



Laboratory Equipment Manufacturer  
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# Operation Manual for Infrared Sulfur Analyzer **ELAN-12**



**PLEASE READ THIS MANUAL CAREFULLY BEFORE OPERATION**

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**MRC.VER.01-4.12**

## **Attention**

- **Read this instruction book carefully before using MRC Company's instrument.**
  
- **Matters need attention when using the instrument.**
  - **Only high-temperature power cable provided with the instrument can be used.**
  - **Make sure that the electrical parameters of outlet and knife switch meet the requirement of the instrument.**
  - **Power of the instrument shall be cut off when not use them for a long time.**
  - **Before using the instrument, the filling materials in it, such as foam and others shall be taken out and instrument' cover cloth shall be taken off and the inflammable and explosive materials are forbidden to be place near the instrument.**
  - **After use, cover cloth covering the instrument is forbidden until inside and outside temperature of the instrument cools to room temperature.**
  - **The instrument shall be ground connected reliably.**
  - **Repair and dismantle to the instrument are forbidden when it is electriferous.**
  - **Contain filled with liquid is forbidden to place on the instrument.**
  
- **For ensuring stable and reliable operation of the instruments, the instrument parts and consumables provided by OTE Company shall be used. MRC Company will not provide service and guarantee for problems such as performance decreasing, unstable test result and failure rate rising etc. which caused by using parts and consumables not provided by MRC Company.**

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# Chapter 1 Instrument Properties and Features

## 1.1 Range of Application

The instrument is widely applied for the measurement of sulfur content in coal, coal water slurry, coke and other substances in coal, electricity, metallurgy, petrochemicals, geological exploration, environmental protection, school and other industries and sectors.

## 1.2 Property Index

- Analytical method: infrared absorption method
- Sulfur measuring range: (0.01~50) % (may be extended to 100%).
- Analysis time for single sample:  $\leq 110$ s.
- Furnace temperature: (1300-1350) °C.
- Range of sample weight: (250~500) mg, the proposed weight is 300mg.
- Maximum power: 4kW
- Number of placed samples: 12 samples can be placed one time.

## 1.3 Main Features of the Instrument

- Superior performance, highly automated, highly humanized.
- The ultra-low drift infrared cell with internationally advanced level, the optimal gas circuit design and combustion processing are adopted to ensure the excellent stability, precision and accuracy of the equipment.
- With functions of automatic sample sending and throwing, the operation is simple and safe, and the testing efficiency is high.
- Rapid test speed with analysis time of single sample not exceeding 2min.
- 12 samples can be placed at a time; the test process is fully automated and truly unattended.
- Additional samples can be added during the analysis process.
- With balance on-line function, the weighing results can be transmitted automatically.
- With functions of automatic fault alarm and simple self-recovery.

- Gas tightness detection device of humanized design enables the tester to conduct gas tightness detection easily and conveniently.

## Chapter 2 Composition and Working Principle of the Instrument

### 2.1 Composition of the Instrument

ELan-12 infrared sulfur analyzer consists of host, general purpose CAN bus interface, gas supply device, computer (with display), printer, electronic analytical balance (need to be purchased), and the schematic diagram is shown in Fig. 2-1:

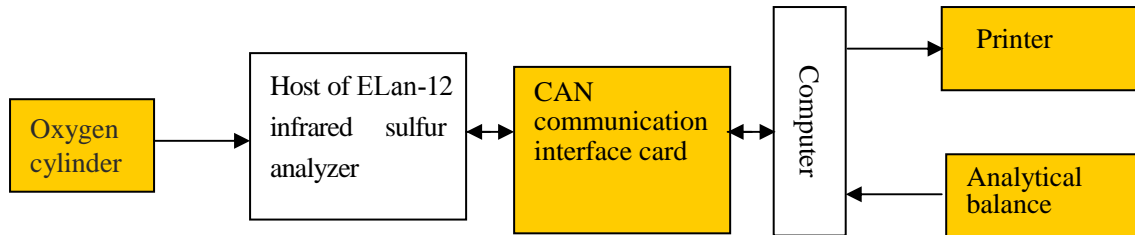


Fig. 2-1

#### 2.1.1 Host Structure

Mainly consists of samples placing platform, combustion furnace, infrared cell, six-stage filter unit and two-stage drying, control valve and air pump, and sample sending rod.

- Samples placing platform: is used to place the samples that are waiting for measurement.
- Combustion furnace: makes the samples fulfill sufficient combustion and secondary combustion under the condition of peroxide.
- Infrared cell: detects the molecular concentration of SO<sub>2</sub>.
- Six-stage filter unit and two-stage drying apparatus: filter out the dust and moisture generated during the combustion process of the samples, enable the infrared cell to gain clean SO<sub>2</sub> gas, improve the precision of the test and protect the infrared cell as well.
- Control valve and air pump: control the gas flow and sequences during the test. .
- Sample sending rod: actuating mechanism for automatic samples taking and sending.

#### 2.1.2 Gas and Auxiliary Equipments

- Oxygen: with purity  $\geq 99.5\%$  and total gas source pressure  $\geq 3\text{MPa}$ .

- Reducing valve: range of high pressure gauge is 25MPa; and range of low pressure gauge is 0.4MPa; the proposed type is 152X -40-V (oxygen).
- Gas transmission duct

### **2.1.3 Auxiliary Reagents**

- Silica wool
- Dehydrite

### **2.1.4 Printer**

Samsung series laser printer.

### **2.1.5 On-line Balance**

The measuring range is 100g, the inductance is 0.0001g, and Sartorius BS224S is recommended.

## **2.2 Working Principle and Process**

ELan-212 infrared sulfur analyzer is an instrument scheduled to analyze the sulfur content in coal or other substances by infrared spectroscopy.

For a complete analysis made by ELan-12 infrared sulfur analyzer to a sample, three steps: gas circuit cleaning, combustion and analysis shall be experienced. First, the tester shall place the samples in matching box by sequence, input the interrelated parameters, and click the "start test", then place the samples on the platform by sequence according to the system prompt. The system will automatically analyze the sulfur element content in the sample according to the specified procedures and show the test results on the main interface window of the measurement & control software.

In the combustion process, the sample is delivered into the combustion furnace for peroxide combustion, and the gases generated therefrom shall be conveyed into combustion tube for secondary combustion, after multi-stage filtration and drying, the gases go into the infrared cell for real-time analysis in the form of SO<sub>2</sub> by the infrared sensor.

The final analysis results are shown on the main interface window of the measurement & control software in the form of percentage by the samples quality.



## Chapter 3 Installation and Commissioning of the Instrument

### 3.1 Environmental Requirements

#### 3.1.1 Working Conditions

- Ambient temperature: (15~30) °C.
- Humidity: ≤85%.
- The working environment shall be clean and tidy, with no smoke and raise dust.
- The environment shall be stable, with no strong interference source, vibration source and corrosive gases.

#### 3.1.2 Requirement of Power Source

- Power source: 242VAC~187VAC, (50±1) Hz
- Be equipped with reliable ground wire.

#### 3.1.3 Requirement of Gases

- Combustion gas: oxygen with purity of more than 99.5%, the pressure of low pressure oxygen gauge is (0.28±0.01) MPa, and the total pressure of gas source shall be not lower than 3MPa. The electrolytic oxygen is forbidden and the oxygen with purity of 99.99% is recommended.

#### 3.1.4 Reagents

- Silica wool.
- Dehydrite: the granularity shall be  $\phi$  (3~4)mm and the powdery dehydrite cannot be used, 80g shall be placed for the first time.

#### Note:

- ✧ Cotton for medical purpose or absorbent cotton shall not be adopted to replace silica wool.
- ✧ The dehydrite should have a granularity of  $\phi$  3~4mm, domestic manufactured dehydrite, powdery dehydrite and other desiccants can not be used.
- ✧ Please refer to Fig. 3-3 *Placing of Desiccant* for detailed installation sequence and dosage of silica wool and dehydrite.
- ✧ The dehydrite shall be placed 20mm from silica tube mouth, the

**position shall be not too high or too low so that it is convenient for change.**

- ✧ **When three-quarters of dehydrite in No.1 drying tube has got wet, the dehydrite in No.1 drying tube shall be replaced.**

### **3.1.5 Software Environment**

**1. Operating system:** WindowsXP of English version

**2. Basic configuration:**

- CPU: above Pentium 1.8GHz;
- Internal memory: above 512MB;
- Display card: standard VGA1024×768 display mode;
- Hard disk: 80G or higher level;
- Driver: 52× CD-ROM or above 8× DVD-ROM;
- Other devices: USD interface, mouse, keyboard and so on.

## **3.2 Installation of the Instrument**

### **3.2.1 Preparations before Installation**

- Prepare appropriate laboratory according to the requirements of 3.1.
- Prepare crucible, standard samples, and related equipments.
- Prepare dehydrite, silica wool and oxygen.

### **3.2.2 Installation Precautions**

- Carefully remove the instrument from the packaging box, put in place to facilitate the operation of the tester, meanwhile, pay attention that the back and both sides of the instrument shall be 0.4m~0.5m from the wall, and shall not close to the wall.
- After the unpacking, the users shall check the instrument, accessories and consumables, and properly keep the balance, computer, display, printer and related data, packaging box and packaging protective materials.
- Carefully check if all wearing parts are intact, and carry out dust removal for various components before they are available for use.

### **©3.2.3 Installation of Instrument Parts**

**1. Open the instrument enclosure and take the sponge and other fillings out of**

**the instrument.**

## **2. Install silicon-carbon tube, ceramic jacket, inner and outer combustion tube**

- 1) Take silicon-carbon tube, ceramic jacket, inner and outer combustion tube out of the packaging box.
- 2) Put the ceramic jacket from the end of the furnace into the furnace until the ceramic jacket and the furnace are tight fit. Remember not to force too much during the installation.
- 3) Then put the silicon-carbon tube from the end of the furnace into the furnace, make sure that the front-end of the silicon-carbon tube is placed at the forefront of the furnace steps, and remember not to force too much during the installation so as to prevent damage to silicon-carbon tube.
- 4) After the installation of the silicon-carbon tube, insert the inner and outer combustion tube into the furnace through the silicon-carbon tube until they reach the base of the sample sending mouth.
- 5) After the installation, the ohms range of multimeter shall be used for short-circuit inspection of two terminals of the silicon-carbon tube. The silicon-carbon tube shall not achieve conduction with the instrument enclosure or furnace shell; otherwise, the power-on test cannot be conducted.
- 6) The detailed installation diagram is shown in Fig. 3-1:

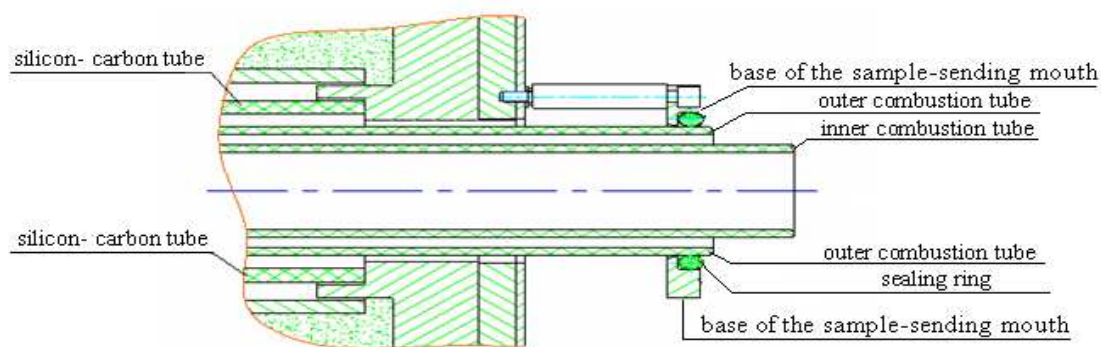


Fig. 3-1 Installation Diagram of Inner and Outer Combustion Tube and Silicon-carbon Tube

## **3. Install sandwich cover, end cover, loose wool and end panel of sample sending mouth**

- 1) Take sandwich cover, end cover, loose wool and end panel of sample

sending mouth out of the packaging box.

- 2) Put the seal ring with the specification of 53005070 on the base of the sample sending mouth, and then put the sandwich cover through the inner and outer combustion tube from the front end of the furnace so as to press the seal ring on the base, and finally use the screws to fix the sandwich cover on the base of the sample sending mouth.
- 3) After the sandwich cover is installed, place the seal ring with specification of 53003470 on the sandwich cover of the sample sending mouth, and then put the end cover from the front end of the furnace to press the seal ring on the sandwich cover, and finally use the screws to fix the end cover on the sandwich cover.
- 4) After the installation of sandwich cover and end cover, use the loose wool to fill the gap between silicon-carbon tube and ceramic jacket.
- 5) Connect the terminals of the silicon-carbon tube, pay attention that the screws must be tightened, otherwise, the contact resistance may be overlarge so as to result in arc and other abnormal phenomenon when heating and thereby affect the service life.
- 6) Finally, cover the insulating mat on the end panel, and then insert it from the end of the furnace into the furnace so as to make it cover the outside tube of the combustion furnace, fasten the end panel and use loose wool to fill up the round hole on the end panel.
- 7) After the installation, the ohms range of multimeter shall be used for short-circuit inspection of terminals of the silicon-carbon tube and furnace ends.
- 8) The detailed installation diagram is shown in Fig. 3.2.

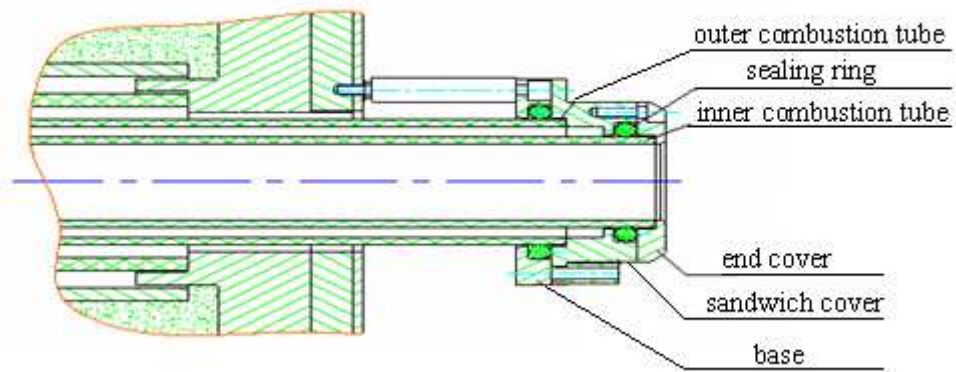


Fig. 3-2 Installation Diagram of Sandwich Cover and End Cover of Sample Presentation Mouth

#### 4. Install desiccant and filter

The detailed installation, placing and dosage of the reagents are shown in Fig. 3-3 and 3-4.

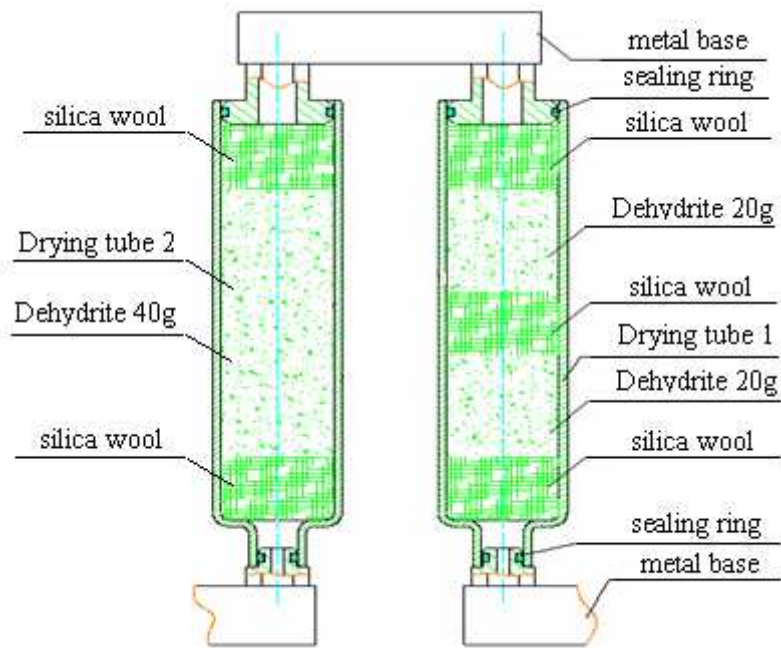


Fig. 3-3 Placing of Desiccant

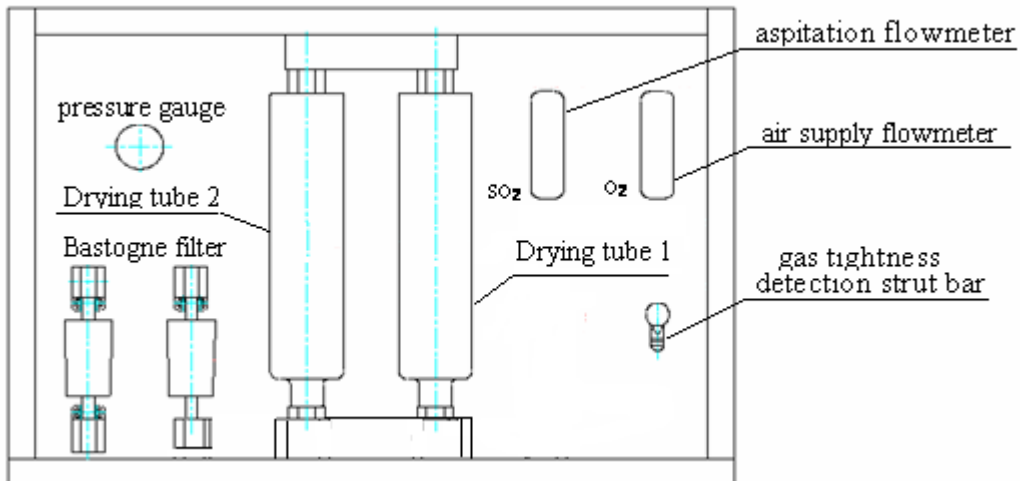


Fig. 3-4 Installation of Filter and Drying Tube

5. Gas circuit of the instrument is shown as below:

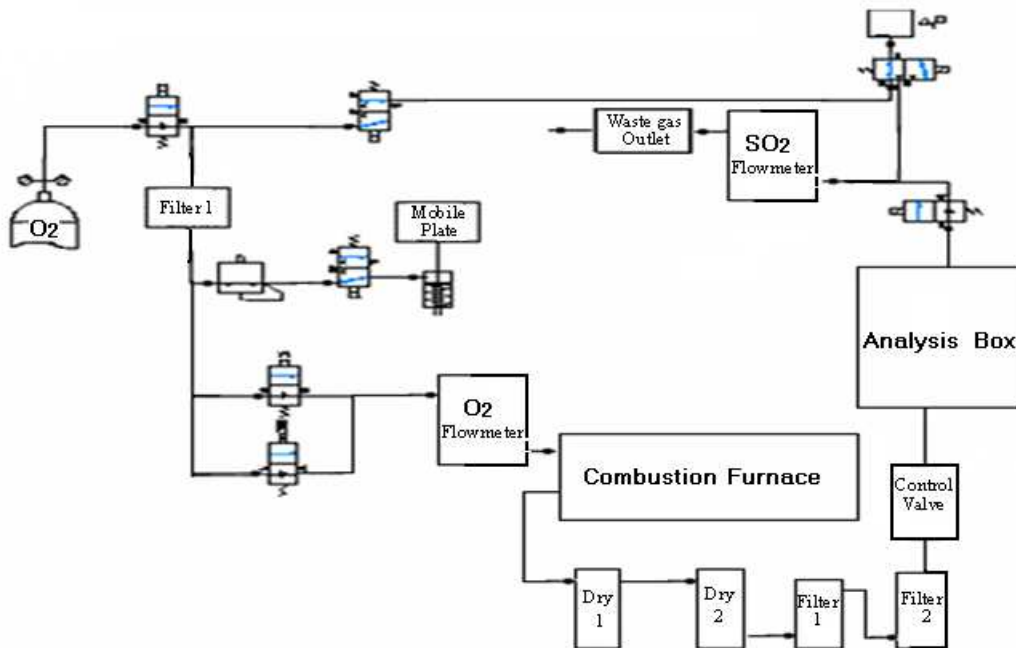


Fig. 3-5 Gas Circuit of the Instrument

### 6. Install thermocouple

Thermocouple is used as thermometric element of the instrument. Before the installation of the thermocouple, the multimeter shall be used to detect the thermocouple. If there is any damage, please contact with after sales service department or on-site commissioning staff of MRC Company

The thermocouple shall be installed as follows:

- 1) Remove the iron bar out of the temperature measuring hole of the combustion furnace, and insert the thermocouple into the hole until the front end of the thermocouple touches the inner wall of the furnace and can not move forward.
- 2) Connect the red wire of the compensating lead wire of the thermocouple with “+” (positive) pole of the thermocouple, and connect the blue wire with the “-” (negative) pole of the thermocouple.
- 3) Slightly tighten the anchor screw in the installation position of the thermocouple
- 4) Fasten the connecting wire of the thermocouple, and check if the compensating lead wire is installed correctly. The compensating lead wire shall not close to the surface of the heating furnace so as to avoid scorch.

## **7. Wiring of USBCAN interface card**

Connect the USB interface of the USBCAN interface card to the USB interface of computer mainframe, and connect CAN interface to the CAN1 (or CAN2) on the back plate of ELan-12 infrared sulfur analyzer, and fasten them with screws.

## **8. Gas circuit connection**

The end of the high pressure gauge of the reducing valve is fixed to the oxygen cylinder, and the end of the low pressure gauge shall be connected to "O<sub>2</sub>" interface of the back cover plate of the instrument through the gas transmission duct.

**9. Check whether there is a drape of the air tube, or whether the air tube is close to the surface of the high temperature furnace, if the phenomenon exists, timely adjustment should be made.**

**10. According to the identification on the back plate of the instrument, connect the control power wire and heating power wire well accordingly.**

### **3.2.4 Software Installation, Uninstallation and Authorization**

#### **1. Software installation**

- 1) Check whether the computer has been installed with “Message Queue”.  
(Method: Start → Control Panel → Add/Remove Programs → Add or Remove Components → Select “Message Queue” in the Components List

- click “Next”, install it according to the prompts).
- 2) Put the CD that is marked with “ELan-12 infrared sulfur analyzer software” into the CD-ROM drive, start the CD drive and find “MRC.exe” in the root directory.
  - 3) Double click “MRC.exe” icon and follow the prompts to install “ELan-12 infrared sulfur analyzer” program and “USBCAN service program”, after the installation, the system will automatically create a shortcut icon called “ELan-12 infrared sulfur analyzer” on the desktop.
  - 4) Right click “My Computer” → “Properties” → “Hardware” → “Device Manager → “+” under “MRC”, you can see identification name as “MRC USBCAN”, that means the USBCAN card driver has been normally installed, otherwise, click “Scan” and re-install USBCAN card driver according to prompts.

## **2. Software uninstallation**

Click the “Start” in the taskbar → “Control Panel” → Double click the “Add / Remove Programs” to open the window → Select “Change or Remove Programs”, click “ELan-12 infrared sulfur analyzer” in the program group → Click “Delete” button to perform the uninstallation. Follow the onscreen prompts to safely and efficiently remove ELan-12 infrared sulfur analyzer software and shortcut icon. But the related parameter files, data base files of ELan-12 infrared sulfur analyzer software will not be uninstalled, they still remain in the operating system.

## **3.3 Instrument Commissioning**

After the hardware, software and authorization of the instrument have been installed, turn on the power, start the program, and enter “Manual Detection” for on-line commissioning, the contents and precautions of the commissioning are as follows:

### **1. Principles for adjusting the initial position of push plate**

The initial position of the push plate shall be 4mm from the rear end of the crucible test tablet; it shall fulfill the accurate positioning and can not hit the limit switch.



## **2. Principles for adjusting the position of mobile platform**

- 1) The mobile platform shall not get close to the end cover of the sample sending mouth, and a certain gap (about 3mm) shall be left for the platform to move back and forth freely.
- 2) The mobile platform can be slightly higher than the lowest point of the furnace mouth, but shall not be too high; the criterion is that the crucible goes in and out of the furnace stably.
- 3) The mobile platform shall be slightly lower than the samples placing platform, and shall not be higher, the criterion is that the crucible can be pushed without overturn.
- 4) Click “Back/forth moving of mobile platform” in “Manual Detection”, if the voice is so loud and the speed is too fast, the flow of SV7 valve shall be adjusted. The criterion is that the mobile platform moves back and forth stably.
- 5) It shall ensure that the mobile cylinder moves back and forth freely.

## **3. Adjustment of the ready position of sample sending rod**

First, put a crucible on the mobile platform, and then click “Take crucible” in the “Manual Detection”, after taking the crucible out, the rear end of the crucible shall exceed 3mm of the right end of throwing crucible test tablet.

## **4. Adjustment of the initial horizontal position of sample sending rod**

First, put a crucible on the mobile platform, and then click “Take crucible” in the “Manual Detection”, after taking the crucible out, the front end of the sample sending rod shall not get close to the rear end of the crucible.

## **5. Adjustment of the top and bottom fixed positions of sample sending rod**

First, put a crucible on the mobile platform, and then click “Rising” or “Descending” in the single unit control options of “Manual Detection”, the criterion for the top fixed position is that the sample sending rod is lower than the highest end of the furnace mouth; and the criterion for the bottom fixed position is that the sample sending rod is lower than the highest point of the crucible.

## **6. Adjustment of the central position of sample sending rod**

First, place the sample sending rod in the top fixed position, then click “to

crucible test position” in the single unit control options of “Manual Detection”, at the time, the sample sending rod moves forth; if the rod swings from side to side fiercely when moving forward, two adjusting screws on the top end of the arched support; if it jumps up and down fiercely, one adjusting screw on the bottom end of the arched support shall be adjusted.

#### **7. Adjustment of pressure of low pressure gauge of oxygen cylinder, aspiration flow SO<sub>2</sub>, gas supply cleaning flow O<sub>2</sub>, gas supply test flow O<sub>2</sub> and pressure indicator**

- Oxygen: in the event that the total pressure of gas source is less than 3MPa, enter into the “Manual Detection” window and click “Gas circuit cleaning”, adjust the low pressure gauge of oxygen to 0.28MPa.
- Gas supply cleaning flow O<sub>2</sub>: click “Gas circuit cleaning” in the “Manual Detection” window, adjust the O<sub>2</sub> flow of SV6 valve to 2.5L and lock the nut of the control valve.
- Gas supply test flow O<sub>2</sub> and aspiration flow SO<sub>2</sub>: carry out the blank test, and adjust the O<sub>2</sub> flow of SV2 valve to 4L during the test; and adjust the flow-limiting valve (on the analysis box), adjust SO<sub>2</sub> flow of aspiration flow valve to 2.5L.
- Pressure indicator: adjust the low pressure gauge of the oxygen cylinder to 0.28MPa, open SV7 valve and adjust the pressure indicator to 0.16MPa.

#### **7. Treatment of test crucible**

- The new test crucible shall be burned in the muffle furnace by slow ash method before use.
- Before its use, the test crucible for daily use shall be put into muffle furnace for burning under the temperature of 920°C after the residue in it has been disposed and cleaned.

#### **3.4 Check and Calibration of the Precision and Accuracy of the Instrument**

- Please refer to Chapter Six for detailed test operations.
- The precision and reproducibility shall be in line with the requirements listed as follows: (refer to GB/T214-2007 *Provisions of Measuring Total Sulfur*

*Precision in Coal by Coulometric Titration)*

Mass fraction of total sulfur St, %	Repeatability limit St,ad%	Reproducibility critical difference St,d%
≤1.50	0.05	0.15
1.50 (excl.) ~ 4.00	0.10	0.25
>4.00	0.20	0.35

## Chapter 4 Use of System

### 4.1 Start and Exit of the Measurement & Control Software

#### 4.1.1 Start of the Measurement & Control Software

**Method 1:** on the taskbar, click “Start”→ “Program” → select “MRC” → click “ELan-12 infrared sulfur analyzer”, and enter into main interface shown in Fig. 4-1.

**Method 2:** double click “ELan-12 infrared sulfur analyzer” icon on desktop, also can enter into measurement state as shown in Fig. 4-1.

#### 4.1.2 Exit of the Measurement & Control Software

Click “X” on top right corner on the main interface or click on main menu bar “Setup” →“Exit” →“Yes”, exit ELan-12 infrared sulfur analyzer measurement & control software and return to desktop.

### 4.2 Functions of the Main Forms

The main forms of the measurement & control software of ELan-12 infrared sulfur analyzer consist of title bar, menu bar, shortcut button, status bar, data sheet etc. Every line in the data sheet can be dragged and placed at will for convenient viewing. Shown in Fig. 4-1:

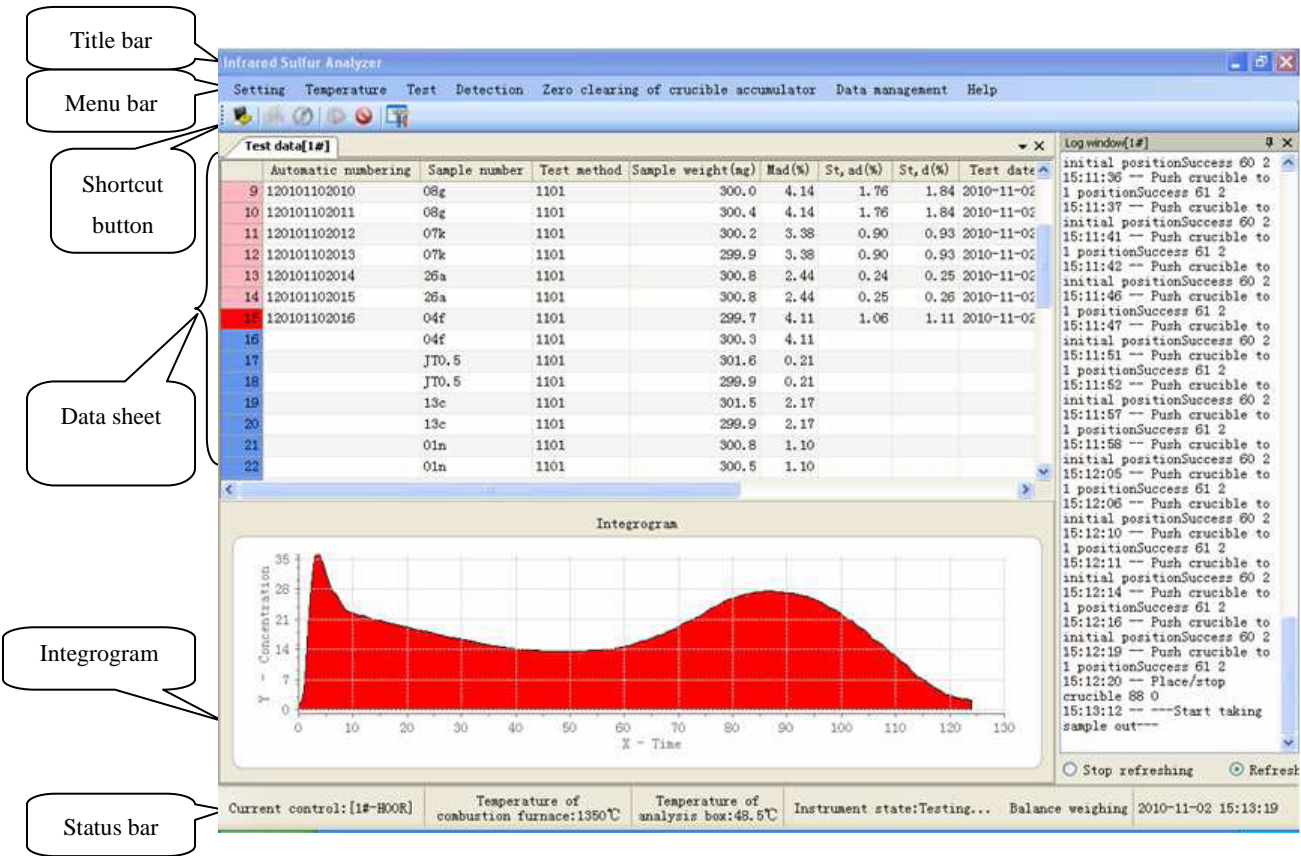


Fig. 4-1

Among of it, data sheet has function of automatically adjusting column width, hide and display all columns, and freely dragging and placing columns. When cursor moves to data bar, and click the right mouse button, Fig. 4-2-1 menu will popup and the below will introduce its functions in details.

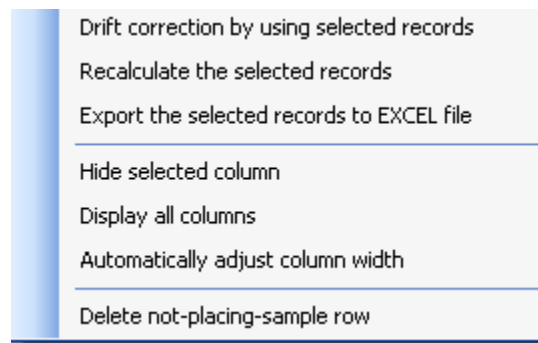


Fig. 4-2-1

- Drift correction by using selected records: select certain record in data bar on main interface of this program to create drift coefficient to conduct drift correction of the instrument.

**Note:**

**Drift correction is an objective reality in infrared absorption method. The operating manual of a foreign famous infrared sulfur analyzer mentioned that “conduct a drift correction every 4h”, and GNcp/12 infrared sulfur analyzer only needs one drift correction in a day if the test condition is relatively stable.**

**Drift coefficient will directly influence accuracy of the instrument, so the selection of records will be of vital importance. The drift records must be selected according to the following principles:**

- ✧ **Drift records, must be standard sample or standard substance and all of them can be queried in standard substance bank.**
- ✧ **2~3 records must be selected as drift records, and their sample number and moisture value must be the same.**
- ✧ **Precision of the drift records must meet the national standard of coulometry.**
- ✧ **Moisture shall be entered into drift records.**
- **Recalculate the selected records: when modifying correction curve, drift coefficient, Mad%, sample weight and sample number, after selecting the records, “Recalculate the selected records” must be clicked for the recalculation of record result and storage in data base, otherwise, the record can not be updated and stored into data base.**

**Note:**

- ✧ **After modifying the sample weight or sample number or Mad% of a certain record, when click “Recalculate the selected records” or “Recalculate”, the system will prompt “Whether replace the correction formula, drift coefficient with latest parameters or not?”, it indicates that the correction formula and intraday drift coefficient of the test method of this record have been changed. If you want to calculate by latest parameters, please click “Yes”, otherwise, click “No”.**
- **Export the selected records to Excel file: can export the selected records to Excel file and edit them.**
- **Hide selected column: hide the selected column.**

- Display all columns: show all configuration display columns.
- Automatically adjust column width: all data columns' width will be adjusted to be suitable.
- Delete not-placing-sample row: can delete records of no sample being placed in sample placing platform.

## 4.3 Functions of Each Menu Bar

### 4.3.1 Setup Menu

As shown in Fig. 4-3-1:

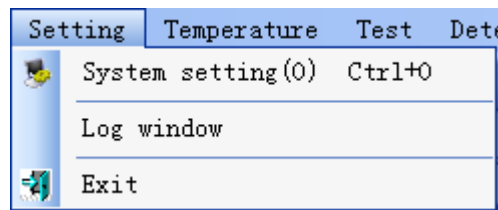


Fig. 4-3-1

**1. System setting:** select this item or click “System Setting” icon in shortcut icon bar, setting windows as shown in the Fig. 4-3-2 will popup.

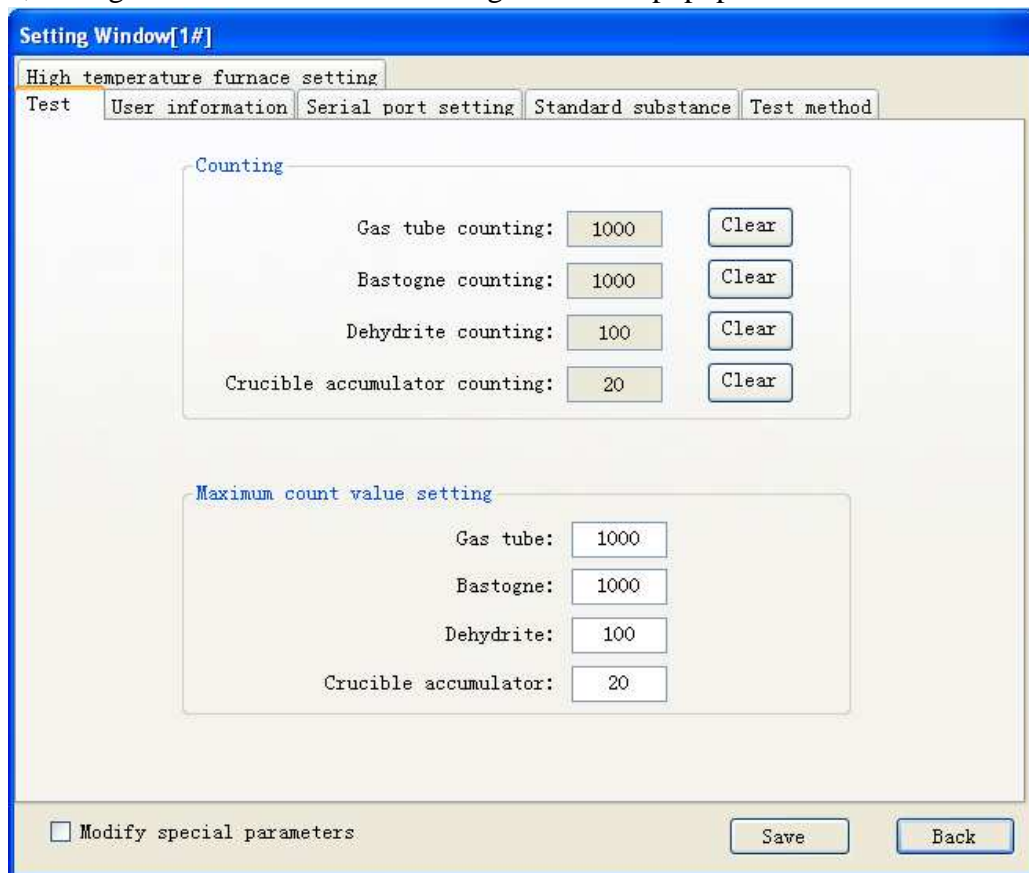


Fig. 4-3-2

- Save: save modified parameter.
- Back: exit the current window and return to main interface window of the program.
- Gas tube counting: record how many samples the gas tube can analyze next, click “clear” on the right, can know the maximum counting number.
- Bastogne counting: record how many samples the Bastogne can continue to analyze and click “clear” on the right can know the maximum counting number
- Dehydrite counting: record how many samples dehydrite can continue to analyze and click “clear” on the right can know the maximum counting number.
- Crucible accumulator counting: record how many crucibles the crucible accumulator can continue to contain and click “clear” on the right can know the maximum counting number.

**Note:**

- ✧ **After changing gas tube, Bastogne or dehydrite, or clearing away the crucibles in the crucible accumulator, click corresponding clear icon and manual refreshing count are necessary.**
- Maximum count value setting: record how many samples the gas tube, Bastogne, dehydrite can analyze respectively, and how many crucibles the crucible accumulator can contain. It's general to keep factory setting.

**1-1. User:** Click “User Information” on “Setting Window”, window shown in Fig. 4-3-3 will popup.



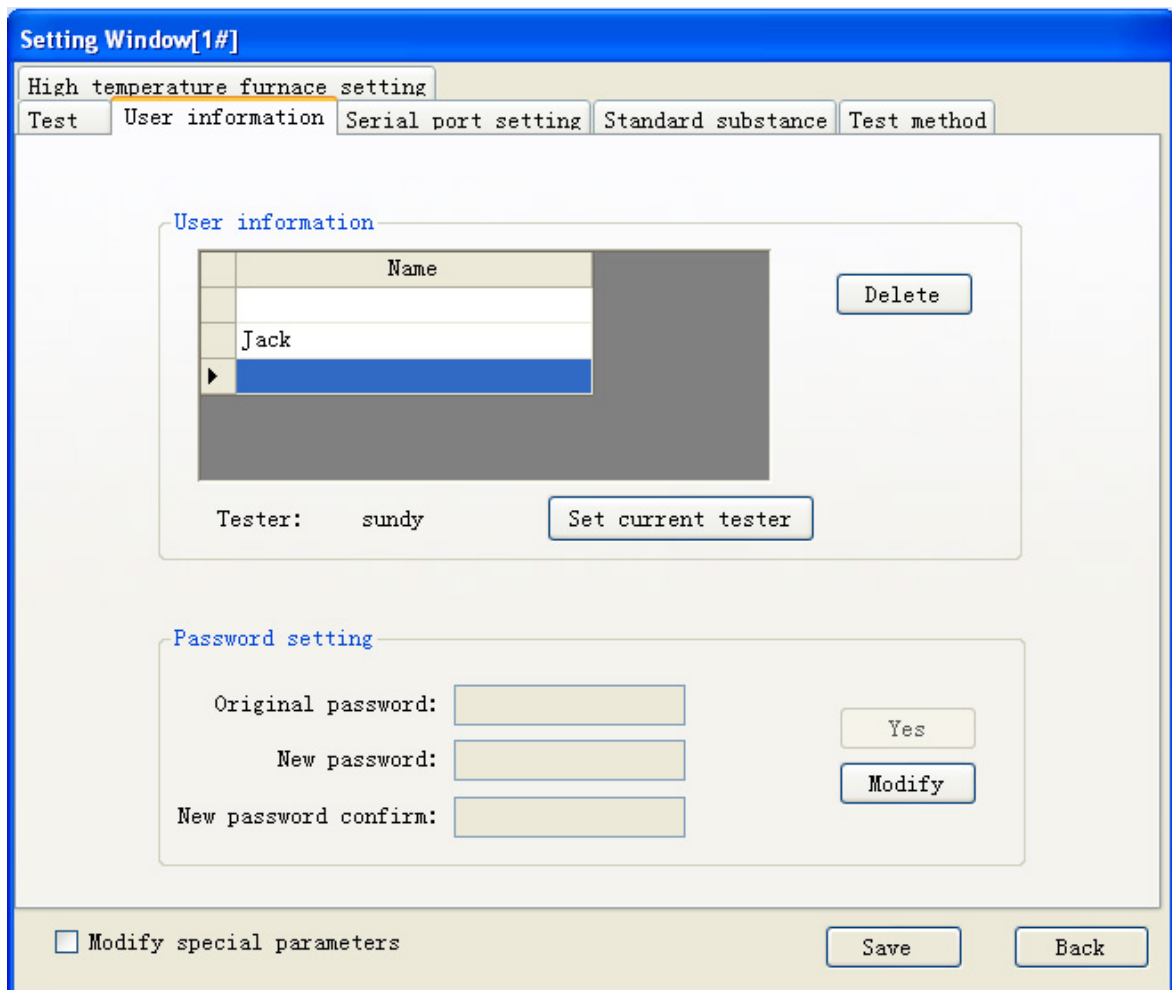


Fig. 4-3-3

- User information tab:
  - ◆ Directly input the name of tester in the list box and the program will automatically add blank record row.
  - ◆ Set current tester: after selecting record on table column on the left, click this icon, the program will automatically display the selected record on the tester's label.
  - ◆ Delete the selected records: Click this icon, the program will automatically delete the selected records in the tables on the left.
  - ◆ Tester: Select displaying name of the tester, link to and display in "Test" column on data sheet on the main interface of the program.
- System password tab:
  - ◆ Original password: input original password

- ◆ New password: input new password.
- ◆ New password confirm: confirm new password.
- ◆ Modify: click the button, activate the three textboxes on the left modify password, otherwise, the password cannot be modified.
- ◆ Yes: click the button to save new password.

**1-2. Serial port setting:** click tab “Serial Port Setting” of “Setting Window”, the window shown in Fig. 4-3-4 will popup.

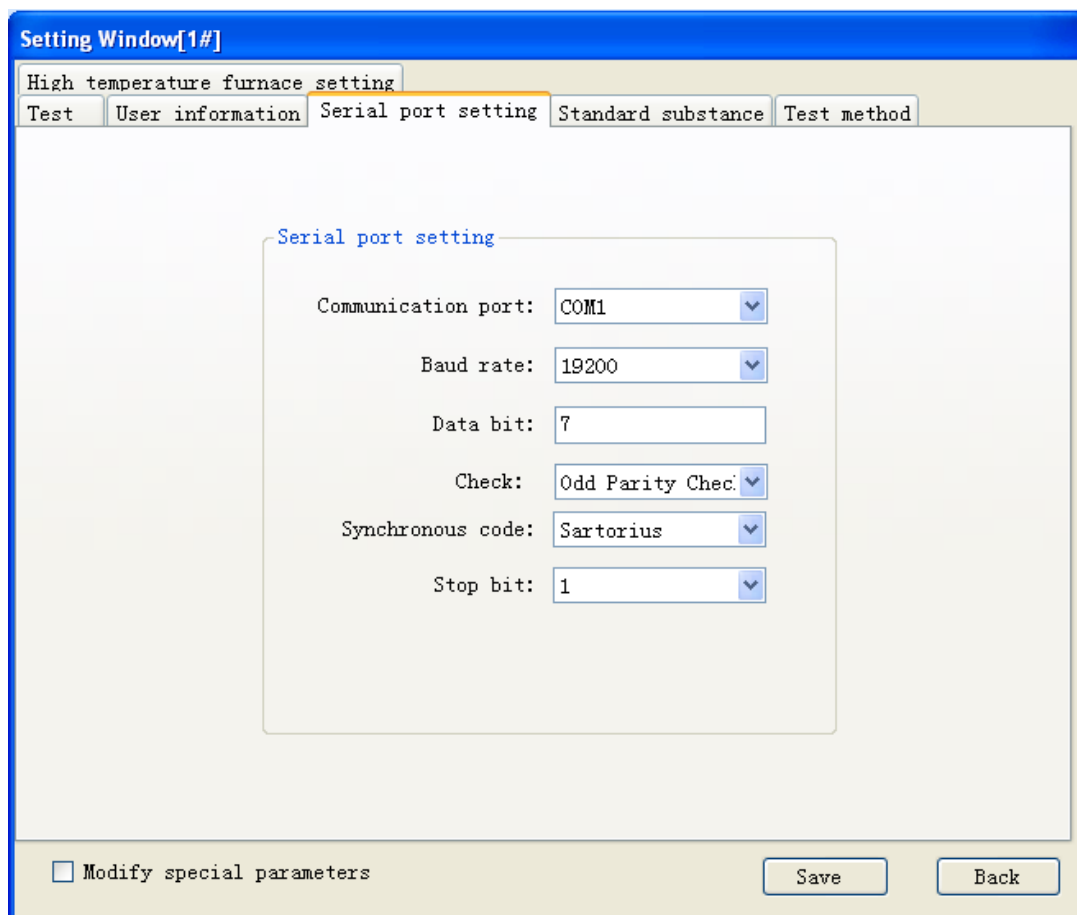


Fig. 4-3-4

Serial port setup tab: set communication parameter of the balance.

- Communication port: setting value of this item according to the practical situation.
- Baud rate: set value of this item according to the parameter of the balance’s own.
- Data bit: set value of this item according to the parameter of the balance’s

- own.
- Check: set value of this item according to the parameter of the balance's own.
  - Synchronous code: set value of this item according to the parameter of the balance's own.
  - Stop bit: set value of this item according to the parameter of the balance's own.

**1-3. Standard substance:** Click “Standard Substance” tab of “Setting Window”, the window shown in Fig. 4-3-5 will popup.

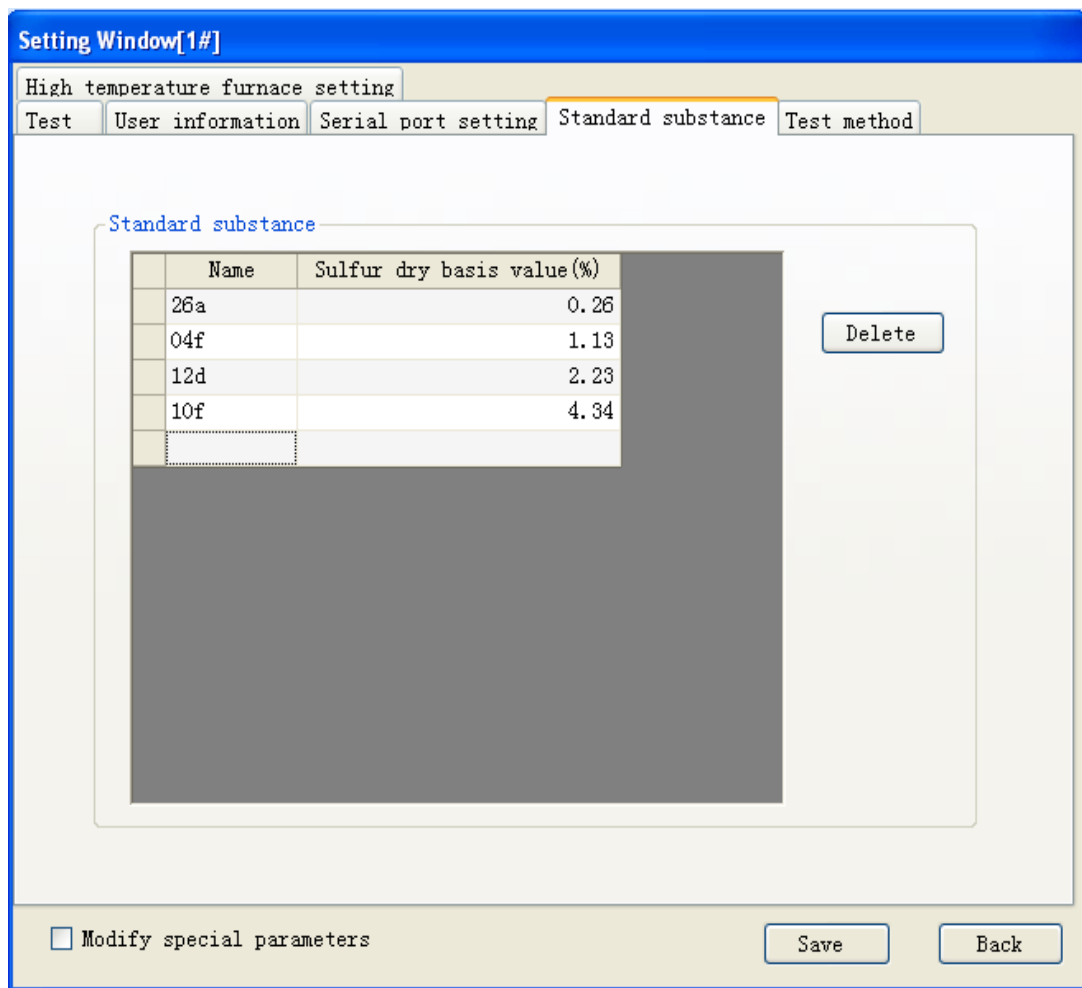


Fig. 4-3-5

- Delete: Click this icon, automatically delete the selected record row in table on the left.
- Add standard sample: directly input related parameter in the table, and the program will automatically add blank record row.

- ◆ Name: input name of standard sample into text box on the left.
- ◆ Sulfur dry basis value (%): input sulfur standard value of the standard sample.
- ◆ If the name column of a record has numbers, but the sulfur dry basis value column is empty, or if the name column is empty, but the sulfur dry basis value has numbers, this record is recognized as invalid record, click “Save”, and it will be deleted automatically.
- ◆ Inputting two records with the same name is not allowed, and the system will delete these records automatically.

**1-4. Test method:** click tab “Test Method” of “Setting Window”, the window shown in Fig. 4-3-6 will popup.

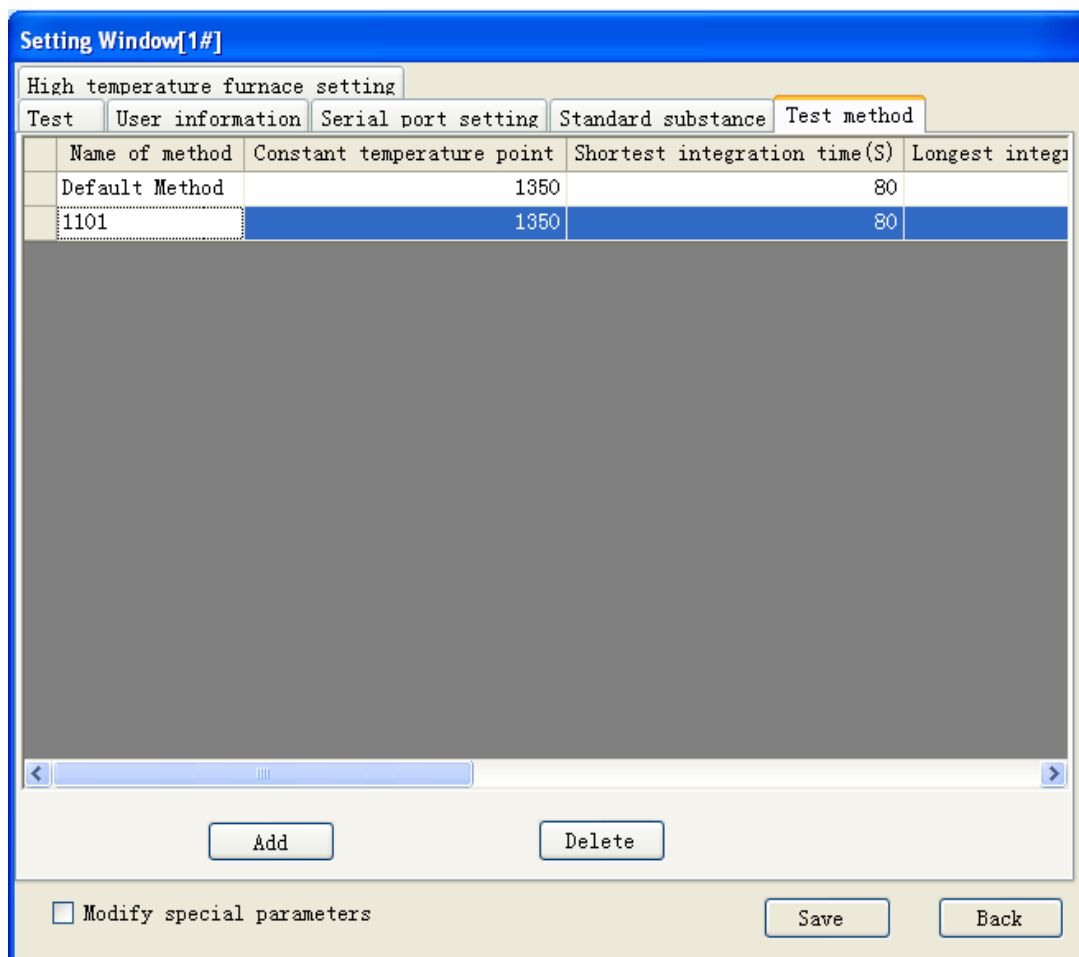


Fig. 4-3-6

➤ Add: Click the icon, automatically add new test method. After click “Save”, the

adding method can be successfully saved.

- Delete: Click this icon, delete the selected records.

**Note:**

- ✧ Can directly edit parameters in the table, but if the method has been selected and used in test data, the name of the method can't be edited.
- ✧ If there is only one method on test method page or a method has been selected and used in test data, these method records cannot be deleted, and the system will give relevant prompts.
- ✧ The methods with empty name or with the same name are invalid methods and cannot be saved.

**1-5. High temperature furnace setup:** click “High Temperature Furnace Setting” tab of “Setting Window”, the window shown in Fig. 4-3-7 will popup.

Setting Window[1#]

Test User information Serial port setting Standard substance Test method

High temperature furnace setting

Temperature setting of high temperature furnace

Thermocouple coefficient: 1035

Cold end temperature(°C): 32.3

Hibernation

Hibernation time (min): 30

Hibernation temperature(°C): 1000

Automatic hibernation

Modify special parameters

Save Back

Fig. 4-3-7

- Temperature setting of high temperature furnace:

- ◆ Thermocouple coefficient: set thermocouple coefficient of high temperature furnace.
- ◆ Cold end temperature: show current cold end temperature of the high temperature furnace.

**Note:**

- ✧ **It's not permitted to modify parameter value of the high temperature furnace before changing high temperature furnace thermocouple; otherwise the instrument may be damaged.**
- Hibernate: if the samples that to be analyzed is less and the wait time is relatively long, to prolong the service life of the instrument, this function is recommended.
  - ◆ Hibernation time: set hibernation time.
  - ◆ Hibernation temperature: set hibernation temperature.
  - ◆ Automatic hibernation: after it is selected, the instrument will automatically hibernate according to the set time.

**2. Log window:** click this item, open log window as shown in Fig. 4-1.

**3. Exit:** click “X” at the top right corner of main interface of this program or this item, window show in Fig. 4-3-8 will popup.

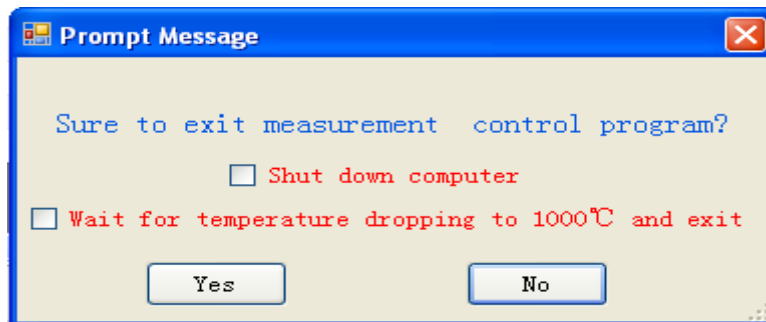


Fig. 4-3-8

- Shut down computer: after selecting it, the system will firstly exit ELan-12 infrared sulfur analyzer program, then shut down computer automatically.
- Wait for temperature dropping to 1000°C and exit: after selecting it the system will wait the temperature of combustion furnace dropping to  $\leq 1000^{\circ}\text{C}$  and exit ELan-12 infrared sulfur analyzer program, and then back to the Windows desktop.
- Yes: click the item and exit measurement & control program of ELan-12

infrared sulfur analyzer.

- No: click the item, close “Prompt Message” window and return to the main interface of measurement & control program of ELan-12 infrared sulfur analyzer.

### 4.3.2 Temperature Menu

Shown in Fig. 4-3-9:

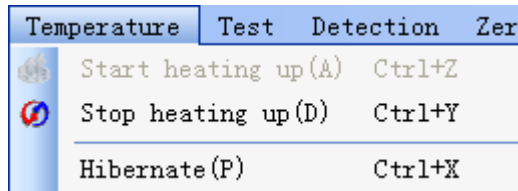


Fig. 4-3-9

- 1. Start heating up:** click this menu or shortcut icon of shortcut icon bar, the program will automatically make the instrument heating and keep constant temperature.
- 2. Stop heating up:** click this menu or shortcut icon of shortcut icon bar, the program will automatically make the instrument cool.
- 3. Hibernate:** Click this menu, the system will automatically hibernate according to the given parameters to protect the instrument

### 4.3.3 Test Menu

Shown in Fig. 4-3-10:

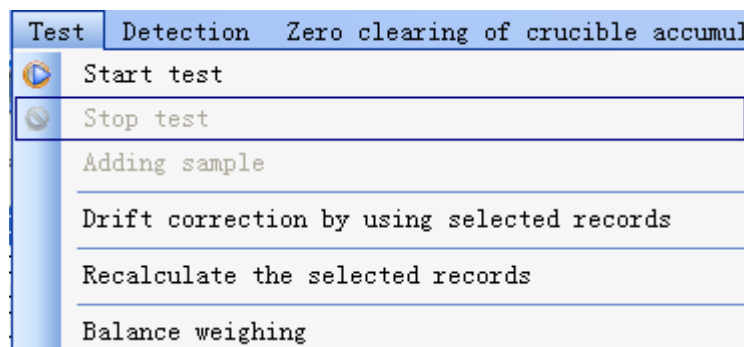


Fig. 4-3-10

- 1. Start test:** click this menu or shortcut icon of shortcut icon bar, the system open sample placing window to prompt user to place sample. Shown in Fig. 4-3-11:

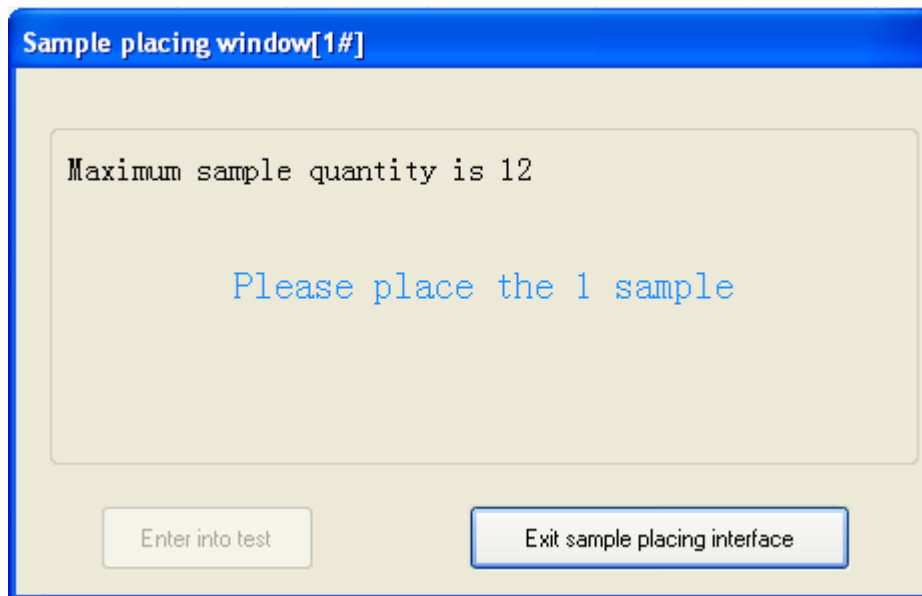


Fig. 4-3-11

- Maximum sample quantity: the system will, according to sample quantity whose weight has been inputted and sample quantity that has been placed, prompt user that the maximum quantity of sample can be placed.
  - Sample placing prompt message: prompt user that which one simple can be placed and when reaching maximum sample placing quantity the window will automatically close and enter into test.
  - Enter into test: Click this icon, can stop sample placing ahead of time and enter into test immediately.
  - Exit sample placing interface: Click this icon to close sample placing window and doesn't enter into test.
- 2. Stop test:** If sample still stay on the platform, click “stop test”, the system will stop current test immediately and the sample being tested will be valid and will be analyzed continuously; If the sample is sent into high temperature furnace or placed on the mobile platform, click “stop test”, the system will stop the next test, but the current test will continue until its completion.
- 3. Adding sample:** Click this icon during test process, the system open placing window and prompt user to place sample. After the analysis of sample placed before been finished, the system will continue analyze the added sample. **If, when adding sample, there is prompt “Please wait for successful initialization of push plate”, it shows that the push plate is occupied by other tasks, and sample**



placing operation can't be conducted, so please wait for push plate returning to initial position and add sample with following the direction.

**4. Drift correction by using selected records:** refer to Section 4.2

**5. Recalculate the selected records:** refer to Section 4.2

**6. Balance weighing:** Click this item, the program will realize online weighing.

**Notice:**

- ✧ **Balance data output condition shall be set as: non-function save, print by single step after sample being stabilized. (613)**
- ✧ **After sample being stabilized, it needs press "print" key on the balance manually to conduct weight transfer and confirmation.**

#### 4.3.4 Detection Menu

As shown in Fig. 4-3-12

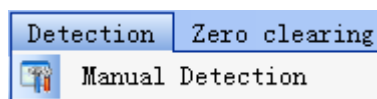


Fig. 4-3-12

**1. Manual detection:** Click this item or "Manual Detection" icon, the detection window shown in Fig. 4-3-13 will popup.

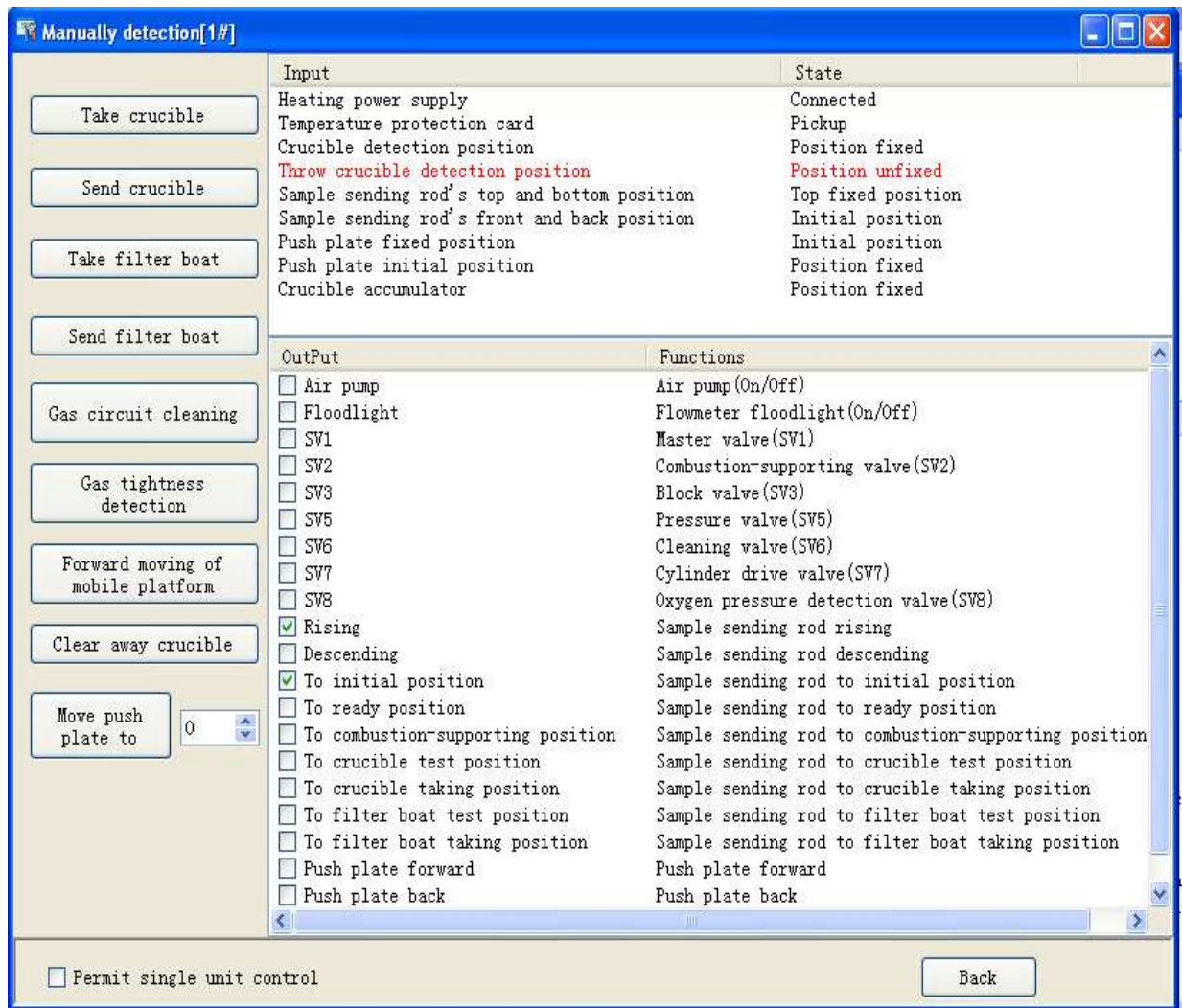


Fig. 4-3-13

- Take crucible: click this item, perform operation of taking crucible.
- Send crucible: Click this item, perform operation of sending crucible.
- Take filter boat: Click this item, perform operation of taking filter boat and **it's suggested that take filter boat under low temperature.**
- Send filter boat: Click this item, perform operation of sending filter boat and **it's suggested that send filter boat under low temperature.**
- Gas circuit cleaning: Click this item, start gas circuit cleaning, until click "stop gas circuit cleaning"
- Gas tightness detection: click this item and carry out gas tightness detection, press the gas tightness detection strut bar according to system prompt, of the SO<sub>2</sub> flow of aspiration flowmeter can return to 0L, it means there is no gas leakage, and the test can be conducted; otherwise, there is a gas leakage and

the test cannot be carried out, and trouble shooting shall be made.

- Backward/forward moving of mobile platform: click this item, and carry out the backward/forward moving of the mobile platform.
- Clear away crucible: click this item, perform operation of clearing away crucible on the sample placing platform. The number of crucible cleared away will be recorded into counting of crucible accumulator.
- Move push plate to: click this item, according to the number in input box at the right (input scope: 0-13), move push plate to this position. If there is sample on the placing platform, please perform operation of clearing away crucible firstly.
- Permit single unit control: select this item, after inputting password, can control certain single unit manually. **Service technicians not from MRC Company shall not do the said operation** to avoid that disoperation influencing normal operation of the instrument.

#### 4.3.5 Zero Clearing of Crucible Accumulator

Click this item, reset “Crucible accumulator” counting to maximum count value and restart the counting.

##### Note:

- ✧ **During the sample placing or push plate moving, the clearing of crucible in “Crucible accumulator” is not allowed; otherwise, the system will prompt accordingly and stop placing sample or test.**
- ✧ **Before click “Zero clearing of crucible accumulator”, please clear away crucible in “Crucible accumulator” first so as to avoid the stoppage resulting from the accumulation of excessive crucibles in crucible accumulator!**

#### 4.3.6 Data Management Menu

Detail introduction refers to Chapter 5

#### 4.3.7 Help Menu

Shown in Fig. 4-3-14

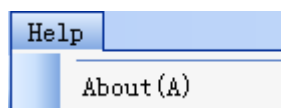


Fig. 4-3-14

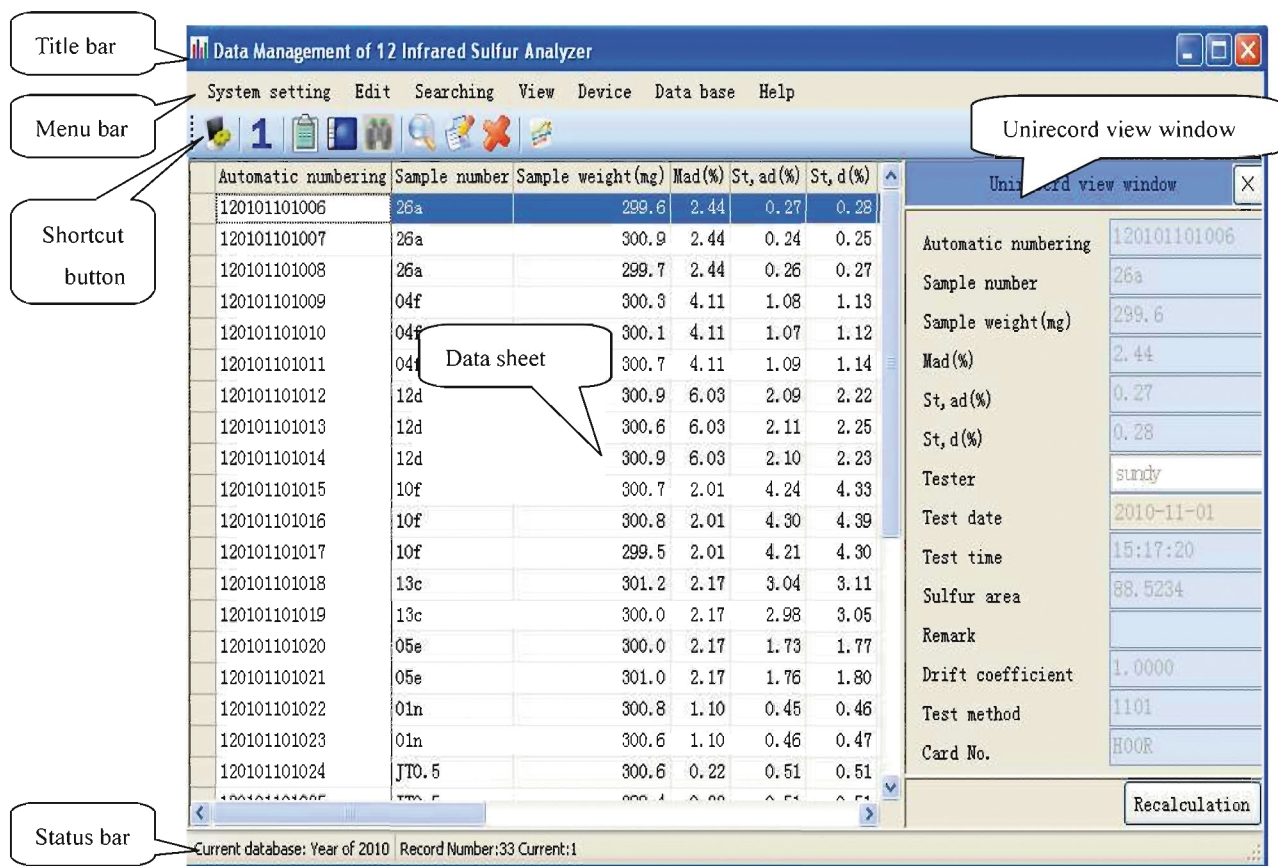
**1. About:** click this item, you can get the program's version information. Click "Yes", return to main interface of the program.

## Chapter 5 Data Management

Click “Data Management” on the main interface menu of ELan-12 infrared sulfur analyzer, popup the indicated window as Fig 5-1, and then enter into Data Management window

### 5.1 Functions of the Main Forms

The main forms of the data base of the ELan-12 infrared sulfur analyzer consist of title bar, menu bar, shortcut button and data sheet etc. Every line in the data sheet can be dragged and placed at will for convenient viewing. The detailed introduction to the menu as follows.



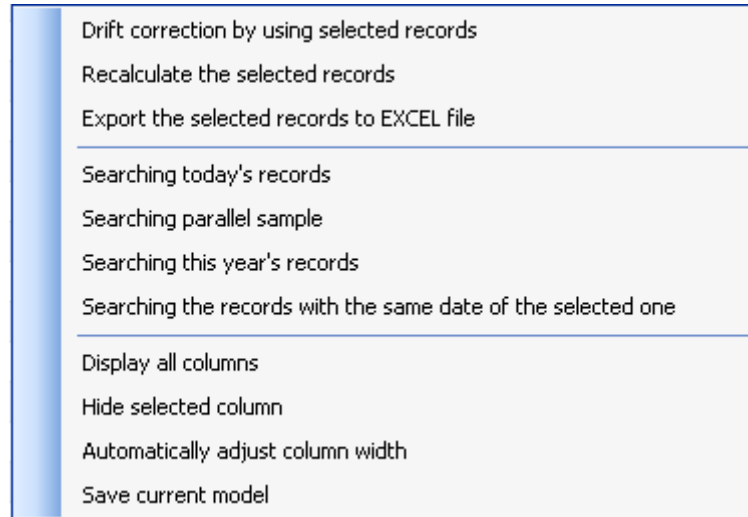


Fig. 5-1

## 5.2 Functions of Each Menu Bar

### 5.2.1 System Menu

As Fig.5-1-1

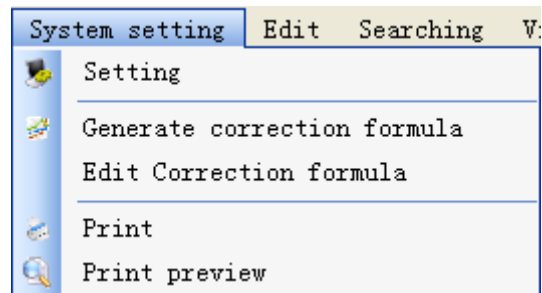


Fig. 5-1-1

**1. Setting:** Click this bar, popup the window as Fig.5-1-2

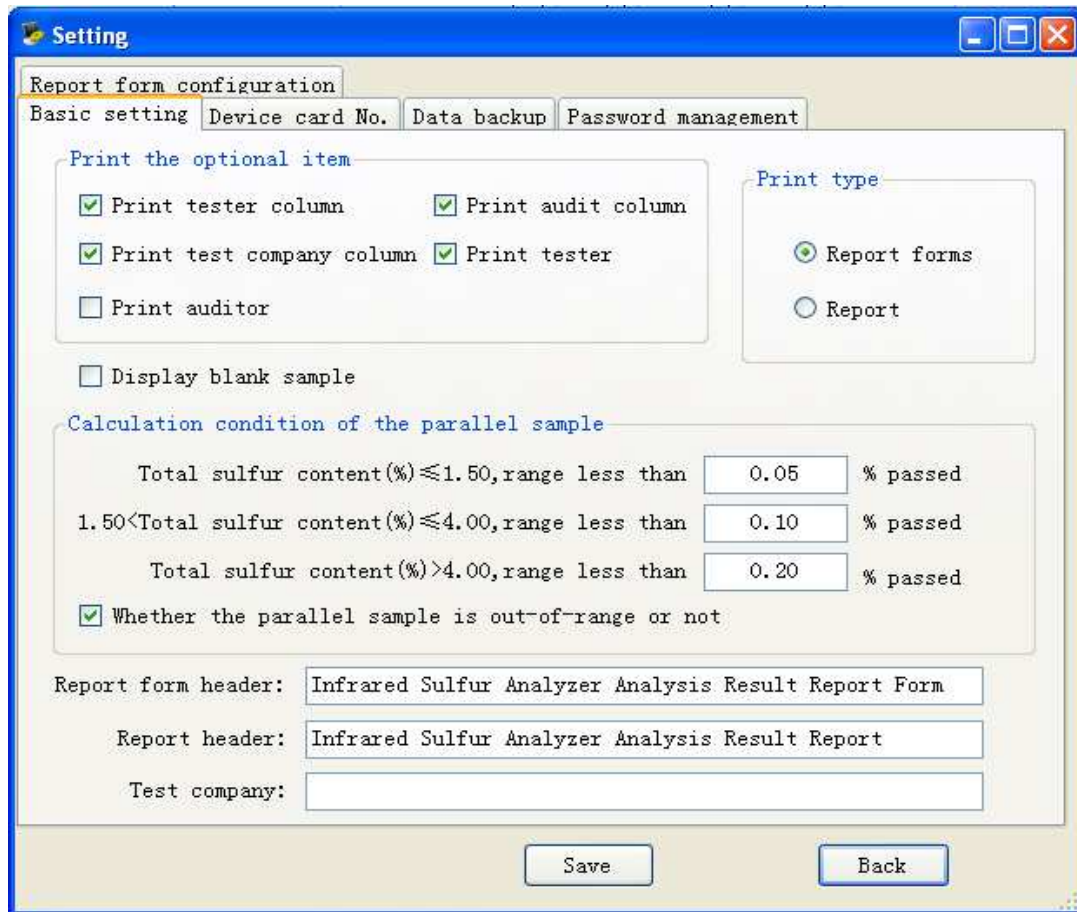


Fig.5-1-2

**1-1.Basic setting:** Click “Basic Setting” on the Setting window popup the window as Fig. 5-1-2.

- Print type
  - ◆ Report: Select the item, then print the selected records in the report form
  - ◆ Report forms: Select this item, then print the selected records in the report forms.
- Print optional items
  - ◆ Print test column: Select this item, then print the tester column under the forms.
  - ◆ Print audit column: Select this item, then print the audit column under the forms.
  - ◆ Print auditor name column: Select this item, and then print the input content on auditor name column under the audit form.
  - ◆ Print tester name column: Select this item, and then print the tester name under the test form.

- ◆ Print test company column: Select this item, then print the test company column under the form.
- ◆ Content of report form heading: Input the content on the right textbox, and then print the content on the report form heading.
- ◆ Content of test company: Input the content on the right textbox, then print the content of the test company column under the form.
- Display blank sample: Select blank sample, then display the blank sample record on the data sheet.
- Calculation condition of the parallel sample.
  - ◆ Total sulfur content (%) range less than in some section: Set up total sulfur content parallel sample in different sections is the condition to judge whether or not it is out-of-range.
  - ◆ Whether the parallel sample is out-of-range or not: Select this item, then mark the parallel results to see whether or not out-of-range according to the set-up parallel sample calculation condition while printing the report or report sheet.
- Save: After modify related parameters, click the button, then the parameters can be saved, otherwise, the parameters can not be saved.
- Back: Click the button, quit the window, then return to the main interface of the data base.

**1-2.Device card No.:** Click “Device Card No.” on the Setup window, popup the window as Fig. 5-1-3.

The function of this window is to set up ID No. corresponding to the device.



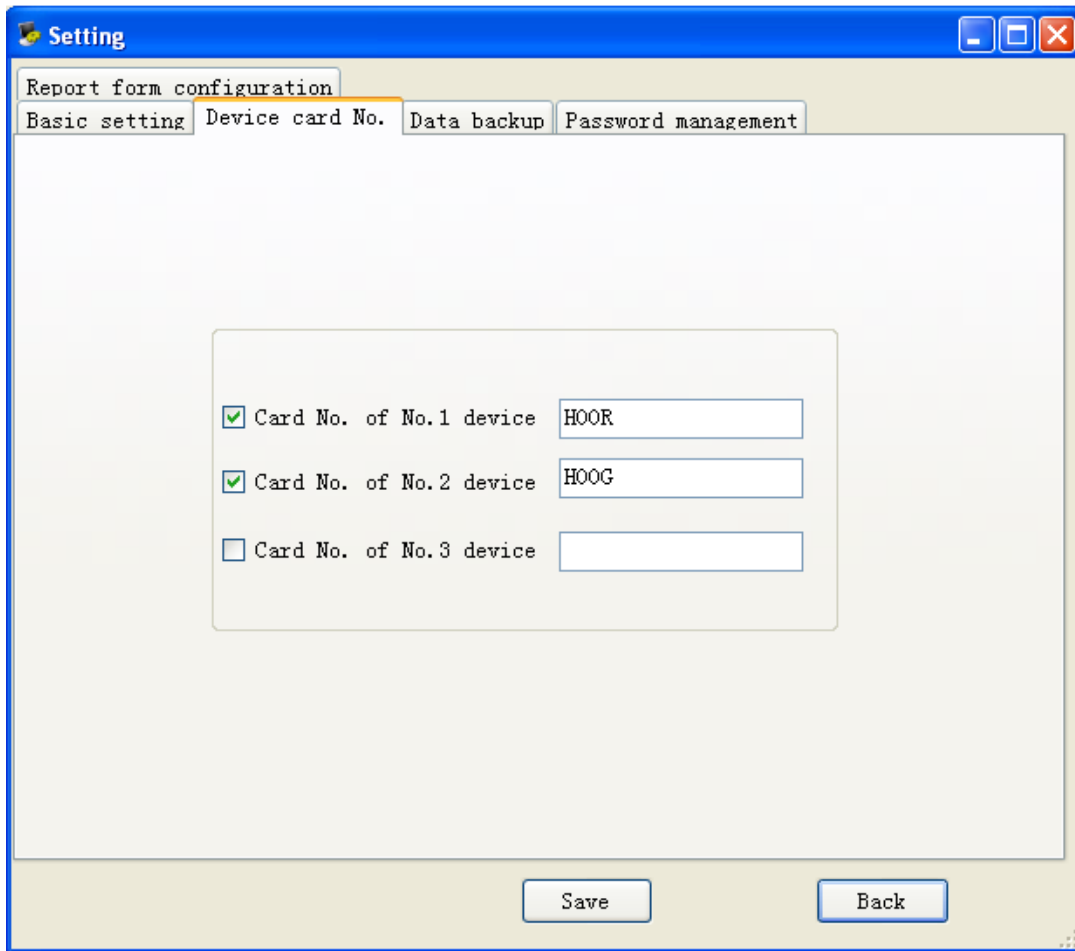


Fig. 5-1-3

**1-3.Data backup:** Click “Data Backup” on the Setup window, popup the window as Fig. 5-1-4.

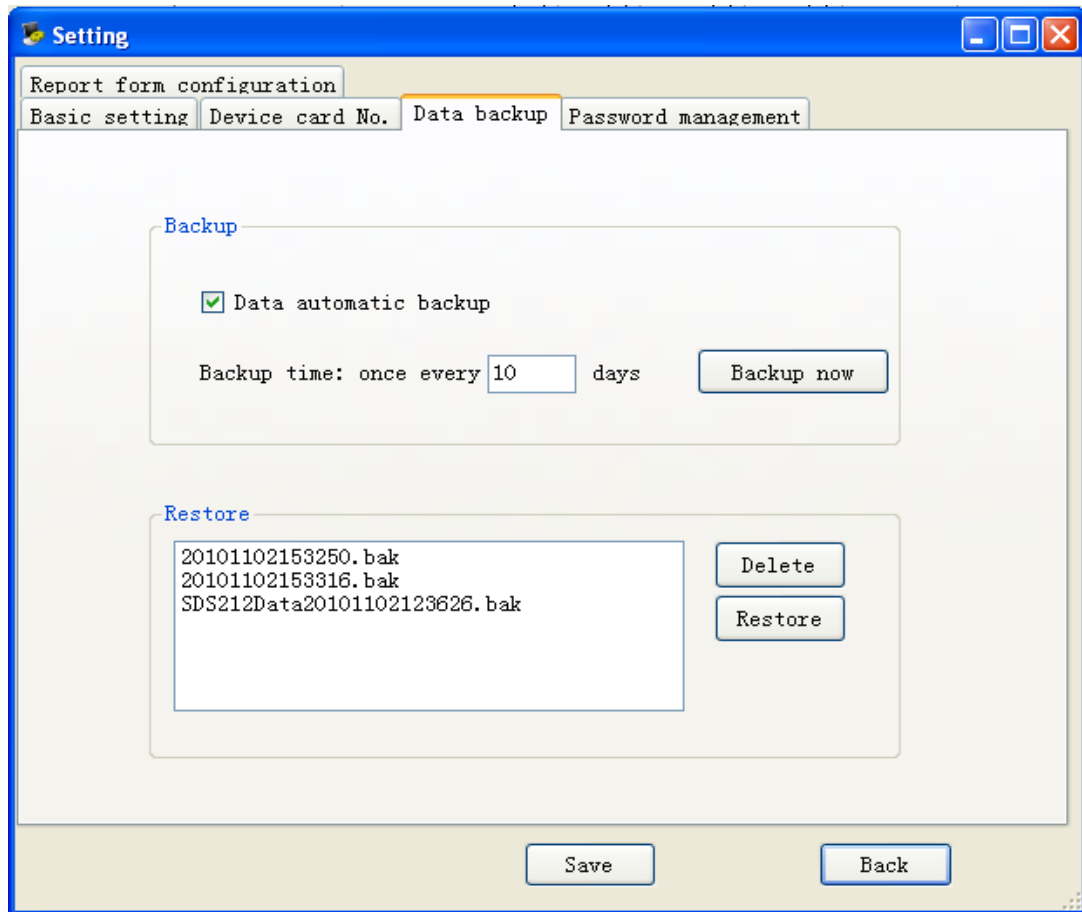


Fig. 5-1-4

- Backup
  - ◆ Data automatic backup: Select this item, the procedure will automatically backup the data base based on the set backup time.
  - ◆ Backup now: Click the button, the data base this time or this year can be backup.
- Restore
  - ◆ Delete: Select the records on the left textbox, then click the button, the backup data base can be deleted.
  - ◆ Restore: Select the records on the left textbox, then click the button, the backup data base can be restored.

**Note:**

- ✧ **When use the function, it shall be careful.**

**1-4.Password management:** Click the “Password Management” on the Setup window, popup the window as Fig.5-1-5.

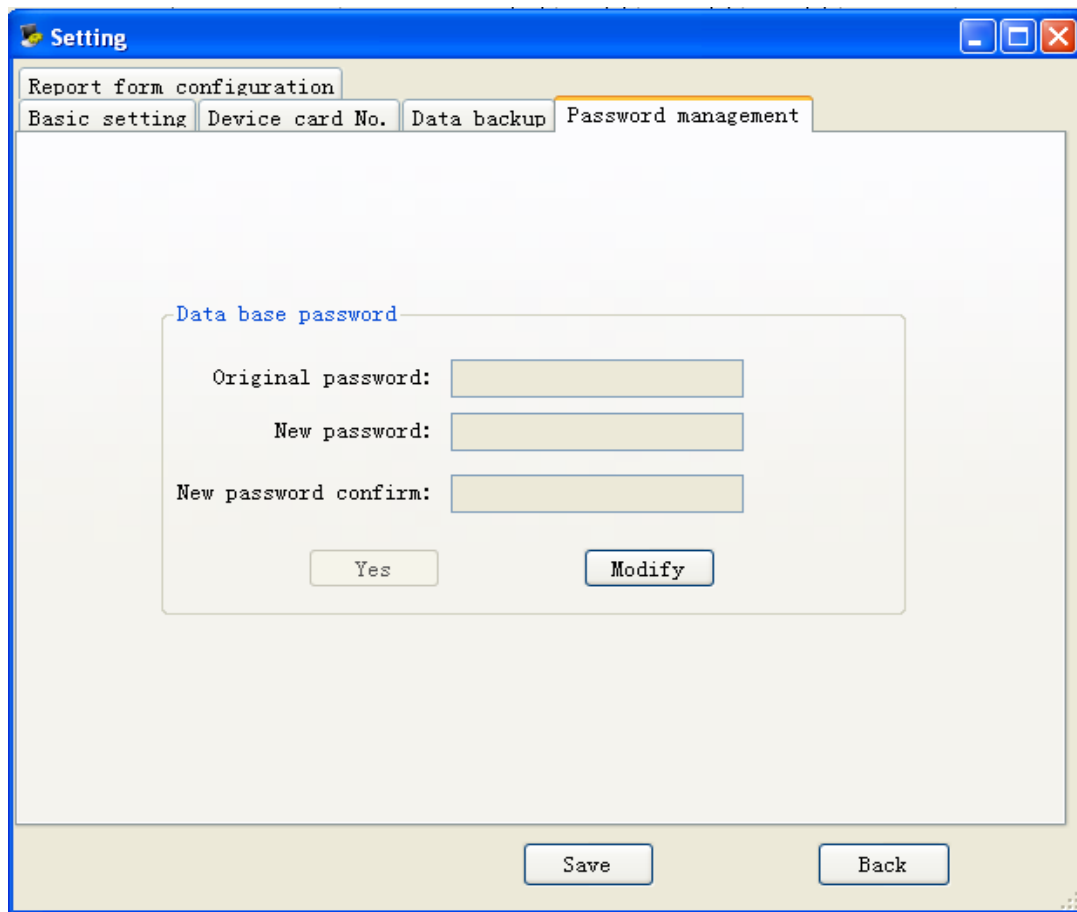


Fig. 5-1-5

- Data base password:
  - ◆ Original password: input original password.
  - ◆ New password: input new password.
  - ◆ New password confirm: confirm new password.
  - ◆ Modify: click the button, and then enter into password edit.
  - ◆ Yes: click the button, and then save the new password.

**1-5.Report form configuration:** Click “Report Form Configuration” on the Setup window, popup the window as Fig. 5-1-6.

- Column name: name corresponding to the main window column.
- Print or not: whether the column is printed on the report form or not.
- Print name: display the column name on the report form.
- Print sequence: The print sequence of each column on the report form shall be based on the ascending sequence.

➤ Print width: The unit is mm for each column width on the report form.

**Note :**

✧ **The selected record lines can not exceed the printed range of A4 paper.**

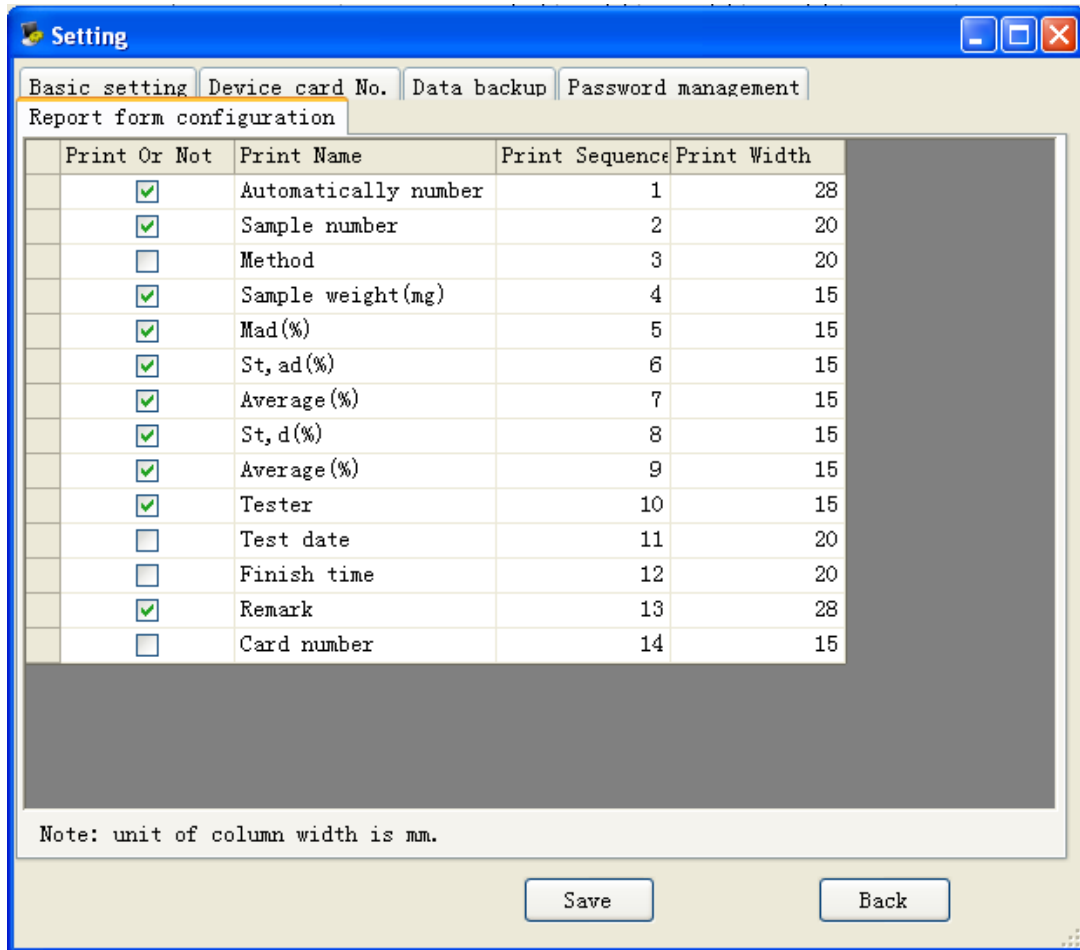


Fig. 5-1-6

**2.Generate correction formula:** Select the records that shall take part in the generating correction formula on the data display column, then click the item, popup the correction window as Fig. 5-1-7.

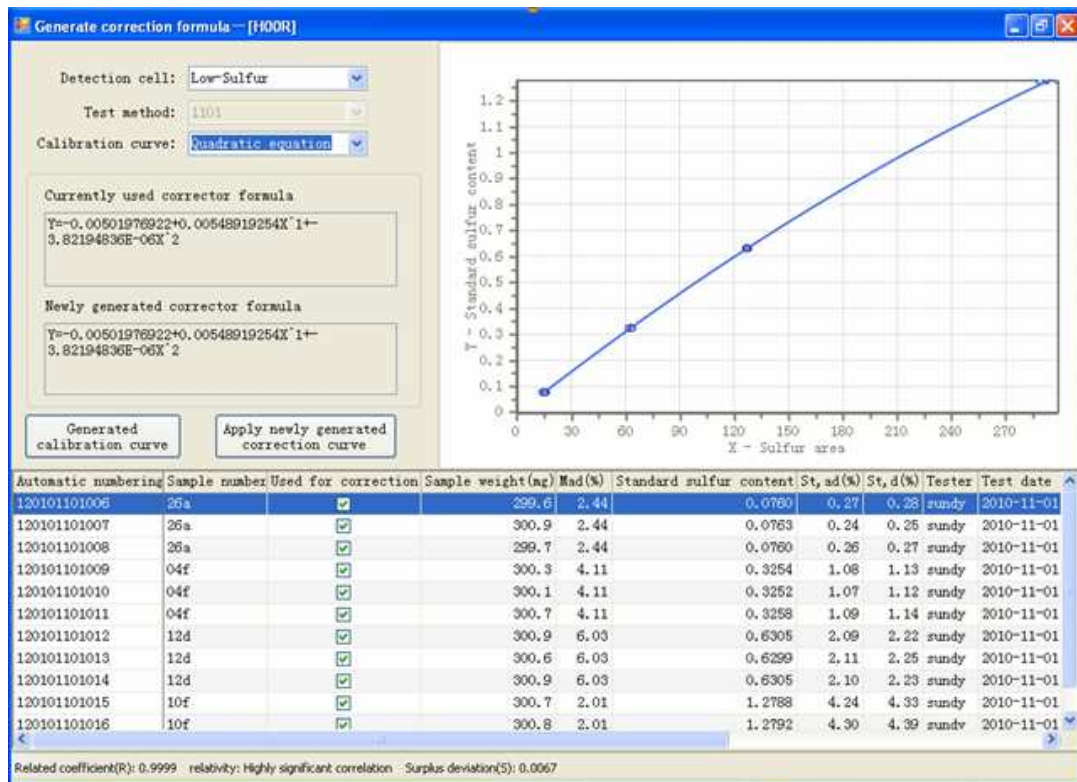


Fig. 5-1-7

Select the correction effective records on the data sheet of the main interface window of the data base, and then click “Generate correction formula” on the shortcut button column or click ”System” → “Generate correction formula” on the menu, pop up the window as above displayed Figure.

- Detection cell: Select the generated correction formula of high sulfur or low sulfur detection cell.
- Test method: Select correction method, generally, it shall coincide the selected record.
- Correction curve: Select the correction line type, generally, quadratic one is selected, with line type as related coefficient (R) >0.9990.
- Currently used correction formula: currently used correction curve formula as the current method.
- Newly generated correction formula: display the newly generated correction curve formula.
- Generate correction curve: click the button, the procedure will automatically generate correction curve.
- Apply newly generated correction curve: click the button, the procedure will

automatically use newly generated correction curve.

- Records on the data sheet used in the correction column: Records listed or selected can take part in the correction and vice versa.

**Note:**

- ✧ **The sample number of the selected generated correction records shall be found on the standard substance bank; otherwise, the records that not satisfy the requirement will be automatically waived when the generate correction curve interface is open in the system.**
- ✧ **After the correction curve modified, it shall recalculate the records of the method; otherwise, the records will not be renewed.**

**3. Edit correction formula:** click this item, popup the window as Fig.5-1-8; check and modify the correction formula and linear of some method.

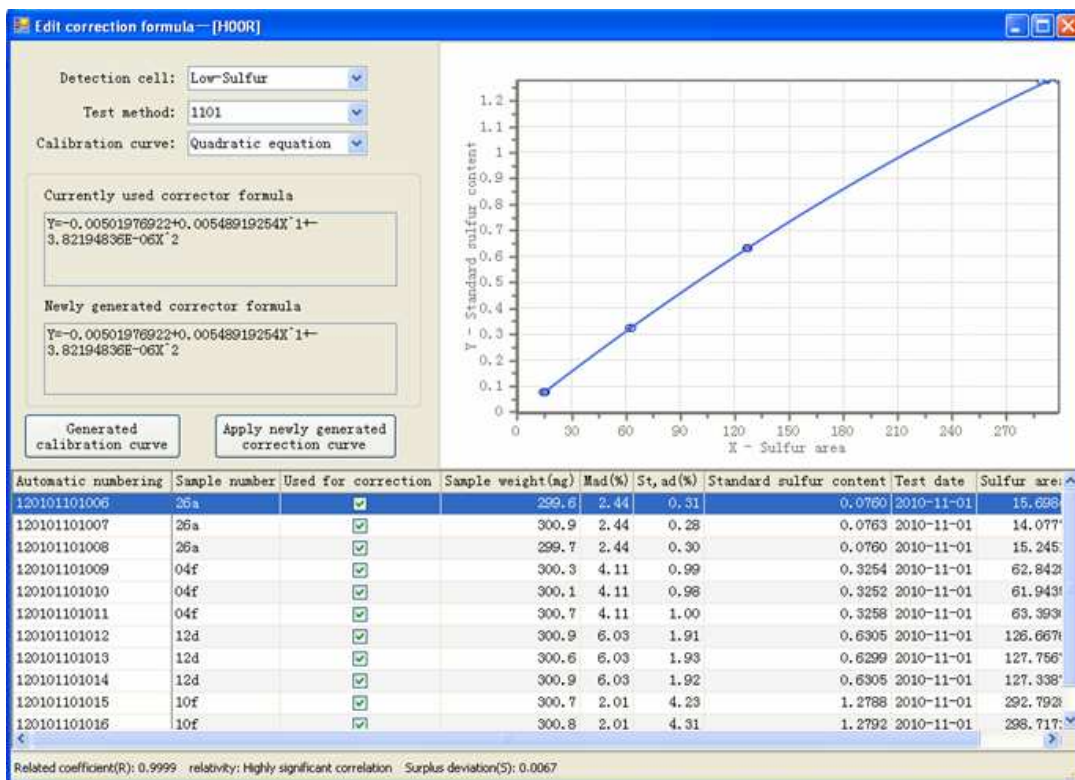


Fig. 5-1-8

**4. Print:** print the selected records in the data sheet.

**5. Print preview:** preview the selected records in the data sheet.

**5.2.2 Edit Menu**

As Fig. 5-2-1

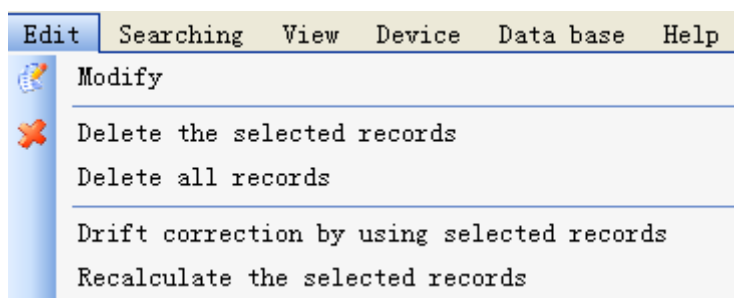


Fig. 5-2-1

1. **Modify:** After click, it automatically appears record preview window.
2. **Delete the selected records:** delete the selected records in the data display column.
3. **Delete all records:** delete all records in the data display column.
4. **Drift correction by using selected records:** to generate drift correction coefficient based on the selected records in the data display column, and recalculate currently selected records based on the new drift correction coefficient.

**Note:**

- ✧ **The sample number of the selected drift correction records shall be found on the standard substance bank; otherwise, the records that not satisfy the requirement will be automatically waived when the drift correction is conducted in the system.**

5. **Recalculate the selected records:** the system will recalculate the selected records in the data display column.

### 5.2.3 Searching Menu

As Fig. 5-3-1

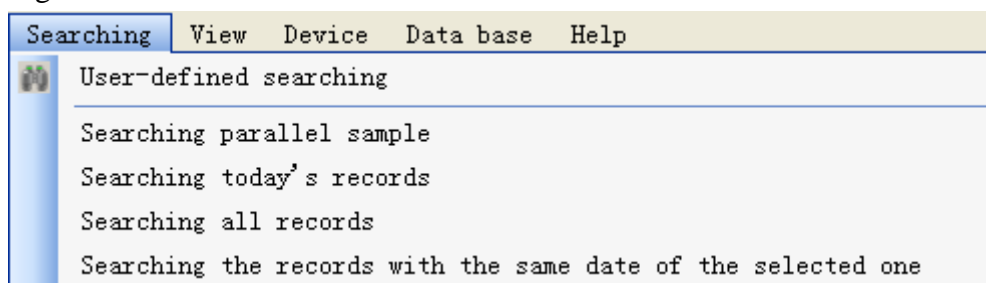


Fig. 5-3-1

1. **Searching parallel sample:** click this item, display the records in the data display column with the similar sample No. and test date as the selected records.

2. **Searching today's records:** display the records in the data display column with the same test date as the computer system date.
3. **Searching all records:** display all records of the data base in the data display column.
4. **Searching the records with the same date of the selected one:** display the records in the data display column with the same test date as the selected records.
5. **User-defined searching:** click this item, popup the displayed window as Fig. 5-3-2.

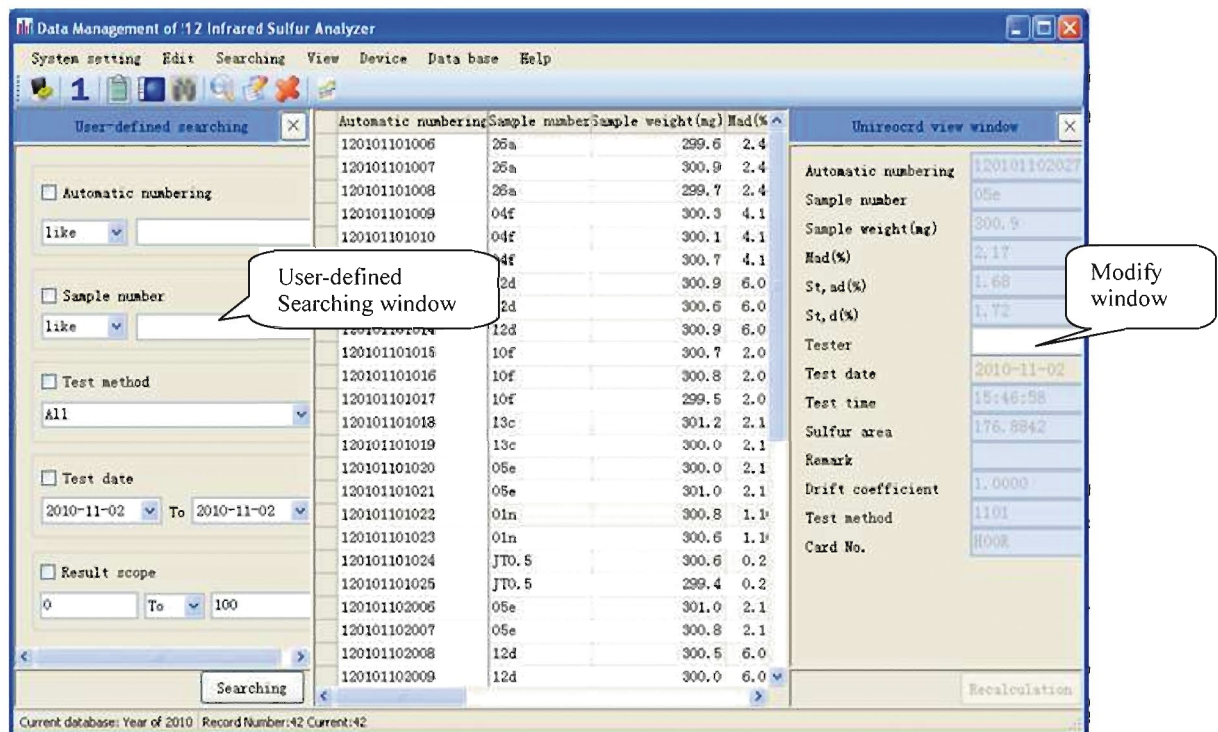


Fig. 5-3-2

There are 5 methods for data query: Automatic numbering, sample numbering, test method, test date and result scope.

Query based on one or more conditions: the first is to select query method and then select the query condition; input related condition in condition box and then click “Searching” button, all records that satisfy the condition will display in the data column, such as the query steps of automatic numbering:

- Setting up searching method: click “Automatic numbering” check box, making it in selected state.
- Setting up searching condition: click “v” button and select one item (such as



“Like”), and then input the date in the right box (such as 201004).

- Searching: click this button, the system will automatically display all test records that contain 201004 automatic numbering in the data display column.

#### 5.2.4 View Menu

As fig. 5-4-1

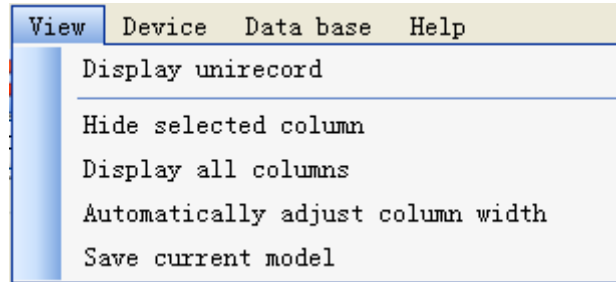


Fig. 5-4-1

- 1. Display unirecord:** click this item, display unirecord browse window on the right side of the data display column.
- 2. Hide selected column:** click this item, hide the selected line in the data display column.
- 3. Display all columns:** click this item, display all configured display columns in the data display column.
- 4. Automatically adjust column width:** click this item; automatically adjust alignment displayed width in the data display column based on the contents in every line.
- 5. Save current model:** click this item, it will automatically save current line format setup in data display column.

#### 5.2.5 Device Menu

As Fig. 5-5-1, to select some device No., display the records corresponding to the device No. in the data display column.

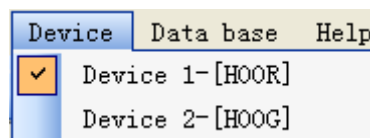


Fig. 5-5-1

#### 5.2.6 Data Base Menu

As Fig. 5-6-1, to select the year, display all records of the year selected in data

display column.

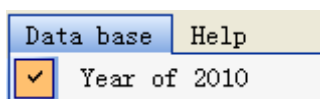


Fig. 5-6-1

### 5.2.7 Help Menu

As Fig. 5-7-1

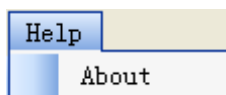


Fig. 5-7-1

**1. About:** click this item, you can obtain the version information about data management program of ELan-12 infrared sulfur analyzer.

### 5.2.8 Exit Data Management

As Fig. 5-8-1, click “×” on the top right corner of the Data Management window, popup the prompt window as the following Figure, and then click (Y) and exit the Data Management window; return to the main program interface of ELan-12 infrared sulfur analyzer; click (N), it is to waive the exit.

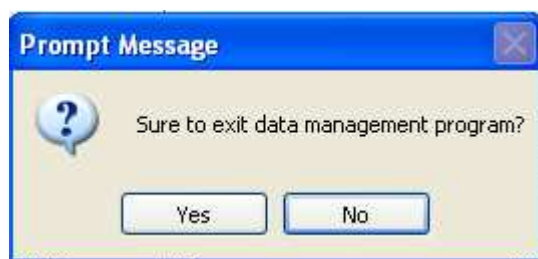


Fig. 5-8-1

## Chapter 6 Instructions to Operation

This chapter introduces how to finish a complete test process, including preparatory work, system detection, blank analysis, standard sample analysis and user sample analysis.

### 6.1 Preparatory Work

- Switch on the power supply of computer, instrument, printer and balance.
- Start the computer, open the Windows desktop, double click the shortcut icon of “ELan-12 Infrared Sulfur Analyzer” to enter the main program window.
- After the program prompts online, confirm whether it is necessary to replace the desiccant and clean the filters in accordance with the intraday test quantity and the information prompted by the program.

#### Note:

- ✧ **After finishing every 100 samples, dehydrite and silica wool in No.1 drying tube must be replaced; and the metal tubes, end cover of sample sending mouth and gas circuit must be cleaned according to system prompts and actual gas circuit flow, otherwise, it may cause incorrect aspiration flow and influence the test result.**
- ✧ **The dehydrite should have a granularity of  $\phi$  3~4mm, domestic manufactured dehydrite, powdery dehydrite and other desiccants are strictly prohibited.**
- ✧ **Ordinary cotton, cotton for medical purpose or absorbent cotton shall not be adopted to replace silica wool. Silica wool should be compacted.**
- ✧ **Please refer to Fig. 3-3 *Placing of Desiccant* for detailed installation sequence and dosage of silica wool and dehydrite.**
- ✧ **Don't shut down the power switch of the instrument during its normal online working and test process to avoid abnormal running of the instrument caused by misoperation.**

- ✧ **Don't press the gas tightness detection strut bar during the normal test process of the instrument, and don't move filter and Bastogne filter, otherwise, it may influence the gas circuit flow and the test result.**

- Heating up

Click “Heating up” icon in the toolbar of the main interface or click “Temperature” → “Start heating up” icon in the menu bar, the instrument will automatically heat up and keep a constant temperature.

- Heat up the instrument to a stable and constant temperature.

**Note:**

- ✧ **For each starting up, the instrument should be preheated for at least 2~3 hours. If the instrument keeps 24-hour uninterrupted work, preheating is unnecessary.**
- ✧ **While preheating the instrument, tester can do other preparatory work.**

- Weighing samples

- ◆ Put a crucible on the balance tray, after the balance is stable, deduct the tare weight, then use a ladle to add about 300mg sample into the crucible, after balance reading is stable, write down the sample mass.
- ◆ Take out the crucible loaded with sample from the balance tray, flatten the sample.
- ◆ Put the weighed samples in the sample boxes in order.

## **6.2 System Detection**

### **1. Detection of gas source:**

Click “Manual Detection” icon in the toolbar of the main interface or click “Detection” → “Manual Detection” → “Gas circuit cleaning” icon in the menu bar, then do the following checks:

- Check whether the switch of the oxygen cylinder is on.
- Check the indicated pressure of the high pressure gauge of the reducing valve on the oxygen cylinder. If the pressure is below 3MPa, the oxygen cylinder

should be replaced.

- Adjust the indicated pressure of the low pressure gauge of the reducing valve on the oxygen cylinder to 0.28MPa.
- Click “Stop cleaning”, exit “Manual Detection”, return to the main interface of the program.

## **2. Detection of gas tightness of the system**

Click “Manual Detection” icon in the toolbar of the main interface or click “Detection” → “Manual Detection” → “Gas tightness detection” icon in the menu bar, press the gas tightness detection strut bar according to system prompt, observe whether the SO<sub>2</sub> flow of aspiration flowmeter drops to 0L: if the SO<sub>2</sub> flow fails to return to 0L, this means there is a gas circuit leakage in the subsequent section of drying tube, please conduct trouble shooting and carry out gas circuit detection again until there is no leakage; If the SO<sub>2</sub> returns to 0L, this means that the system has no gas leakage.

### **Note:**

- ✧ **If there is no gas leakage in the system, the test can be done;**
- ✧ **If there is gas leakage in the system, the test cannot be done;**

## **3. Sample placing**

Place samples on the sample placing platform in accordance with the system prompt and the actual samples placing requirements.

### **Note:**

- ✧ **When clicking “Start test” or “Adding sample”, wait for the push plate of the crucible returning to its initial position, and the sample placing can be conducted after the system giving relevant prompt.**
- ✧ **Place samples on the sample placing platform according to the direction marked on sample placing mouth, meanwhile, pay attention to the placing rhythm.**

## **6.3 Blank Analysis**

When making blank analysis, no sample will be put in the crucible. Input “Blank sample” into the “Sample number” of the data sheet bar of the main interface, input “300” into the sample weight bar, select method in the method bar, click “Start test” icon in the toolbar of the main interface or click “Test” → “Start” icon in the menu bar, the program will automatically do blank analysis.

**Note:**

- ✧ **The blank analysis is used for automatically balancing the system baseline and ensuring the system stability.**
- ✧ **Make blank analysis till the instrument reaching balance (parallel sample error $\leq$ 0.3%), the blank analysis should be done at least 3~5 times.**
- ✧ **the blank analysis should be done every day, and should be executed before standard sample analysis and test sample analysis.**
- ✧ **After finishing blank analysis, before standard sample analysis or test sample analysis, it is necessary to do waste sample transition.**
- ✧ **When making blank analysis, no sample will be put in the crucible.**
- ✧ **In this stage, the tester should observe whether the aspiration flow is 2.5L, whether the gas supply test flow is 4L, and whether the gas supply cleaning flow is 2.5L.**
- ✧ **We recommend adopting continuous test method.**

#### **6.4 Standard Sample Analysis**

In the “sample number” of the data sheet bar of the main interface, select adopted standard coal number or input corresponding standard coal number, input standard sample weight into the sample weight bar, input moisture value into the moisture bar, select adopted method in the method bar, the program will automatically do standard sample analysis.

**Note:**

- ✧ **The standard sample analysis is used for instrument correction and check.**
- ✧ **The adopted standard samples must be defined in the standard**

substance bank. For building the standard substance bank, please refer to Chapter 4.

- ✧ Generally, it is necessary to analyze 2~3 standard samples, and the accuracy of sulfur element value in the standard sample analysis should be in the repeatability allowable range.
- ✧ It is suggested to analyzing the samples continuously.

## 6.5 Standard Sample Correction

Standard sample is corrected by adjusting the instrument mathematical model according to the given standard sample. Standard sample correction consists of rating curve correction and drift correction. Rating curve correction is used in generating a certain methodological linear of the instrument, drift correction is used in compensation standard sample correction, for the purpose of correcting the system's slight change influence to the test result.

### 1. Rating curve correction

Operation method:

- Building method. Click “Setup”→ “Test method” → “Adding method” in the menu bar, modify method name in the name bar.
- Define standard sample in the standard substance bank. Click “Setup”→ “Setup”→ “Standard substance” page, input St, d% and name of standard sample into the table of this page, click “Save”.
- Analyze the standard sample in accordance with the requirements in 6.1~6.4.
- After analysis, input standard sample analysis result into the data bank, select standard sample analysis record for rating curve, click “Generate correction curve”, popup dialog box, select relevant parameters such as curve linear in this window for setting up, click “Generate correction curve” → “Apply newly generated correction formula”, finally finish generating rating curve of a certain method.
- Exit the data base, back to the main interface, select standard sample analysis record in the data table bar of the main interface, click the right

mouse button to select “Recalculate the selected records”, and adopt new correction formula to recalculate the analysis result of the standard sample analysis record.

**Note:**

- ✧ **During the analysis, the sample number of the standard sample, which is for correction of rating curve, must be consistent with the number in the standard substance, such standard sample must be the standard sample defined in the standard substance, and its Mad% value must be input.**
- ✧ **Tester can select multi-sample standardization or single-sample standardization. We suggest selecting multi-sample standardization and selecting standard samples with high, medium and low sulfur contents for standardizing curve correction samples.**
- ✧ **We suggest to select quadratic curve linear, and its correlation coefficient (R) should be bigger than 0.9990, the best linear.**
- ✧ **Each standard sample must go through test of 2~3 sub-samples, and the precision must be in the range of national standard.**

**2. Drift correction:**

In the data sheet bar of the main interface, select standard coal analysis record, click “Test” → “Drift correction by using selected records” in the menu bar of the main interface or click the right mouse button to select such item, the program will automatically generate drift coefficient, and sample analysis can be done.

**Note:**

- ✧ **Drift correction shall be conducted at the very start of every day, or conducted when using standard sample to check the accuracy of the instrument and it is unqualified**
- ✧ **For the standard sample used for drift correction, the precision of sulfur element value must be in the range of national standard of coulometry.**
- ✧ **Generally, the standard sample used for drift correction should be**



close to routine analysis samples in property and sulfur element value for drift correction.

- ✧ **The drift correction standard sample must be the standard sample defined in the standard substance bank.**
- ✧ **The standard sample used for reexamination must be different from drift standard sample.**

## **6.6 Analysis of User Sample**

Input number of user sample into the “Sample number” bar of the data sheet bar of the main interface, input weight of such sample into the sample weight bar, select adopted method in the method bar, the program will automatically make an analysis of the user sample.

### **Note:**

- ✧ **If there are quite a few user samples, we suggest to add standard sample analysis after finishing user sample analysis, for the purpose of ensuring the accuracy of the user sample analysis.**

## **6.7 Recalculation**

Select relevant record in the data sheet bar of the main interface, click “recalculate selected records”, the system will use new parameters to recalculate the analysis result.

### **Note:**

- ✧ **Recalculate the selected records: when modifying correction curve, drift coefficient, Mad%, sample weight and sample number, after selecting the records, “Recalculate the selected records” must be clicked for the recalculation of record result and storage in data base, otherwise, the record can not be updated and stored into data base.**
- ✧ **After modifying the sample weight or sample number or Mad% of a certain record, when click “Recalculate the selected records” or “Recalculate”, the system will prompt “Whether replace the correction formula, drift coefficient with latest parameters or not?”, it indicates**

**that the correction formula and intraday drift coefficient of the test method of this record have been changed. If you want to calculate by latest parameters, please click “Yes”, otherwise, click “No”.**

### **6.8 Printing**

After finishing user sample analysis and recalculation, open the data base, print the record required. For printing, please refer to Chapter 5.

### **6.9 Dropping Temperature and Logging Out**

Click “Temperature”→ “Stop heating up” in the menu bar of the main interface. When the instrument temperature drops to 1000°C below, log out of the program, turn off the power supply of the instrument and the computer.

**Note:**

- ✧ **To shut down the power supply of the instrument will influence the service life of the instrument.**

## Chapter 7 Instrument Maintenance

Equipment maintenance is of very importance, which directly concerns the accuracy, precision, fault rate and service life of the equipment. Please carefully read this chapter to finish normal maintenance work of equipment in order to ensure normal maintenance of ELan-12 infrared sulfur analyzer.

- 1) Computer and printer equipped with the instrument shall be maintained as required in relating operating manual. In computer virus shall be periodically checked and killed to prevent virus invasion from affecting normal operation of instrument.
- 2) Instrument shall be operated in dry environment to avoid invasion of dust or corrosive gas. If instrument is not operated for long time, please use special dustproof cover to protect the instrument and periodically power on the instrument. The time for increasing temperature by powering on instrument shall be not less than 90 minutes and the time for flushing gas circuit shall be 30 minutes.
- 3) Instrument shall be maintained by special person. Each part of instrument must not be dismantled at will to avoid fault due to malfunction.
- 4) Test shall be strictly operated as required in Chapter 6.
- 5) Instrument shall be used for a special purpose to avoid affecting the normal operation of system.
- 6) Carefully carry instrument to avoid damaging the wearing part in instrument or displacing key part.
- 7) After finishing every 100 samples, dehydrite and silica wool in No.1 drying tube must be replaced; and the metal tubes, end cover of sample sending mouth and gas circuit must be cleaned according to system prompts and actual gas circuit flow so as to avoid SO<sub>2</sub> aspiration flow change influencing the test result.
- 8) When instrument surface is dirty, after the instrument is powered off, use wet towel coated with a little detergent (soap, water or alcohol) to slightly wipe

housing, then use clean towel to remove detergent.

**The following matters shall be noticed during wiping:**

- a) Before wiping, power supply must be cut off to avoid electric shock and damaging instrument.
- b) During wiping, water should be prevented from penetrating into instrument to result in fault.

9) The following matters shall be noticed when using crucible:

Before its use, the test crucible for daily use shall be put into muffle furnace for burning under the temperature of 920°C after the residue in it has been disposed and cleaned.

- c) Treatment of new crucible: the new test crucible shall be burned in the muffle furnace by slow ash method before use.
- d) Treatment of test crucible: clear off the residue in the crucible and burn it in muffle furnace under the temperature of 920°C for 20min, after cooling down, the crucible shall be stored in drying tower and ready for use.
- e) Clearing method of residue in crucible: after the cooling of the crucible, use tweezers to scrape the residue in crucible gently (Note: the tweezers shall not scrape the residue by leaning closely against the wall of the crucible, and the scraping strength shall not be big, so as to avoid the damage to the crucible), then use a small and clean brush to brush down the residue in the crucible.
- f) Take and place the crucible gently so as to avoid knocking and breaking of the crucible.

10) The following matters shall be noticed when changing silicon-carbon tube:

- a) Before the installation of silicon-carbon tube, use ohms range of multimeter (200ohms range) to measure the cold-state resistance of the silicon-carbon tube, if the resistivity is less than 4ohms or is infinite, it means there is a short circuit or an open circuit, and the silicon-carbon tube of this type shall not be used.
- b) Take, place and install the silicon-carbon tube gently, operation behavior should be normalized so as to avoid damage of the tube caused by

improper operation.

- c) After the installation, the ohms range of multimeter shall be used for short-circuit inspection of two terminals of the silicon-carbon tube. The silicon-carbon tube shall not achieve conduction with the instrument enclosure or furnace shell; otherwise, the power-on test cannot be conducted.
  - d) Before the use of the installed silicon-carbon tube, the anti-aging treatment shall be carried out first. Anti-aging treatment: add method to test method page of system setup, such as method 1, then set the constant temperature point of "Method 1" at 200°C, exit test method page, and select "Method 1" in test data sheet bar on the main interface, click "Start heating up", wait for the temperature of the combustion furnace rising to 200°C and maintaining this temperature for 30min, click "Stop heating up", and set the constant temperature point of "Method 1" at 1000°C, click "Start heating up", after maintaining 1000 °C for 30min, set the constant temperature at 1350°C according to the foregoing steps, after maintaining 1350°C for 1h, the anti-aging treatment is finished.
- 2) While the installed new silicon-carbon tube is being heated for the first time, the tester shall observe whether there is fire striking voice or cracking voice or not, if there is, stop heating up at once and carry out failure checking, if there is not, continue the heating.

## Chapter 8 Common Troubles and Solutions

This chapter describes the common trouble and maintenance knowledge of the instrument. If user can not solve it by itself, please contact MRC Company.

Trouble	Cause and solution
1. System displays that machine is not online.	<ol style="list-style-type: none"> <li>1. System is not authorized or authorization is expired or computer time is not in conformity with CAN card time. Professional can apply for application authority from The Manufacturer.</li> <li>2. USB-CAN card is not well connected.</li> <li>3. Instrument is not powered on. Turn on power supply of instrument.</li> <li>4. Drive program of USB-CAN card is not installed. Install the drive program and restart computer.</li> <li>5. Program was damaged by virus.</li> <li>6. Communication is abnormal. Please fix it by professional.</li> </ol>
2. "Heating power supply not powered on" is prompted.	<ol style="list-style-type: none"> <li>1. Heating power supply is not powered on or badly connected.</li> <li>2. Instrument fuse is broken. Please replace it.</li> <li>3. Control card has trouble. Please fix it by professional.</li> </ol>
3. Test status can not be entered.	<ol style="list-style-type: none"> <li>1. Various temperature points are out of constant temperature range.</li> <li>2. Sample quality is not entered into data sheet of main program.</li> <li>3. System has abnormal prompt.</li> </ol>
4. Test results are not ideal.	<ol style="list-style-type: none"> <li>1. Weighing is not accurate or operation is not correct.</li> <li>2. Preheating time of instrument constant temperature is not enough.</li> <li>3. Blank analysis is not made until instrument is stable.</li> <li>4. Correction is not made timely.</li> <li>5. Flow is too low due to leakage or blockage of gas circuit.</li> <li>6. Pressure and purity of oxygen are not correct.</li> <li>7. Balance is not preheated for 30min.</li> <li>8. Sample combustion is incomplete.</li> <li>9. Infrared pool or gas circuit is contaminated.</li> <li>10. Drying agent and filter are not timely replaced and cleaned.</li> </ol>
5. Aspiration flow can not be regulated to 2.5L or to top all along.	<ol style="list-style-type: none"> <li>1. Drying agent is not timely replaced and filter is not timely cleaned.</li> <li>2. Gas circuit is blocked. Please clean the metal air tube at inlet of combustion furnace.</li> <li>3. Bastogne filter is blocked. Please replace it.</li> </ol>
6. During test, message for	<ol style="list-style-type: none"> <li>1. Oxygen is not opened or pressure is not enough.</li> </ol>

<p>motive platform error is prompted.</p>	<p>2. Gas circuit has leakage or blockage.  3. The flow of cylinder drive valve is too small or the gas cylinder is deformed. .  4. Positioning card is damaged or installation position is not correct.</p>
<p>7. "Push plate initialization failure" is prompted or push plate has no action.</p>	<p>1. Ineffective sample is placed on measuring position of crucible.  2. Positioning card is damaged or position regulation is not correct.  3. The crucible measurement magnetic steel does not separate from or stuck on the outer shell.</p>
<p>8. When instrument is powered on, buzzer continuously rings and machine can not be normally connected.</p>	<p>RS485 communication cable between analysis box and instrument master has connection error or disconnection or damage.</p>
<p>9. Printing can not be made or printing error occurs.</p>	<p>1. Check whether signal cable of printer is well connected or damaged.  2. Printer program has problem. Reset printer.  3. Measurement &amp; control software has problem. Replace the software.  4. Printer has problem. Hold warranty to contact local maintenance agent.</p>
<p>10. Computer is halted.</p>	<p>1. Check and change computer CONFIG.SYS setup. Test software should be re-installed.  2. Computer has virus. The virus should be killed.  3. Test software is damaged.  4. Computer has trouble. Hold warranty to contact local computer maintenance agent.</p>