-voltage unit and ray source.

2.3.2 Optical Path System

The working principle schematic diagram of the optical path system is as follows:

Figure 2-4

2.3.3 Detection System

The detection system mainly includes:

1) Amplification circuit and digital multi-channel acquisition system: The amplifier counter receives signals and undergoes digital processing.
2) Embedded Android industrial tablet system: Equipped with specialized analysis software, capable of controlling instrument operations, and collecting and processing data.
3) The information obtained by the system is displayed, and output results are provided.

Chapter III Product Specifications and Technical Parameters

3.1 Standard Configuration

1) Large-area beryllium window Fass SDD ($75mm^2$) silicon drift detector
2) Tube and high-low voltage power supply
3) Amplification circuit and digital multi-channel system
4) Power and control system
5) Embedded Android industrial tablet system
6) Intelligent temperature control constant temperature and air-cooling system
7) High-voltage stable power supply
8) Optical diffracting crystal
9) EDX3300S dedicated analysis software
10) 110V/220V universal adapter
11) Optional 118,000mAh ultra-large mobile power supply
12) Ultra-large capacity USB storage card
13) Shock-resistant, pressure-resistant, and lockable waterproof pull rod case

3.2 Technical Specifications

- Analysis Method: Energy Dispersive Fluorescence Analysis Method
- Detector: $75mm^2$ 0.3mil, SDD detector, minimum resolution up to 125eV
- Excitation Source: Chromium target side window and high-voltage power supply
- Measured Elements: Sulfur (S), Chlorine (Cl), Silicon (Si), and other elements
- Detection Time: 200-300s
- Detection Objects: Solid, liquid, powder
- Detection Limit: Lowest detection limit reaches ppm level
- Content Range: 1ppm-5%
- Calibration Method: Plastic calibration sheet, calibration element Ar element
- Processor (CPU): Deca-core2.5 GHz
- External Storage: 16GB USB flash drive
- Operability: One-click testing, no need to select specific testing modes
- Operating Voltage: AC 220V

- Operating Environment Humidity: ≤90%
- Operating Environment Temperature: -20℃～+50℃
- Instrument Dimensions: 335mm*255mm*268mm
- Instrument Weight: Approximately 15Kg

3.3 Product Description

S/N	Item	Technical Specifications
1	Weight	15 kg
2	Dimensions	335mm*255mm*268mm
3	Excitation Source	Tube (Cr target)
4	Detector	SDD, 75mm2, 0.3mil, resolution <125eV
5	Operating System	Embedded PDA, Android 7.1
6	Software	New FP, EC software
7	Wi-Fi	Built-in
8	Power Consumption	DC24V 12W Max (during operation) 8W Max (standby) 2W Max (sleep)
9	Power/Power Charger	Optional battery capacity of 118,000mAh, sustainable for 24 hours of work Equipped with a wide-voltage 110V-220V, 50/60Hz, universal adapter for AC power supply
10	Display screen	Semi-transparent LCD touchscreen (resolution above 1080×720)
11	Data Transfer	Digital multi-channel technology, SPI data transmission, fast analysis, high count rate; Can be connected to a desktop computer;
12	USB flash drive	Standard 16GB;
13	Optical Devices	Diffracting crystal (1 piece)
14	Temperature Control System	Intelligent constant temperature and air-cooling heat dissipation system
15	Safety	Automatic sensing, high-voltage shutdown when the instrument cover is opened; Maximum radiation dose to a person during instrument operation is <5μSv/hr;
16	Warning Indicators	Green power indicator light flashes when powered on; yellow radiation warning indicator light during testing;
17	Packaging Box	Military-grade aluminum packaging box with lock, pressure resistance, shock absorption, and waterproof;
18	Field of Application	Suitable for oil and petrochemical field non-oil analysis testing;

Chapter IV Instrument Operation Safety

This chapter mainly introduces the basic knowledge of radiation to prevent unnecessary exposure to radiation for users and those in the surrounding environment. Simultaneously, basic graphics are used to illustrate how operators should apply this knowledge.

4.1 Radiation Basics

Radiation is generally divided into ionizing radiation and non-ionizing radiation. Ionizing radiation refers to radiation (particles or waves) with short wavelengths, high frequencies, and high energy. Ionizing radiation can ionize at least one electron from atoms or molecules. In contrast, non-ionizing radiation does not have this ability. Solar radiation, electromagnetic radiation, and thermal radiation fall under non-ionizing radiation. Ionizing radiation is a general term for all radiation that can cause the ionization of matter. The radiation generated by this instrument is mainly ionizing radiation.

This type of instrument is classified as a Class III radiation device. To effectively protect the safety of users, the instrument has been designed with the following features:

- The low-power X-ray tube, collimation system, and diffracting crystal effectively reduce radiation exposure.
- The radiation shielding layer prevents radiation leakage.
- The radiation-generating components are all located inside the diffracting chamber, eliminating the need for radiation leakage, ensuring that no radiation is detected during instrument operation.
- The indicator light alerts the user to the radiation generation.
- Dual error-proofing protection systems to prevent radiation leakage.
- Independent safety circuits, three-dimensional maze-like design, emergency safety interlock devices, and unique test protection devices effectively ensure the safety of users.

4.2 Leakage

Radiation can cause certain harm to various tissues and organs. Regarding protection and radiation exposure limits, recommendations have been provided in the national standard (GB18871-2002 Basic standards for protection against ionizing radiation and for the safety of

radiation sources).
With the aim of protecting users, instruments are equipped with various safety mechanisms to prevent radiation from irradiating the human body. Additionally, in terms of regulations, the amount of radiation leakage from the instrument is specified to be far below the recommended levels in the national standard. For a given radiation source, three factors determine the radiation dose received by the human body:

1. Radiation Time: The longer the radiation time, the greater the radiation dose received by the human body. The radiation dose is directly proportional to the exposure time.
2. Distance from the Radiation Source: The closer to the radiation source, the greater the radiation dose received. The received radiation dose is inversely proportional to the square of the distance from the radiation source. For example, the radiation dose received at a distance of 10cm is nine times that received at a distance of 30cm. Therefore, the aluminum alloy interior of the diffracting chamber is lined with lead-platinum to block and absorb all radiation. Without the top and side-rear cover panels, the radiation dose around the outer perimeter is close to the natural radiation dose value.
3. Aluminum alloy decorative panels serve as the final electrical barrier. When testing, using the above protective components as additional shielding devices ensures absolute radiation safety for testing personnel.

4.3 Radiation Profile

The EDX3300S instrument prioritizes radiation protection as the primary design element. The intelligent safety interlock device ensures automatic protection by rapidly responding and closing when the sample chamber is opened during the testing process. The radiation intensity is typically highest at the test window. The unique design of the sample cup's cover completely isolates any radiation overflow from the window. The high-voltage radiation indicator light remains steadily lit in yellow during operation, ensuring the safety of the operator and surrounding personnel. Specific protection areas are indicated in the radiation profile diagram.
The radiation profile diagram categorizes the surrounding areas of the instrument, as shown in Figure 4-1.

Figure 4-1

Zone A: This is the primary radiation beam area. Opening the sample chamber cover is prohibited when radiation is emitted.

Zone B: It is a non-radiation area where it is safe to touch the instrument during normal operation. The maximum radiation dose measured within a 5 cm range is <0.5μSv/h, significantly below international safety requirements.

Zone C: It is a non-radiation area where it is safe to touch the instrument during normal operation. The maximum radiation dose measured within a 5 cm range is <0.5μSv/h, significantly below international safety requirements.

Zone D: It is a non-radiation area where it is safe to touch the instrument during normal operation. The maximum radiation dose measured within a 5 cm range is <0.5μSv/h, significantly below international safety requirements.

⚠**Warning**	● When the tube is operating, the instrument's power indicator light remains steadily green, and the high-voltage radiation indicator light remains steadily yellow. ● In Zone A, it is strictly prohibited to operate when the tube is working. ● When the tube is operating, avoid moving the equipment as much as possible.

4.4 Safety Operation

When conducting sample tests, it is crucial to give sufficient attention to radiation. During the measurement process: During the measurement process, opening the sample chamber cover is strictly prohibited. The sample chamber cover should not be partially opened, and observing the sample through the measurement window is not allowed. Avoid having the radiation collimator device in the critical induction range to prevent radiation exposure.

Figure 4-2

Correct procedure: After completing the equipment test, only open the chamber cover to remove or replace the test sample when confirming that the high-voltage indicator light is not illuminated, as shown in Figure 4-2.

⚠**Warning**	The design of this product is based on safety limitations and regulations. Regarding equipment use reporting and safety management, please comply with relevant national laws and environmental protection department regulations and take necessary measures.

Chapter V Basic Operation of the Instrument

5.1 Device Connection

5.1.1 Main Unit

Remove the instrument from the packaging and place it on the working platform, as shown in the figure below:

1) Connect the adapter to the main unit interface, and then connect the power adapter power cord to the power source (the power adapter lights up green when powered).

Figure 5-1

5.2 Use of the Adapter

The power adapter is connected to the instrument for power supply as shown in the diagram below:

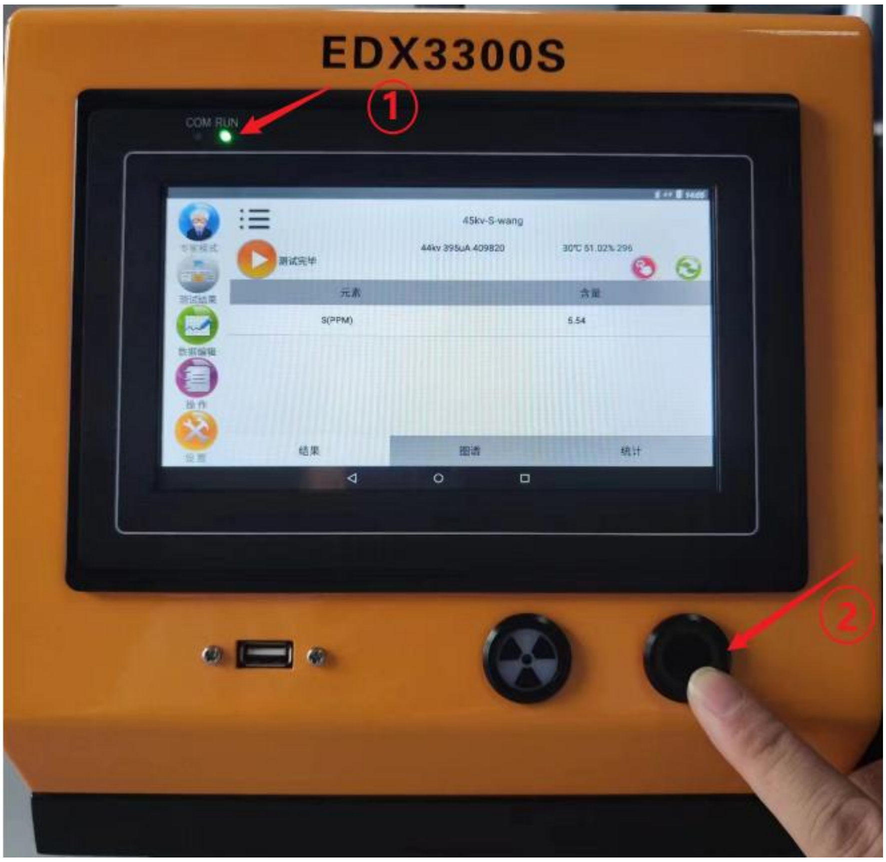
① Mains power outlet (AC 110/220V)

Figure 5-2

⚠**Warning** **To ensure safety, be sure to use the power adapter provided. Using other power cords or power adapters may cause malfunctions or dangers.**

5.3 Power On/Off

Before turning on the instrument, make sure the instrument is properly connected to the adapter power or battery. Press the instrument power button, the power indicator lights up green, entering the login interface, indicating normal startup. Similarly, in the powered-on state, press the power button, and release it to turn off the instrument. The power indicator green light goes out, indicating a normal shutdown.



① Power Indicator Light; ② Power Switch

Figure 5-3

Note: When turning on the instrument's power switch, please proceed with gentle movements. Avoid applying excessive force to prevent damage to the buttons. The power-on indicator light will illuminate with a flashing green light when the power is turned on.

5.4 Usage Requirements

1) Environmental Temperature and Humidity Requirements:

Operating environment temperature: -20°C to +50°C Operating environment humidity: ≤90% (non-condensing), and it should meet the default constant temperature setting of the device.

2) Maintain cleanliness in the installation and usage environment, preventing the entry of any corrosive gases.
3) Avoid damage caused by static electricity and interference from strong electromagnetic fields.

5.5 Sample Preparation

If you are only performing qualitative analysis and are interested in identifying the elements present in the sample, our instrument can directly measure both natural and irregularly shaped samples to identify the elements present. However, for accurate quantitative analysis, sample processing is necessary.

As we know, fluorescence analysis is essentially a relative measurement that requires standard samples as a measurement reference, and the geometric conditions of the standard samples and the test samples need to be consistent. Therefore, measurements of natural samples in the field may have slightly lower accuracy. In a laboratory setting, after processing the samples, more accurate results can be obtained.

Sample Forms	Main factors in the sample that lead to measurement errors
Liquid Samples	Concentration changes due to precipitation, crystallization, or evaporation; formation of bubbles, etc.

1. Liquid Samples

There are three main sample preparation methods:

1) Direct method: Pour the liquid sample directly into the sample cup for analysis.

2) Enrichment method: Use related methods (such as copper reagents and ion exchange resins) to enrich the elements to be tested in liquid samples.

3) Drop method: Analyze liquid samples by dropping them onto filter paper.

During sample preparation, sometimes a certain element is intentionally added to the sample to serve as an internal standard. This method is called the internal standard method.

2. **Sample Preparation Process**

2.1 Preparation

Prepare the test sample, sample cup, test film, disposable pipette, utility knife, tissues, etc.

Figure 5-4

2.2 Sample Cup Loading

Use a disposable pipette to draw approximately 2.5ml of the sample, twice for about 5ml in total, place it in the sample cup, and seal the film with a ring. Use a utility knife to cut off excess test film.

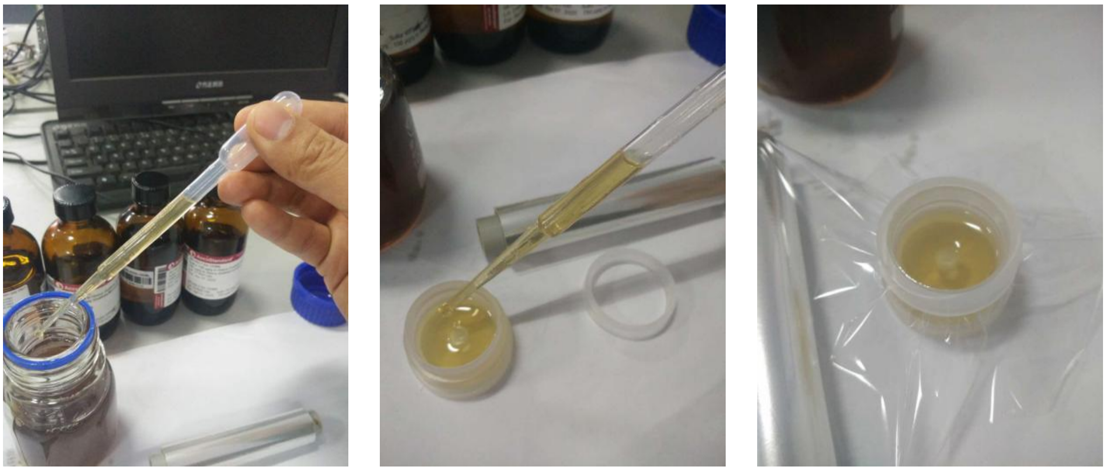


Figure 5-5

2.3 Sample Operation

Before moving the sample to the sample chamber, ensure that there is an exhaust hole at the top of the sample cup to prevent liquid evaporation and expansion during testing, causing liquid leakage and contaminating the optical path. Check that there is no leakage in the bottom film of the sample cup, the window film on the irradiation window is smooth, without wrinkles or contamination. Place the sample cup smoothly into the test sample, and then proceed with the measurement directly. During operation, special attention should be paid. When replacing the window film, avoid damaging the detector's beryllium window. Immediately remove the test sample after completing the test.

When replacing the window film, sealing the sample, and taking out the sample, pay attention to the following two points:

1) The sample film is a dedicated film for analysis; be careful to avoid misuse.
2) The test window film and the sample cup film are the same test film. When replacing the film, do not touch the window film and sample cup film with your hands. Avoid touching the inner wall of the sample cup with your hands to prevent non-standard operations that may cause testing errors.
3) It is prohibited to use tweezers or other tools when taking samples or replacing the test window film to prevent sharp objects from piercing the window film and damaging the detector's beryllium window. This practice also avoids potential leakage from the sample cup, preventing contamination of the optical path system.

Chapter VI Software Introduction

After the instrument is powered on, it enters the software interface.

6.1 Power On

Press the instrument power button, and the instrument enters the startup interface. The current interface is the system interface. To enter the software, click on the "EDX3300S" icon, as shown in Figure 6-1. Typically, after powering on, the software defaults to self-start mode. The software automatically starts and enters the software user mode (as shown in Figure 6-2).

Figure 6-1

Figure 6-2

6.2 User Mode Main Interface

After entering the user mode main interface, the interface is as shown in Figure 6-2. The functions of each icon are listed in Table 6-1.

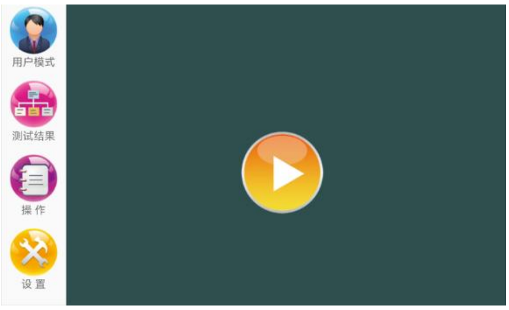


Figure 6-3

Figure 6-4

Figure 6-5

Figure 6-6

Figure 6-7

Figure 6-8

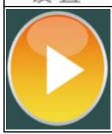
Options	Functions
	Mode: Two modes, user mode, and expert mode. Long-press the icon to switch modes. The login password for expert mode is 456 (as shown in Figure 6-3/4).
	Test Result Button: Click to enter the test result interface, where you can view the measurement results, spectra, statistics, and other indicators for the elements in the current test sample (as shown in Figure 6-5).
	Operation Interface Button: Click to enter the operation interface for functions such as opening spectra, qualitative analysis, viewing historical records, elemental content correction, and Bluetooth printing (as shown in Figure 6-6).
	Settings Interface Button: Click to enter the system settings interface for options such as pre-test settings, software updates, and interface language (in Chinese or English). (as shown in Figure 6-7).
	Test Button in User Mode: Click the button to enter pre-test settings, including sample name, supplier, measurement count, test time, operator, single/multiple point tests, save historical records, spectrum data, and report generation (as shown in Figure 6-8).

Table 6-1

6.3 Test Results

The test results interface displays test information, and users can view measurement results, spectra, and statistical information for multiple measurements, as shown below. The functions of the icons in the interface are shown in Table 6-2.

Figure 6-9

Figure 6-10

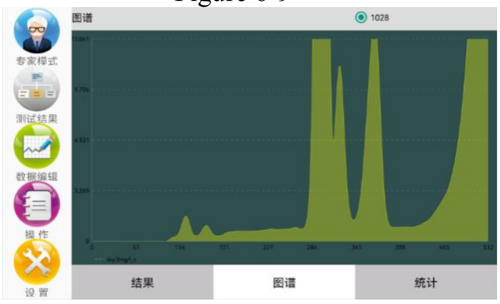


Figure 6-11

Figure 6-12

Options	Functions
	Initialization: Click for the software to automatically perform initialization tasks (as shown in Figure 6-9).
	Preheat Button: Perform preheating work on the instrument before testing (as shown in Figure 6-9).
	Test Button: Click to start the test with relevant information settings (as shown in Figure 6-10).
	Quick Toolbar: Includes options for historical records, Bluetooth printing, opening spectra, initialization, qualitative analysis, and 4G transmission. Figure 6-9
	Test Results: Click to view measurement results, spectral information, and statistics (as shown in Figures 6-11/6-12).

Table 6-2

6.4 Operation

The operation interface is shown in Figure 6-13, and this module includes opening spectra, qualitative analysis, history records, switching content correction, and Bluetooth printing functions. Details of these functions are described in Table 6-3.

Figure 6-13

Options	**Functions**
	Open Spectrum: In the spectrum opening interface, you can open, delete, and clear spectrum graphs. Spectrum types include pure element spectra and non-pure element spectra, as shown in Figure 6-14.
	Qualitative Analysis: Divided into manual and automatic analysis. Manual analysis is shown in Figure 6-15.
	History Records: Displays the current spectrum scan and opens the history records of scanned spectra (Note: Before testing, you must choose to save the spectrum graph to generate history records), as shown in Figure 6-16.
	Content Correction: Select correction elements in the working curve to correct measurement results, as shown in Figure 6-17.
	Bluetooth Printer: The Bluetooth printer can print the latest measurement results and can also display the spectrum graph and print the measurement results of that spectrum graph, as shown in Figure 6-18/19.

Table 6-3

Figure 6-14

Figure 6-15

Figure 6-16

Figure 6-17

Figure 6-18

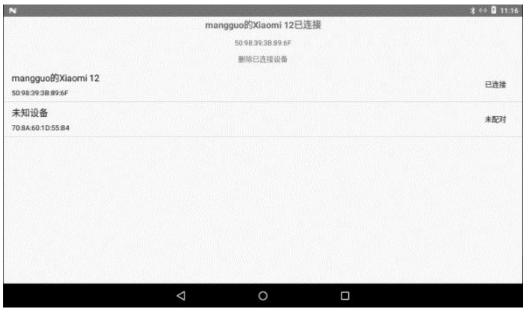


Figure 6-19

6.5 Settings

Users can perform routine function tests in the testing interface (Figure 6-20), such as pre-testing options like sample name, and measurement times. Additionally, language settings can be adjusted (Figure 6-21). Detailed function descriptions are provided in Table 6-4.

Figure 6-20

Figure 6-21

Options	Functions
	Pre-Testing Options: Set testing times, time, report saving, report generation, specification analysis, and other related settings, as shown in Figure 6-20.
	Software Update: Install software updates, as shown in Figure 6-21.
	Interface Language: Local, Simplified Chinese, English (local language needs to be pre-set in the language library), as shown in Figure 6-21.

Table 6-4

Chapter VII Sample Measurement

7.1 Sample Measurement

If you are only conducting qualitative analysis and are concerned about which light elements exist in the sample, then liquid samples for testing can include finished oils (gasoline, diesel), lubricating oil, naphtha, and raw material and component oils. Our instruments can directly measure these samples and identify the elements present. However, for accurate quantitative analysis, sample processing is necessary.

As we know, fluorescence analysis is essentially a relative measurement that requires standard samples as a measurement reference, and the geometric conditions of the standard samples and the test samples need to be consistent. Therefore, measurements of natural samples in the field may have slightly lower accuracy. In a laboratory setting, after processing the samples, more accurate results can be obtained.

Sample Forms	Main factors in the sample that lead to measurement errors
Liquid Samples	1. Concentration changes due to precipitation, crystallization, or evaporation; formation of bubbles, impurities, etc. 2. Due to factors such as the density of liquids and differences in matrices. 3. Factors such as contamination of the window film, sample cup, cup film, and sampling tube.

7.1.1. Liquid Samples

There are three main sample preparation methods:

1) Direct method: Pour the liquid sample directly into the sample cup for analysis.

2) Enrichment method: Use related methods (such as copper reagents and ion exchange resins) to enrich the elements to be tested in liquid samples.

During sample preparation, sometimes a certain element is intentionally added to the sample to serve as an internal standard. This method is called the internal standard method.

7.1.2 Oil Sample Preparation Process

7.1.2.1 Preparation

Prepare the test sample, sample cup, test film, disposable pipette, utility knife, tissues, etc.

Figure 7-1

7.1.2.2 Sample Cup Loading

Use a disposable pipette to draw approximately 2.5ml of the sample, repeat the sampling twice for a total of about 5ml, place it in the sample cup, and seal it with a film and a ring. Use a utility knife to cut off excess test film.

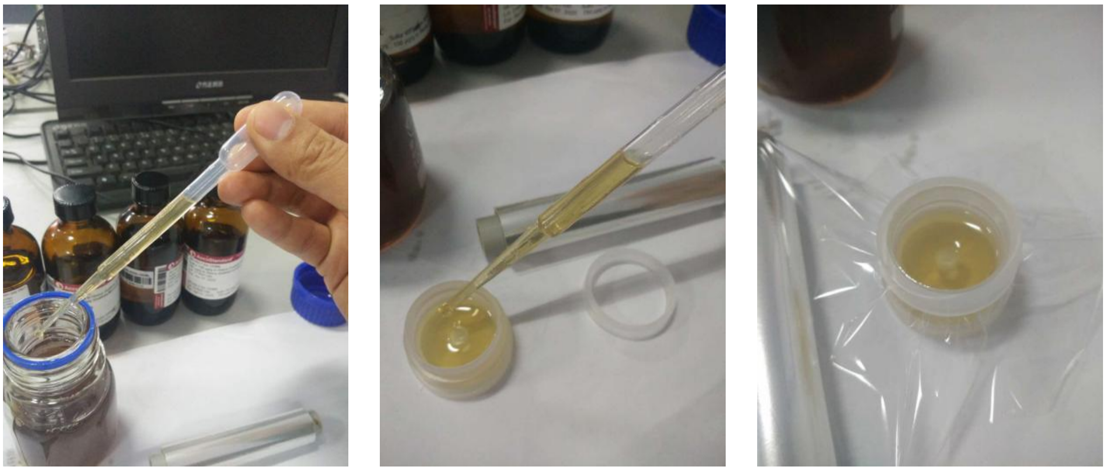


Figure 7-2

7.1.2.3 Placing Samples into the Instrument

Place the prepared sample into the instrument's testing window and cover the instrument.

Figure 7-3

7.1 Sample Operation

During sample testing, moving the instrument is prohibited to prevent liquid leakage and contamination of the optical path system. However, it is essential to note that during the measurement process, when placing or replacing the film for sampling, precautions should be taken to prevent irregular and sharp samples from piercing the test film, potentially damaging the detector beryllium window.

Points to note during sample testing:

1) The window film and sample cup film are special-purpose test films of the same specifications. Different film thicknesses may introduce testing errors.

2) When encapsulating the window film, sample cup film, and inner wall of the sample cup, avoid touching them with hands to prevent contamination of the test sample and affecting measurement results.

3) Before testing, check whether the sample to be tested has liquid leakage, whether the X-ray window film is smooth, flat, free of wrinkles, and without contamination.

4) When taking or placing samples, be careful not to splash liquids or drop foreign objects, as this may contaminate the internal optical path structure, leading to measurement inaccuracies or even instrument malfunctions. (Replace the test film promptly if contaminated)

5) When picking up and putting down sample cups and mesh rings, handle them gently. Do not use sharp or irregular objects to puncture the X-ray window film to avoid damaging the thin film of the measurement window and causing damage to the detector.

7.2 Preheating

The purpose of instrument preheating is to ensure that the instrument is in the optimal working state before testing. All calibration curves for factory equipment are completed at the default temperature setting of the instrument, usually set at 30°C. Therefore, it is prohibited to set the temperature during preheating, as doing so may result in measurement deviations. The equipment has its own constant temperature control system, ensuring that long-term testing remains in a stable constant temperature state.

Typically, the startup temperature in the laboratory is slightly lower than the room temperature. Therefore, necessary preheating work is required before starting up, with a default time of 200s. After completing the preheating work and meeting the preset temperature conditions, the equipment will automatically stop testing. If the preset test temperature is not met, the equipment will automatically extend the testing time until the measurement conditions are satisfied, then stop the preheating work, as shown in Figure 7-4.

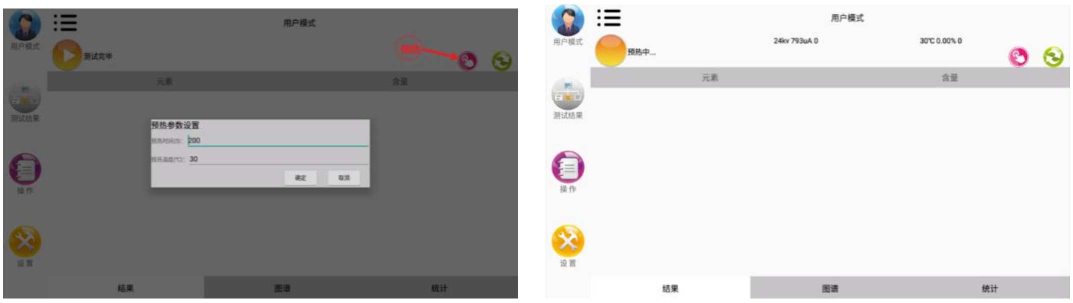


Figure 7-4

Note: During preheating, high pressure will be activated, displaying the testing time, but measurements such as pressure and flow rate will not be displayed. The instrument is in a normal preheating working state and will automatically stop after preheating is complete.

7.3 Initialization

Usually, it is recommended for users to perform initialization when the instrument is first used or when the original initialization conditions of the instrument are altered. Go to "Test Results" (Figure 7-5), then click "  " to initialize. After confirming, the system initialization process will take 3s to 10s (Figure 7-6), and users are advised to wait patiently. After initialization, a prompt will indicate "Initialization Successful” (Figure 7-7).

If initialization fails, the software will display a prompt: Initialization Failed. There are various reasons for initialization failure, and the most commonly used troubleshooting method is to check whether the pressure and flow rate for initialization are too low. Adjustments can be attempted, and initialization can be retried until successful. Additionally, users can try turning off the power of the instrument, restarting the device, and performing the initial steps as a secondary troubleshooting step.

Figure 7-5

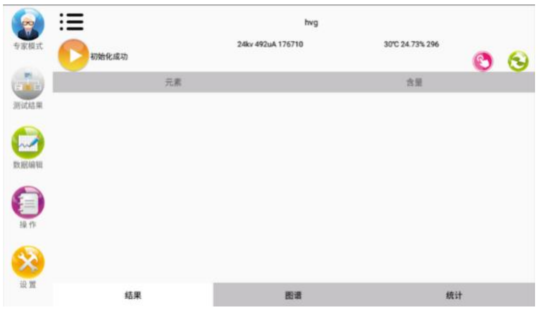


Figure 7-6 Figure 7-7

7.2 Testing

1. After powering on, enter the user mode Place the sample in the testing window position, click "", and the test will begin. The first 10 seconds are the discard time and do not display measurement results, as shown in the left image (Figure 7-8). Then, the test restarts, and the measurement results are displayed, as shown in the right image (Figure 7-9). If testing without placing a sample, the test can be stopped during the process.

Figure 7-8 Figure 7-9

Figure 7-10

Points to note during measurement:

- The fluorescence spectrometer is sensitive to surface contamination, window bottom film, and sample cup film, including contamination on the inner wall of the sample cup, which may affect detection accuracy.
- The detection area of the X-ray fluorescence spectrometer is approximately Φ5mm. The liquid loading amount in the sample cup should not be less than 5ml, as too little may affect detection accuracy.

7.3 Result Analysis

After the sample measurement is completed, the data result interface appears. The data result interface mainly includes elements, content, and units, as shown in the left image (Figure 7-11). The statistical interface mainly includes elements (units), minimum/maximum values, average value, range, and standard deviation, as shown in the right image (Figure 7-11).

Figure 7-11

7.4 Printing

Bluetooth printing can print the results of the latest measurement and can also display and print the spectrum graph of the measurement results. First, start the Bluetooth printer, as shown in the image (Figure 7-12), press the switch button in the middle at the bottom to start the Bluetooth printer.

Figure 7-12

Figure 7-13

Figure 7-14

Figure 7-15

Figure 7-16

Figure 7-17

Enter the Operation interface of the instrument, select Bluetooth Printing, and choose Search as shown in Figure 7-13.

When the Bluetooth printer is found, as shown in the left image of Figure 7-14, select the printer name, then click Connect as illustrated in Figure 7-15. After a successful connection, as depicted in Figure 7-16, choose Print, and the Bluetooth printer will print the corresponding report, as shown in the right image of Figure 7-17.

Chapter VIII Connecting to the Computer

8.1 Synchronized Display

The use of synchronization tools enables screen synchronization. First, connect the instrument to the computer using a USB cable, and ensure that USB debugging and USB file transfer functions are enabled, as shown in Figure 8-1. Then, double-click on scrcpy.exe or scrcpy-noconsole.exe on the computer. At this point, the computer screen will display the Explorer device screen, and you can click on the screen to control the instrument, as shown in Figure 8-2.

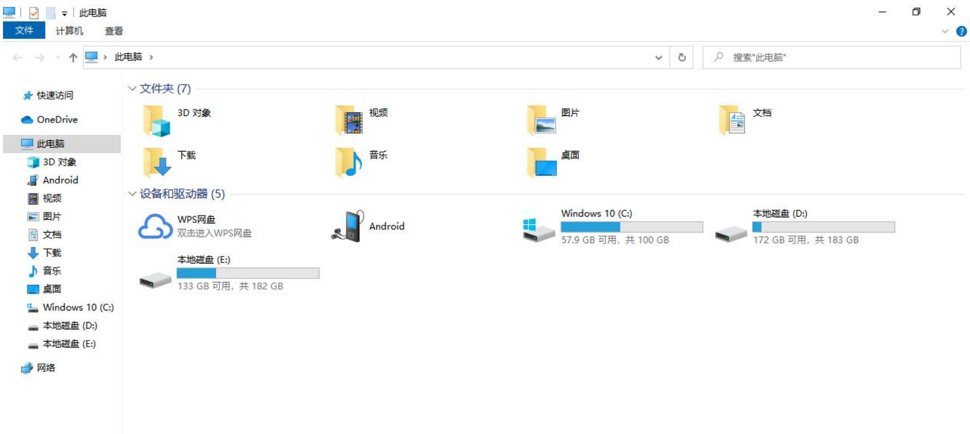


Figure 8-1

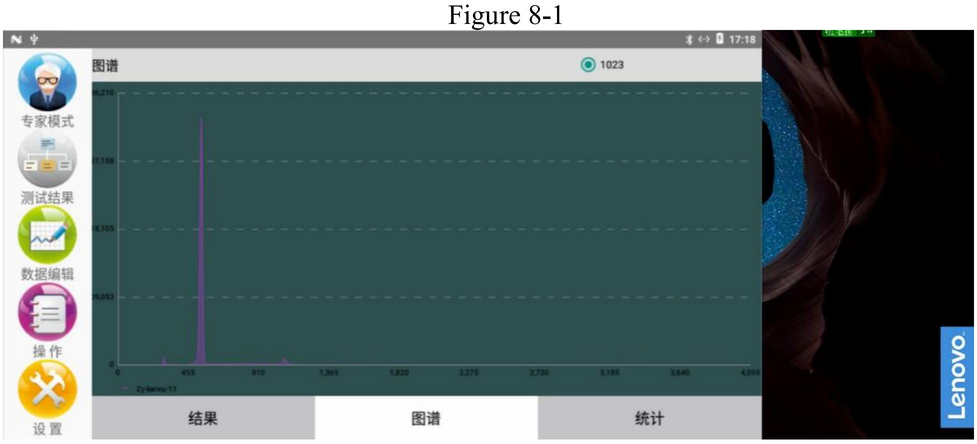
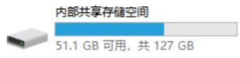


Figure 8-2

8.2 File Transfer

File transfer can be achieved using synchronization tools. First, connect the instrument to the computer using a USB cable and ensure that USB debugging and USB file transfer functions are enabled, as shown in Figure 8-2. Open This PC as shown in Figure 8-3; double-click 

, as shown in Figure 8-3; after double-clicking 

, as shown in Figure 8-4. At this point, you can see the test report in the Report folder and the test history in the History folder, as in Figure 8-5.

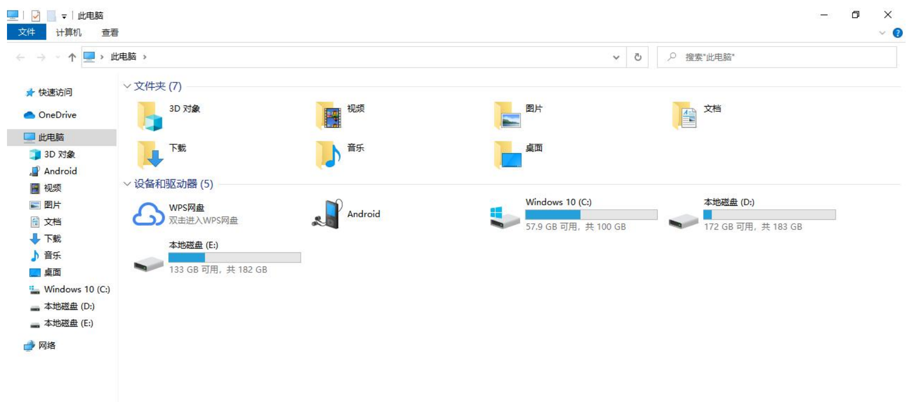


Figure 8-3

Figure 8-4

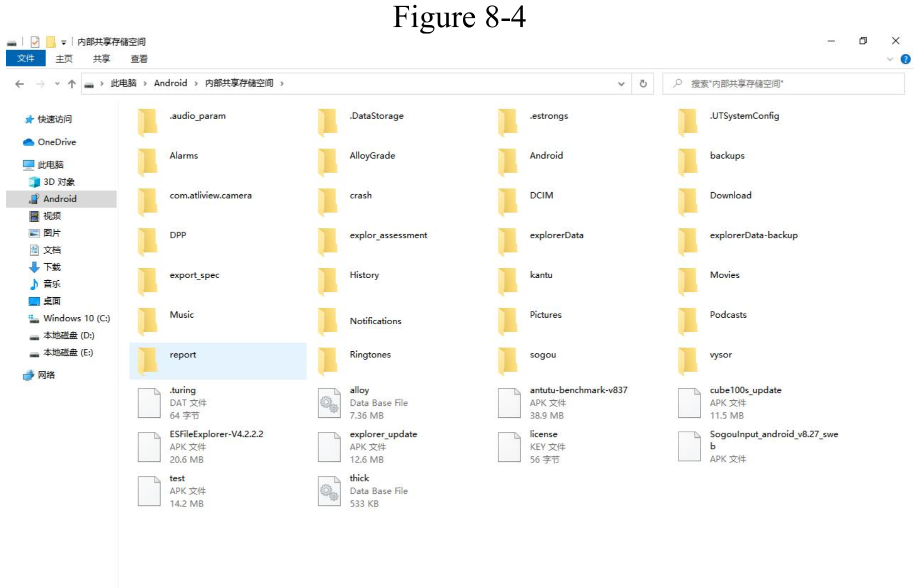


Figure 8-5

Chapter IX Maintenance and Care

9.1 Daily Maintenance

Drawell Instrument possesses products with excellent design and craftsmanship, representing high-tech, valuable, and precision instruments. To ensure careful usage and prolonged instrument lifespan, we provide the following suggestions that can assist users in adhering to warranty terms and extending the longevity of the instrument.

1) The instrument should be used and kept by designated personnel. Unauthorized individuals should not touch, operate, or move the instrument.
2) Do not attempt to disassemble the instrument, as non-professionals may damage precision components during disassembly and assembly.
3) Handle the instrument with care during use, movement, and storage to avoid collisions that may damage internal components or affect the appearance.
4) Avoid interference during the measurement process, such as interference from motors, vibrations, welding, electromagnetic fields, and high voltage.
5) Do not use the instrument in dusty or dirty places, places with excessively high or low temperatures, as it may result in inaccurate measurements or damage to internal components.
6) Keep the instrument dry at all times, as rain, humidity, and liquids containing alloys can corrode precision components.
7) Do not clean or wipe the instrument with corrosive chemicals or strong detergents. Wipe the instrument gently with a soft cloth to remove dust. If there are stains, gently clean them with alcohol-soaked cotton balls.
8) When the instrument is not in use, cover it with a dust cover and store it in a dry, well-ventilated, and safe place.
9) To ensure the long-term normal operation of the instrument, regularly test and adjust its various parameters.

9.2 Maintenance Inspection Summary Table

The table below indicates some routine maintenance checks that need to be performed regularly.

Maintenance Item	Recommended Frequency
Cleaning and drying of instrument surface and head (sample placement area)	Once per week
Peak position calibration (Initialization)	Once per week
Preheat calibration	Once per day

9.3 Storage Precautions

1) The instrument should not be stored in dusty or dirty places, as it may contaminate the optical path system, leading to inaccurate measurement results.
2) The instrument should not be stored in places with excessively high temperatures, as it may shorten the lifespan of electronic components.
3) The instrument should not be stored in places with excessively low temperatures, as moisture may form inside the instrument when the surrounding temperature rises (to room temperature), damaging the circuit board.

9.4 Transportation Precautions

During transportation, please separate the instrument from the battery and place the instrument and accessories in the manufacturer's vacuum packaging box. This provides waterproof, pressure-resistant, and shock-absorbing protection.

Chapter X Safety Precautions

1. Do not attempt to disassemble or modify the instrument. Non-professionals handling the instrument may cause damage.
2. Do not allow liquids or any foreign objects to enter the instrument. Contact between foreign objects and the electrical components inside the instrument may result in a short circuit, leading to fire or electric shock accidents.
3. Do not align the test window with a person during testing.
4. Avoid piercing the test film with irregular or sharp-edged samples during testing, as this may damage the detector beryllium window.
5. Avoid moving the instrument during testing to prevent it from falling or causing liquid leakage that may damage the instrument.
6. If the instrument emits smoke, unusual odors, or abnormal noises, immediately turn off the main power switch, unplug the power cord from the power outlet, disconnect all power devices connected to the instrument, and then contact the Drawell after-sales service center. Continuing to use the instrument in such conditions may result in fire or electric shock accidents. Also, avoid placing items near the power plug so that the machine's power plug can be unplugged at any time.
7. For safety, when not using the instrument for an extended period (such as at night), turn off the instrument's power switch. Additionally, as an additional safety measure for long periods of non-use (such as during extended holidays), cover the instrument with a dust cover, store it in a dry, ventilated, and safe place, turn off the main power switch, and remove the battery and unplug the power cord.
8. Furthermore, ensure to use the provided power cord for safety. Using other power cords may result in malfunctions or dangers. The following actions may cause fire or electric shock accidents:
   - The power cord plug is not fully inserted into the power outlet.
   - The power cord is near a heat source, causing surface melting.
   - Disassembling or modifying the instrument.
   - Damaging or modifying the power cord.
   - Placing heavy objects on the power cord.
   - Pulling, tying, knotting, or excessively bending the power cord.
   - Plugging or unplugging the power plug with wet hands.

Chapter XI Fault Analysis and Handling

Spectrometers contain complex systems, and problems may arise during practical applications. To facilitate users in dealing with abnormal phenomena during operation, the following are explanations and solutions for several common abnormal phenomena.

11.1 Radiation Indicator Light Not Illuminated During Testing

Under normal circumstances, the radiation indicator light should remain yellow during the testing process. If the radiation indicator light is not illuminated, it may be caused by the following reasons or faults:

1. Instrument Power Not Turned On

If the power switch on the instrument is not turned on, the instrument cannot enter the operational state, and the radiation indicator light will not be illuminated.

Solution: Confirm that the power adapter is connected and supplying power, turn on the instrument power switch, and proceed with testing according to the normal procedure.

2. Abnormal Radiation Protection System:

To prevent radiation leakage, the high-voltage generator can only start when the radiation protection system is functioning properly. The status of the radiation protection system is mainly checked in the following two parts:

1) a. It is prohibited to open the sample chamber cover during the testing process, although the equipment has automatic protection and high-voltage shutdown measures, there is a possibility of momentary radiation leakage.
2) b. Ensure that the sample is properly placed in the instrument sample chamber; if the cover cannot be completely closed due to misplacement, the equipment may not detect the closed status of the cover and, therefore, cannot proceed with the test.

3. Abnormal Tube High Voltage

Improper operation may cause the tube pressure and tube current to be too high,

leading to discharge or damage to the tube when it cannot handle the load. If other factors causing the abnormal operation of the radiation indicator light have been ruled out, the issue may be with the tube high voltage itself.
Solution: Promptly contact the Drawell after-sales service center to replace the integrated tube high voltage.

11.2 Instrument Smoking or Emitting Abnormal Noise

Smoking from the instrument may be due to a short circuit that has burned out electrical components on the hardware. Abnormal noise from the instrument may result from discharge in the high-voltage power supply. Additionally, if the heating resistor patch of the temperature control system is not securely attached and falls off, it may also cause smoking. In such cases, continuing to use the machine may lead to fire or electric shock accidents. Resolution: Immediately turn off the main power switch, unplug the power from the power outlet, disconnect all power devices connected to the equipment, and then contact Drawell after-sales service center.

11.3 Other Malfunctions

When the instrument malfunctions during use, it is recommended to refer to the above methods for troubleshooting. If the instrument still cannot operate normally, please do not dismantle the instrument for internal inspection randomly, as it may damage internal components and even pose a threat to user safety.
Resolution: Contact Drawell after-sales service center promptly.

Chapter XII Radiation Safety

The effects of ionizing radiation on the human body are a very complex process. It ionizes or excites molecules in the human body through direct or indirect ionization. In the case of water molecules in the human body, it produces various free radicals and activated molecules. Severe exposure can cause damage or even death to cells or organisms. Of course, the effects of ionizing radiation on the human body are "reversible," and the human body has a repair function. The extent of this repair ability depends on individual qualities and the degree of the initial damage. For individuals not exposed to radiation in their daily work, the normal annual natural radiation (mainly due to radon radiation in the air) is 1000-2000μSv. A radiation dose of less than 100μSv has no effect on the human body. For workers related to radiation, the maximum annual radiation dose is 50,000μSv. However, short-term high-dose radiation can cause certain harm to the human body, as shown in the following figure. In the case of short-term high-dose radiation, it is recommended to seek medical attention for examination.

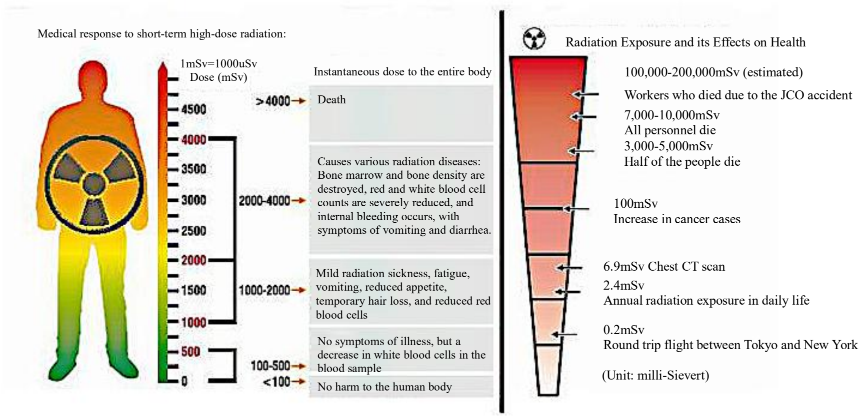


Figure 12-1

When radiation such as neutrons is directed at the human body from outside, there are some important protective measures, including: 1) Maintain distance: the farther from the radiation source, the less the human body absorbs. 2) Reduce the exposure time. 3) Use shielding materials for protection. When radiation contacts with matter, the energy is reduced. Therefore, installing shielding material between the radiation source and the human body provides protection. Lead has the best shielding effect, and water, iron, cement, bricks, stones, and lead glass are also commonly used. So there is no need to overly worry, but personal protection must be done well.

To prevent radiation accidents, China has established regulations and standards for safe use:

◆ Radiation Dose Limits for Occupational and Public Exposure

Radiation dose limits vary depending on whether it is occupational exposure (in environments where radiation can be produced) or public exposure (elsewhere).

Item	Occupational Exposure	Public Exposure
Lifetime radiation dose limit	1Sv	-
Effective radiation dose limit	50 mSv/year, averaged over 5 years with a maximum of 20 mSv/year (100 mSv over 5 years)	1 mSv/year
Lens of the eye	150 mSv/year	15 mSv/year
Skin	500 mSv/year	50 mSv/year
Hands and fingertips	500 mSv/year	-

◆ Chinese Regulations and Guidelines

To prevent radiation exposure to the human body, various countries have established different regulations for radiation-generating instruments. China, the United States, and Japan have the following regulations. China, the United States, and Japan have the following regulations.

Country	Name
China	GB16355-1996 (Specification) GBZ115-2002 (Specification) GB8703-88 (Rules) (Radiation Protection Regulations)
Japan	Regulation concerning Prevention from Radiation Hazards due to Ionizing Radiation (Rules), Revised on July 1, 2012
United States	ANSI/HPS N43.2-2001 (Specification) American National Standards Institute Health Physics Society

◆ GB16355-1996 / GBZ115-2002

The Chinese standards specify radiation protection standards and safety operating requirements for diffractometers and fluorescence spectrometers. Here are some key indicators:

Item	Specification
Instrument Leakage	≤ 2.5 uSv/hr
Monitoring	● Installation of a radiation dosimeter is required for repairs such as remodeling, alterations, and replacement of radiation tubes. ● This is done when there is a possibility that the amount of radiation exceeds 5 mSv/year.
Instrument design	● The radiation tube is mounted inside a closed instrument enclosure. ● In general operation, the shield is designed so that no part of the human body can enter inside the shield. ● When the protective shield is removed, a mechanism is in place to cut off the power supply or close the shutter for radiation generation.
Indication	● Radiation symbol ● Sequence number, type, grade, manufacturer's name, and manufacturing date of the radiation tube ● Use conspicuous text to indicate "Contains radioactive source, please be careful."
When replacing the sample	Close the shutter.
Management and repair	● When installing or removing radiation tubes and other light-sensitive components, close the shutter and disconnect the power. ● Adjustments to the instrument are prohibited while the radiation tube is exposed ● When adjusting the instrument, operate under low tube voltage and tube current conditions.

◆ GB18871-2002 (Radiation Protection Regulations)

This standard stipulates the requirements for the protection of individuals from ionizing radiation exposure and the safety of sources during practice and interventions.

Item	Specification
Radiation Limits for the Human Body:	● Whole Body: 50 mSv/year ● Lens of the Eye: 150 mSv/year ● Other Organs: 500 mSv/year
Designation of Controlled Areas	● Controlled Area: Areas exceeding 3/10 of the radiation limit ● Supervised Area: Areas exceeding 1/10 of the radiation limit ● Unrestricted Area: Areas not exceeding 1/10 of the radiation limit
Health Management	● Regular physical and blood examinations should be conducted before engaging in operations. ● A periodic physical examination should be conducted every year.

Appendix

Packing List

Category	Accessory Name	Quantity	Remarks
Standard Configuration	Main Unit		
	Fluorescence Sulfur Detector (Single Wavelength)	1 unit	EDX3300S
	Power cord	1 pce	Includes warranty card and qualification card.
	Plug Power Cord	1 sheet	
	Sample Cup	100 pce	
	Sample Components	1 set	
	Pasteur Pipette	100 pcs	
	Test Special Film	2 rolls	
	Dual-purpose Screwdriver	1 pce	
	USB Flash Drive (16GB)	1 pce	
	Packaging:		
	Trolley Case	1 pce	
	Optional:		
	Portable Bluetooth Printer	1 pce	
	Mobile Power Supply	1 pce	

Drawell International Technology Limited

Shanghai Drawell Scientific Instrument Co.,Ltd.

Chongqing Drawell Instrument Co.,Ltd.

Add:Suite 2705,Building No.12,Shiyou Road No.1,Yuzhong District, Chongqing,China

Tel: 0086-023-63268643

Web : www.drawell.com.cn

Email : sales05@drawell.com.cn