Operation Manual for
Infrared Carbon Hydrogen and Nitrogen Analyzer
ELan-35

PLEASE READ THIS MANUAL CAREFULLY BEFORE OPERATION

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 MRC 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.**

Content

Chapter 1 Instrument Properties and Features

This book is applicable to products such as ELan-35 Infrared Carbon Hydrogen & Nitrogen Analyzer. The book takes ELan-35 Carbon Hydrogen & Nitrogen Analyzer as an example to illustrate how to operate these machines. The operating instructions of the other products are similar to this one.

1.1 Range of Application

The instrument is widely used to test the carbon, hydrogen, and nitrogen content in coal, coal water slurry, coke and other substances. It can be applied in coal industry, electrical power, metallurgical industry, petrochemical industry, environment protection, scientific research, educational institutions and so forth.

1.2 Property Index

➢ Analytical method: infrared absorption, thermal conduction

➢ Carbon measuring range: 0.02%~100%

➢ Hydrogen measuring range: 0.02%~50%

➢ Nitrogen measuring range: 0.008%~100%

➢ Repeatability: Cad≤0.5%, Had≤0.15%, Nad≤0.08%

➢ Analysis time for single sample: ≤5min.

➢ Combustion furnace temperature: 950℃±5℃.

➢ Reagent furnace temperature: 850℃±5℃.

➢ Reduction furnace temperature: 700℃±5℃

➢ Range of sample weight: 75~105mg, the proposed weight is 100mg.

➢ Maximum power: 4.5kW.

➢ Number of placed samples: 34 samples can be placed consecutively at once.

1.3 Main Features of the Instrument

Superior performance, high automation, and high humanization

➢ Ultra-low drift infrared cell and thermal conductivity cell of international advanced techniques, and optimal gas circuit design and combustion processing are adopted to ensure excellent stability, precision and accuracy.

➢ With precise thermostatic control, the ultra-low drift infrared cell and thermal conductivity cell researched and developed by MRC maximize the thermal stability.

➢ The only infrared analyzer which can change crucibles automatically.

➢ The unique air-blowing sample dropping method, which is quite different from the universally adopted sliding-plate sample dropping method, is adopted to avoid the gas leakage during combustion, and make sure that all gases go into the gas collection chamber so as to effectively improve the detection accuracy of carbon and hydrogen content.

➢ Rapid test speed with analysis time of single sample not exceeding 5min.

➢ 34 samples can be placed at a time; the test process is fully automated and truly unattended.

➢ Split type furnace reagent tube is used for the convenient change of furnace reagents and it effectively improves the service efficiency of the instrument.

➢ Additional samples can be added during the analysis process, and the weighing results can be transmitted automatically with balance on-line function.

Chapter 2 Composition and Working Principle of the Instrument

2.1 Composition of the Instrument

ELan-35 Infrared Carbon Hydrogen & Nitrogen Analyzer consists of main frame, general purpose CAN bus interface, gas supply device, computer (with display apparatus), printer, electronic analytical balance (need to be purchased). The schematic diagram is as Fig. 2-1 shows:
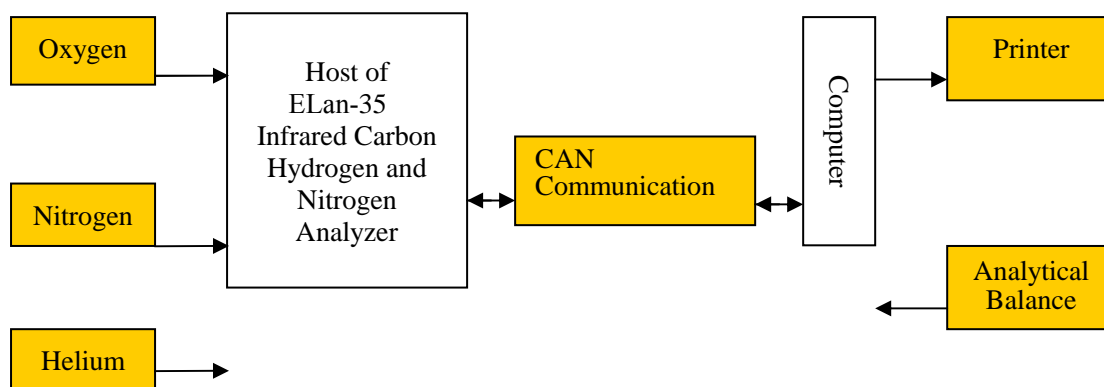
Fig. 2-1

2.1.1 Main Frame Structure

It mainly consists of sample placing tray, combustion furnace, reagent furnace, reduction furnace, gas collection chamber, infrared cell, thermal conductivity cell, drying tube, filter unit, control valve, manipulator and so on.

- ➢ Sample placing tray: where to place samples waiting for measurement.
- ➢ Combustion furnace: make samples combusted completely with sufficient oxygen.
- ➢ Reagent furnace: secondary combustion, and SO_2 removal.
- ➢ Gas collection chamber: collect combustion gases of samples.
- ➢ Infrared cell: detect molecular concentration of CO_2 or H_2O.
- ➢ Thermal conductivity cell: analyze the concentration of N_2.
- ➢ Drying tube: remove moisture and carbon dioxides in N_2 and sample gases.
- ➢ Filter unit: filter out dust generated during the combustion process, and

protect gas collection chamber and infrared cell.

➢ Control valve: control the flow and sequences of gases during the test.

➢ Manipulator: change crucibles automatically.

2.1.2 Gas and Auxiliary Equipments

➢ Combustion supporting gas: oxygen purity $\geq 99.5\%$, total gas source pressure $\geq 1MPa$.

➢ Driving gas: nitrogen or dry compressed air, total gas source pressure $\geq 1Mpa$.

➢ Carrier gas: helium purity $\geq 99.5\%$, total gas source pressure $\geq 1MPa$.

➢ Reducing valve: range of high pressure gauge is 25MPa; and range of low pressure gauge is 0.4MPa; the proposed mode is 152X -40-V (oxygen), 152IN-40-V (nitrogen), and 152X-40-V (helium).

➢ PU tubes.

2.1.3 Printer

Laser printer.

2.1.4 On-line Balance

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

2.2 Working Principle

ELan-35 Infrared Carbon Hydrogen & Nitrogen Analyzer is used to analyze the carbon, hydrogen and nitrogen content in coal or other substances.

A complete sample analysis by ELan-35 consists of three steps: gas circuit cleaning, combustion and analysis. First, the operator will place samples in matching tray in sequence. Then he will input interrelated parameters, and Click on "Start test". Next, the system will analyze the carbon and hydrogen content in the sample automatically under specified procedures. At last, the system will show the results on the main interface window.

In the combustion process, the sample is delivered into the combustion furnace for peroxide combustion. Gases generated shall be conveyed into reagent furnace for

secondary combustion and desulphurization. After multi-stage filtration, the gases will be collected to the gas collection chamber.

During the analysis process, the combustion gases collected in the gas collection bottle will be mixed completely. Then the carbon will be detected by the CO_2 infrared sensor in the form of CO_2; and the hydrogen will be detected by the H_2O infrared sensor in the form of H_2O. Gases in the proportional chamber will first be carried by helium over copper at an elevated temperature for reduction of nitrogen oxides to elemental nitrogen. The carbon dioxide, water vapor will be eliminated by soda asbestos and magnesium perchlorate. Then the gas will be introduced to the thermal conductivity cell to detect the nitrogen content.

The final analysis results shall be shown on the main interface window in the form of percentage.

O_2 → Filter → Automatic flow control → Flow meter → Automatic sample blowing/Automatic sample dropping (N_2) → Combustion furnace → Reagent furnace → Filter → Gas collection chamber → (N_2, Exhaust emission)

H sensor, Signal output, C sensor ← Gas collection chamber

Combustion furnace → Automatic crucible changing

Proportional valve (Exhaust emission, He) → Reduction furnace → Filter → Thermal conductivity cell → Signal output / Exhaust emission
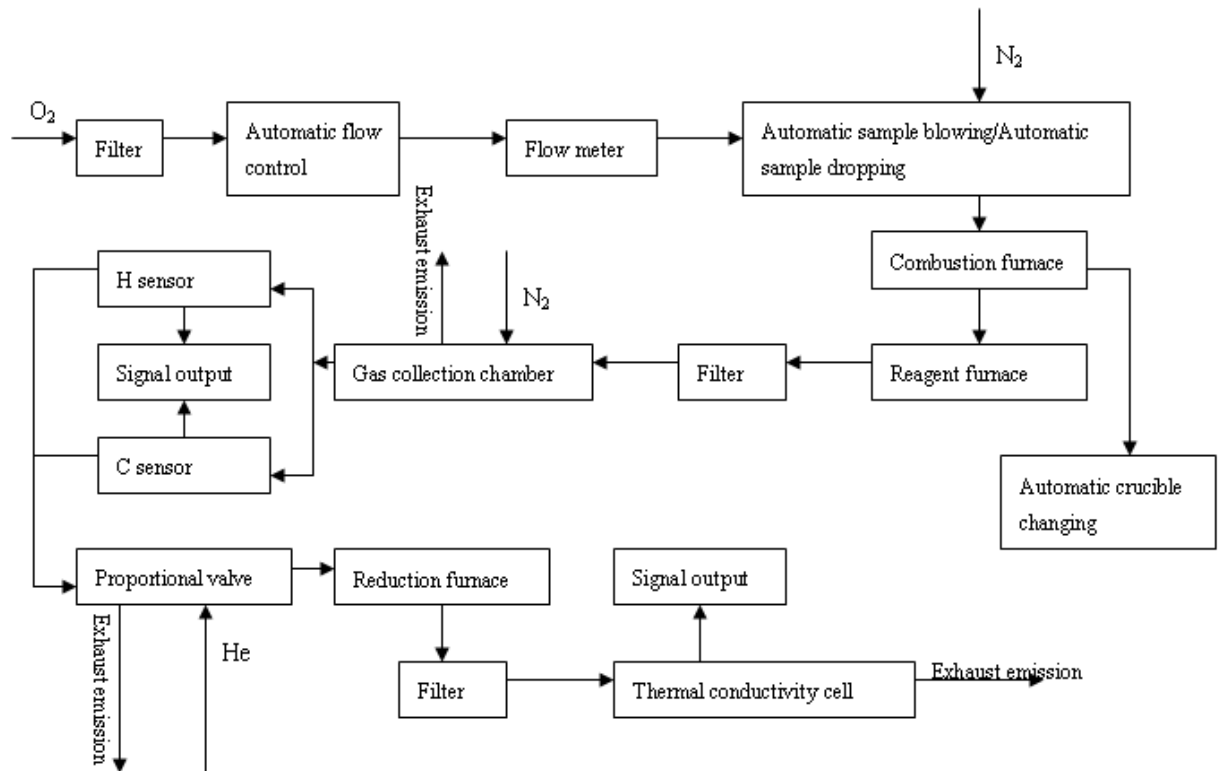
Fig. 2-1 ELan-35 Working Principle

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Chapter 3 Installation and Debugging of the Instrument

3.1 Environmental Requirements

3.1.1 Working Conditions

➢ Ambient temperature: 15~28℃.

➢ 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.

➢ The lab should be installed with air-conditioning. The instrument can not be placed near the window or heat source.

3.1.2 Requirement of Power Source

➢ Power source: 220VAC±10%, 50Hz±1Hz.

➢ Be equipped with reliable ground wire.

3.1.3 Requirement of Gases

➢ Combustion supporting gas: oxygen purity ≥ 99.5%, pressure (0.18±0.01) MPa, and the total pressure of gas source ≥ 1MPa. The electrolytic oxygen is forbidden and oxygen with purity of 99.99% is recommended.

➢ Driving gas: nitrogen or dry compressed air, pressurof (0.18±0.01) MPa, and the total pressure of gas source ≥ 1MPa.

➢ Carrier gas: nitrogen purity ≥ 99.5%, pressure (0.18±0.01) MPa, and the total pressure of gas source ≥ 1MPa. Nitrogen with purity of 99.999% is recommended.

3.1.4 Reagents

➢ Silica wool

➢ Furnace reagents

➢ Copper wire

➢ Grained copper

➢ Soda asbestos

- ➢ Magnesium perchlorate

- ➢ Nitrogen catalyst

3.1.5 Software Environment

- ➢ Operating system: Windows XP, Windows 7, or Windows 7above

- ➢ Basic configuration:

  - ● CPU：above 3.00GHz;

  - ● Internal memory: above1G;

  - ● Hard disk: 80G or above;

  - ● Driver: DVD-ROM or CD-ROM;

3.2 Installation of the Instrument

3.2.1 Preparations before Installation

- ➢ Appropriate lab in accordance with 3.1.

- ➢ Tinfoil cups, standard samples, and related equipments.

- ➢ Reagents, combustion supporting gas (oxygen), driving gas, and carrier gas (nitrogen).

3.2.2 Installation Precautions

- ● Unpack the instrument carefully, and place it at proper place for convenient operation; meanwhile, make sure that the back side, front side and left side of the instrument is 0.4 meters from the wall at least。

- ● After unpacking, the user should count the instrument, accessories and consumables. Please properly keep relative booklets of the balance, computer, display apparatus, and printer, and the packaging cases and packaging protective material as well.

- ● Carefully check if all wearing parts are in good condition.

- ● No online test can be carried out if the instrument is not authorized

3.2.3 Installation of Instrument Parts

1. Take off the instrument enclosure, and take the sponge and other filling material out of the instrument.

2. Installation of silica tube:

a. Take three silica tubes(see Fig. 3-1, Fig. 3-1, and 3-3), clean them with alcohol and then make them dry;

b. Install the silica tube in the combustion furnace: firstly, move the manipulator to the crucible change position, so you can dismount the sealing socket located at the bottom of the furnace. Secondly, mount two mode 3550400 O rings on the outer wall at the lower end of the silica tube (refer to Fig. 3-2 for the mounting position of O rings), and then insert the silica tube slowly into the furnace. Lastly, fasten the sealing socket at the bottom of the furnace, and mount two 26501800 type seal rings on the outer wall of silica tube, which is at the top of the combustion furnace.

c. Install the silica tube in the reagent furnace: firstly, move the reagents furnace out of the instrument cabinet, so you can dismount the sealing socket at the top of the furnace. Secondly, slowly insert the silica tube filled with reagents into the furnace from the top (refer to 3.2.3.3 for hoe to place the reagent furnace). At last, fasten the sealing socket and screws when the tube reaches the bottom.

d. Install the silica tube in the reduction furnace: firstly, move the reduction furnace out of the instrument cabinet, so you can dismount the sealing socket at the top of the furnace. Secondly, slowly insert the silica tube filled with reagents into the furnace from the top (refer to 3.2.3.3 for hoe to place the reduction furnace). At last, fasten the sealing socket and screws when the tube reaches the bottom.

3. Placement and dosage of the reagent, and installation of the silica tube in the combustion furnace and installation of the manipulator (see Fig.3-1):
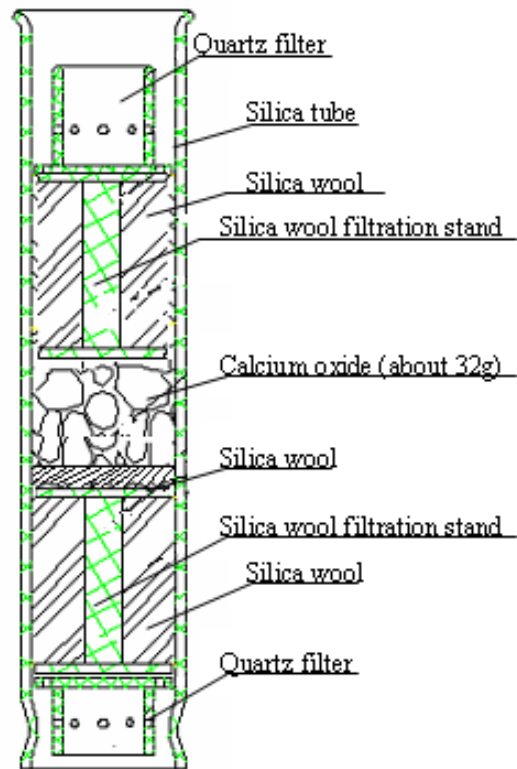
Fig. 3-1 Placement of Silica Tube and Reagents of Reagent Furnace
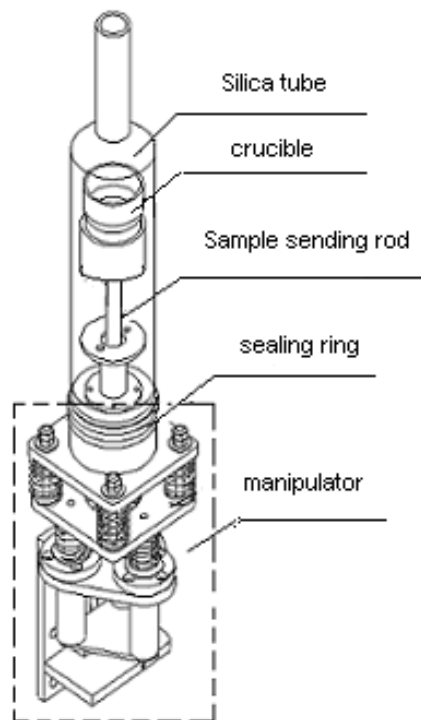

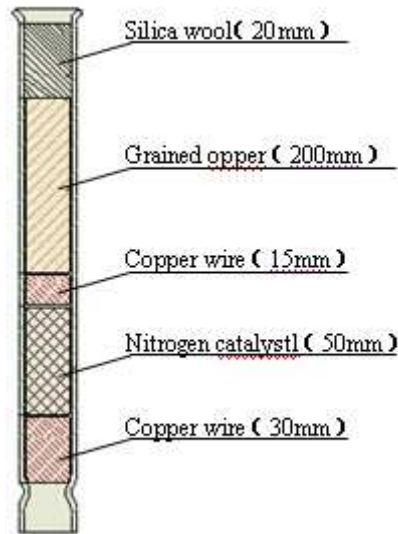Fig. 3-2 Silica Tube of Combustion Furnace and Related Components

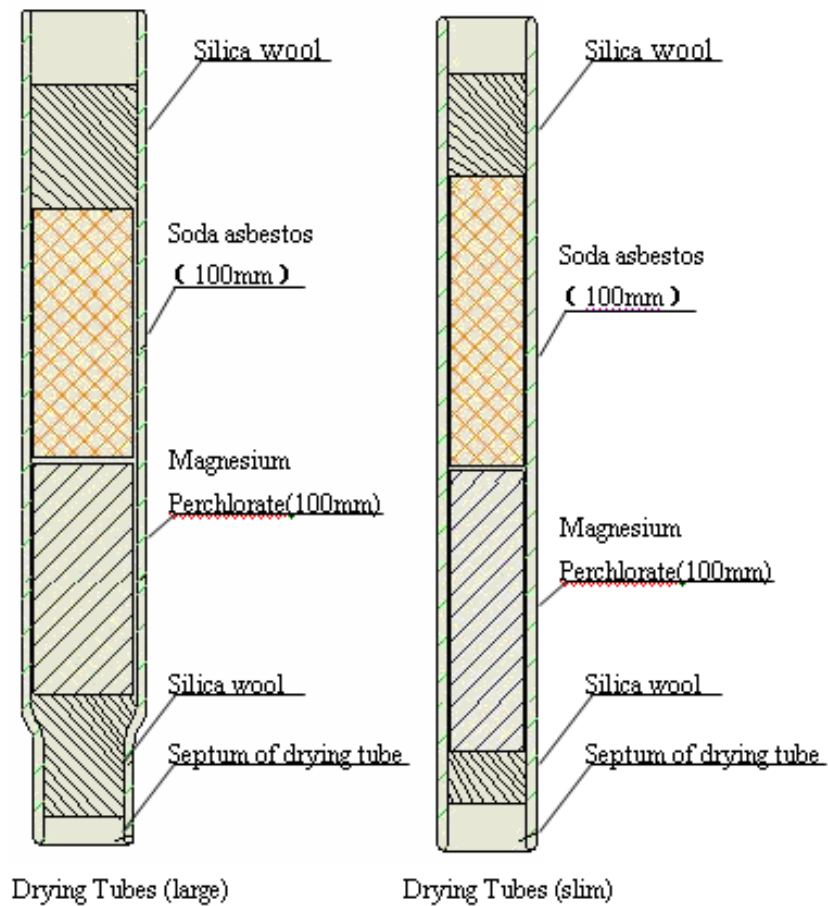Fig. 3-3 Placement of Silica Tube and Reagents of Reduction Furnace

Fig. 3-4 Placement of Reagent of Drying Tubes

4. Installation of thermocouple:

a. Take three thermocouples (K) and insert them respectively into the thermometer holes of the combustion furnace, reagent furnace, and reduction furnace, until the front end of the thermocouple reaching the silica tubes in furnaces.

b. Connect the red wire of the compensating lead with the "+" (positive) pole of the thermocouple, and the blue one with the "-" (negative) pole of the thermocouple.

c. Fix the position of the thermocouple, and properly connect the connecting wire (compensating lead). Make sure the thermocouples will not be scorched in case of touching the heating furnace.

Note:

✧ **When installing thermocouples, pay attention to the number of the thermocouples. "R" is specialized for combustion furnace, "S" is for reagent furnace, and "H" is for reduction furnace.**

5. Installation of crucible support:

   a. Take the sample sending rod and crucibles out of the case;

   b. Fix the whole sample sending rod onto the manipulator with screws, and then place crucibles on the crucible support;

   c. Adjust the position of the manipulator (refer to 3.3 Instrument Debugging for more details). Make sure the manipulator will not touch and damage crucibles during its moving.

6. Installation of sample placing tray

   Put the sample placing tray on the round hole at the top of the instrument in prescribed direction.

7. Wiring of USBCAN interface card

   Connect the USB interface of the card to the USB interface of computer mainframe, and CAN interface to the CAN1 (or CAN2) on the back plate of ELan-35, and fasten them with screws.

8. Combustion gas, driving gas, and carrier gas connection

   The end of the high pressure gauge of the reducing valve is fixed to the oxygen

cylinder or nitrogen cylinder, and the end of the low pressure gauge shall be connected to the related connector of the back cover plate of the instrument by the gas transmission duct.

9. Check if there is a drape of the air tube, or if the air tube is close to the surface of the high temperature furnace. If yes, adjust it at once.

10. According to the prompts on the back plate of the instrument, connect the control power wire and heating power wire

3.2.4 Software Installation, Un-installation and Authorization

3.2.4.1 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 on "Next", and install "Message Queue" according to the prompts).

2. Put the CD that is marked with "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer Software" into the CD-ROM drive. Start the CD drive and find "MRC.exe" in the root directory.

3. Double click on "MRC.exe" icon and follow the prompts to install "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer" program and "USBCAN service program". After the installation, the system will automatically create a shortcut icon called "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer" on the desktop.

4. Right click on "My Computer" → "Properties" → "Hardware" → "Device Manager → "+" under "MRC". Then you can see identification name as "MRC USBCAN", which means the USBCAN card driver has been normally installed; otherwise, click on "Scan" and re-install USBCAN card driver according to prompts.

3.2.4.2 Software un-installation

Click on the "Start" in the task bar→ "Control Panel"→ double click on "Add/Remove Programs" → Select "Change or Remove Programs", click on "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer" in the program group

→ Click on "Delete" button to perform the un-installation. ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer software and shortcut icon can be safely and efficiently removed following onscreen prompts. But the related parameter files, data base files of ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer software will not be uninstalled. In stead, they still remain in the operating system.

3.2.4.3 Authorization

After having installed hardware and software, double Click on ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer icon. Then press "F6" (or Click on "Start" at the task bar – "All Programs" – "MRC" – "USBCAN" – "MRC USBCAN Service Program") to open the service program window, and select the instrument ID number. Click on "Tool" at the menu bar – "Authorization", and send the content in the Card Verification Code textbox and the Local Verification Code textbox to MRC to ask for its authorization. Finally, input or copy the authorization code provided by MRC into the Authorization Code textbox, and Click on "Add". If a period of validity is suggested by the software, the authorization is completed successfully. Otherwise, the program can not work normally.

3.3 Instrument Debugging

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 debugging, the contents and precautions of the debugging are as follows:

3.3.1 Hole Position Adjustment of Manipulator at Combustion Furnace

First Click on "Descending" in "Manual Detection", to move the manipulator in combustion low order, and then insert the sample sending rod into the rod pedestal and fasten it with screws (screws cannot be over tightened; they should just touch the milling plane of the sample sending rod). Observe whether the rod, the rod pedestal, and the combustion furnace hole are aligned. If the rod pedestal and hole are not aligned, adjust the locator cards of the combustion position and align them as much as possible; if the road and the furnace hole are not aligned, adjust four screws on the pedestal of the sample sending rod, align the crucible with the furnace hole, and then

slowly rise the manipulator into the combustion furnace in the way of inching (The crucible should not scratch other parts or components during the up and down of samples sending).

3.3.2 Hole Position Adjustment of Manipulator at Crucible Change Position

After the hole position of manipulator at the combustion furnace has been adjusted, Click on "Descending" to move the manipulator to the low order. And then Click on "Forward moving" to move the manipulator to the crucible change position. Open the crucible change door and check whether the sample sending rod, rod pedestal, crucible, and crucible change hole are aligned. If the crucible and the crucible change hole are not aligned, adjust the locator card of the crucible change position and make them locate in a straight line as much as possible (The crucible should not scratch other parts or components during the up and down of crucible change).

3.3.3 Adjustment of the Top, Middle and Bottom Fixed Positions of Manipulator

Top fixed position: to fix the top position when changing crucibles. Adjust the top and bottom positions of the manipulator, and make the crucible stay at the crucible change hole. Then adjust continually until it is convenient to fetch crucibles with small crucible tongs. For ELan-35 Infrared Carbon & Hydrogen Analyzer and ELan-35 Infrared Hydrogen Analyzer, there is no need to adjust the top fixed position.

Middle fixed position: adjust the position to keep the sealing socket in sealing status, that is, compress the up/down buffer spring 10mm.

Bottom fixed position: adjust the locator card, and make sure the manipulator does not scratch other parts or components during its forward and backward moving.

3.3.4 Pressure Adjustment of Combustion Supporting Gas, Driving Gas and Carrier Gas

The total gas source pressure of combustion supporting gas (oxygen), of driving gas, and of carrier gas (nitrogen) are not less than 1MPa. When gas flow rate is not less than 1L/min, adjust the low pressure gauges of combustion supporting gas (oxygen), of driving gas, and of carrier gas (nitrogen) to 0.18MPa.

3.3.5 Hole Position Adjustment of Sample Placing Tray

After the sample placing tray has been installed, click on "SV11" valve and "SV12" valve in "Manual Detection". Check whether the sample hole and sample dropping hole of the sample placing tray are aligned. If not, adjust the reset block on the sample dropping slider to control the rotation distance of the tray; if the moving sound of the sample dropping slider is too loud or if the pushing is not steady, adjust the flows of "SV12" valve and of "SV13" valve to make the moving steady.

3.3.6 Adjustment of Flow and Precision Pressure-limiting Valve

1. Adjustment of precision pressure-limiting valve in gas circuit of oxygen: open SV9→SV16→SV17→SV18→SV7→SV6→SV10→SV13→SV4 successively on the single unit control in the window of "Manual Detection". Adjust the pressure of pressure-limiting valve to 0.04MPa, and the flow above 7L.

2. Adjustment of precision pressure-limiting valve in driving gas circuit: open SV7→SV6→SV10→SV13→SV4 successively on the single unit control in the window of "Manual Detection", raise the piston of oxygen cylinder to the top fixed position, and then close SV4 valve; open SV18 and preset the pressure of precision pressure-limiting valve to 0.05MPa. Connect an oxygen flow meter to "Exhaust 1" at the I/O pad, open SV9→SV16→SV18, and adjust the pressure of the precision pressure-limiting valve to 0.04MPa. Finally, adjust SV18, and set the oxygen flow meter to 1.5L/min.

3. Flow adjustment of SV3 valve: open SV9→SV16→SV17→SV18→SV7→SV6 →SV10→SV13→SV3 successively on the single unit control in the window of "Manual Detection", adjust SV3 valve and set the flow of the flow meter to 5L.

4. Flow adjustment of SV2 valve: open SV9→SV16→SV17→SV18→SV7→SV6 →SV10→SV13→SV2 successively on the single unit control in the window of "Manual Detection", adjust SV2 valve and set the flow of the flow meter to 1.0L.

5. Flow adjustment of SV1 valve: open SV9→SV16→SV17→SV18→SV7→SV6 →SV10→SV13→SV1 successively on the single unit control in the window of "Manual Detection", adjust SV1 valve and set the flow of the flow meter to 0.5L.

6. Adjustment of precision pressure-limiting valve in carrier gas (helium) circuit:

open SV35→SV34→SV36 successively on the single unit control in the window of "Manual Detection". Adjust the pressure of the precision pressure-limiting valve to 0.04MPa.

7. Flow adjustment of carrier gas (helium): open helium bottle, and connect an oxygen flow meter of 300mL/min (or 100mL/min) to "Exhaust 4" at the I/O pad. Adjust the precision pressure-limiting valves of reference arm and measuring arm, and set flow rate of helium flow meter to be 0L/min. Then slowly adjust the precision pressure-limiting valve of the reference arm, and set flow rate of helium flow meter to be 50mL/min. Finally, connect an oxygen flow meter of 1.0L/min to "Exhaust 4" at the I/O pad, adjust the precision pressure-limiting valves of measuring arm, and set flow rate of helium flow meter to be 700mL/min.

Note:
 ✧ **Flow of carrier gas has been adjusted in factory. No need to adjust again.**

3.3.7 Parameter Tuning

Click on "Detection" at the menu bar of the main interface → "Parameter tuning". Then operate under prompts of the program.

Note:
 ✧ **For the parameters missing results from the first use of the instrument or software upgrades, the precision and accuracy tests can be conducted only after the parameter tuning is finished.**
 ✧ **The parameter tuning can be carried out only after the temperature of the instrument have been constant and stable for 2h.**
 ✧ **The pressure of the low pressure gauge of reducing valve on oxygen cylinder and the gas flow of the instrument must be stable and cannot be adjusted randomly during the parameter tuning and subsequent tests.**
 ✧ **After the pressure of the low pressure gauge of reducing valve on oxygen cylinder and the gas flow of the instrument has been adjusted, it is proposed to restart the parameter tuning.**
 ✧ **A new parameter tuning must be made after the adjustment of gas collection bottle.**

3.3.8 Check and Calibrate the Precision and Accuracy of the Instrument

1. Please refer to Chapter Six for detailed test procedures.

2. The precision and reproducibility shall be in line with the requirements listed below:

(Unit: %)

Item	Repeatability	Item	Reproducibility
Cad	0.50	Cd	1.00
Had	0.15	Hd	0.25
Nad	0.08	Nd	0.15

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: Click on "Start" at the task bar → "Program" → select "MRC" → click on "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer", to enter into the main interface shown as Fig. 4-1.

Method 2: directly double Click on "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer" shortcut icon on desktop, to start the software (Fig. 4-1).

4.1.2 Exit of the Measurement & Control Software

Click on "X" on top right corner of the main interface or click on "Set" on main menu bar →"Exit" →"Yes" to exit the software and back to desktop.

4.2 Functions of the Main Forms

The main forms of ELan-35 measurement & control software consists of title bar, menu bar, shortcut button, status bar, data sheet etc. And all columns in the data sheet can be dragged and placed at will for convenient viewing (Fig. 4-1):
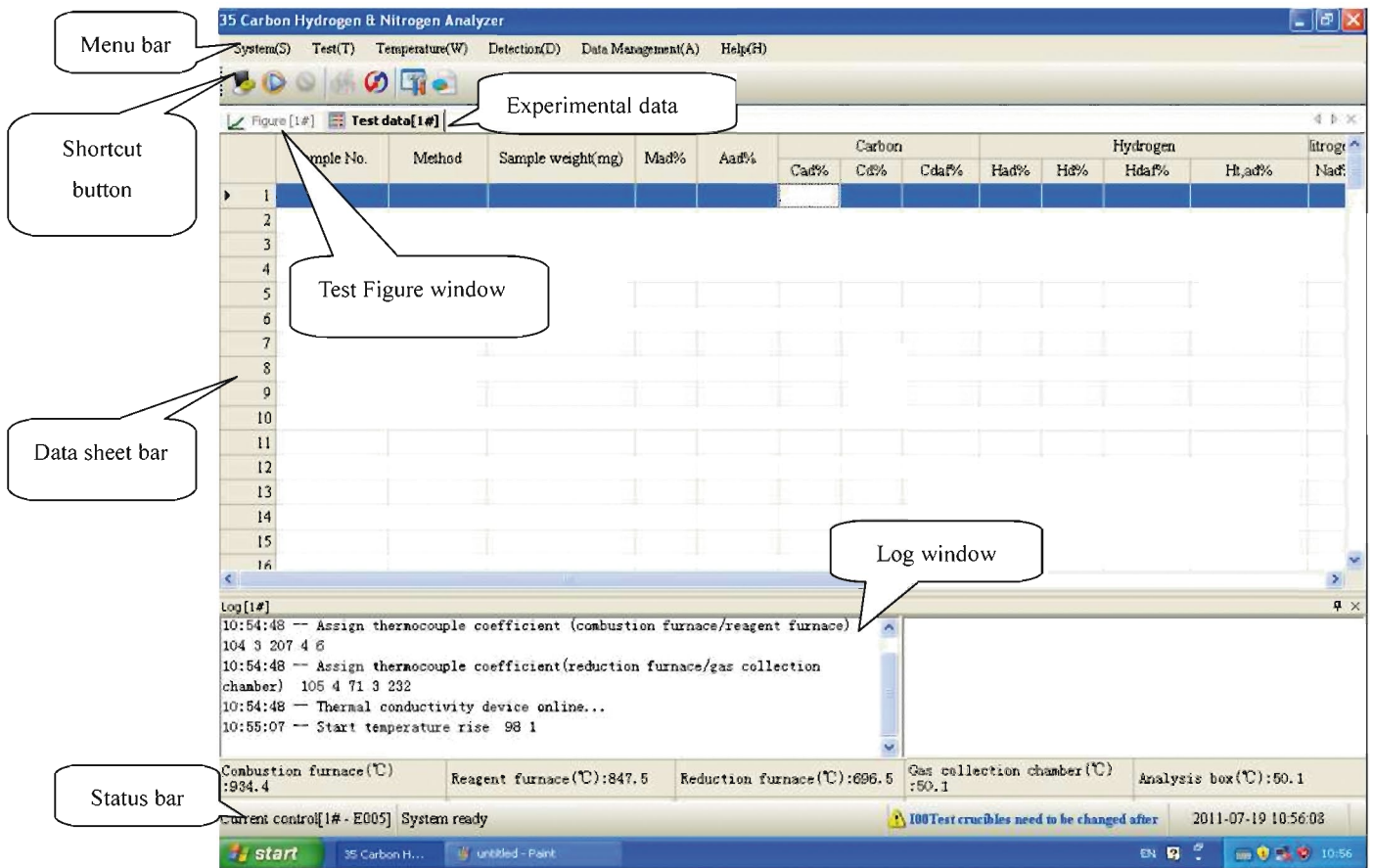
Fig. 4-1

Among them, there are functions of column width adjusting, column hiding and displaying, and column freely dragging and placing on the data sheet. When you move the cursor to data bar, click on the right mouse button, then Fig. 4-2-1 menu will popup. The details of all functions will be introduced below.
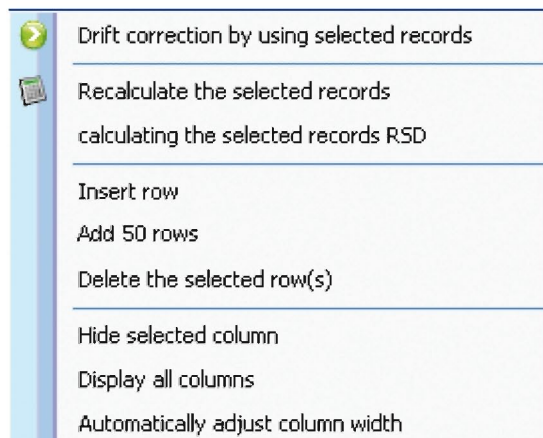

Fig. 4-2

- Conduct drift correction by using the selected record: select a record on the data bar of the program main interface to create drift coefficient for conducting drift correction to the instrument.

  Note: The drift correction coefficient will directly influence the instrument precision, so the selection of record will be of vital importance. It's suggested to select drift record according to the following principles:

  - **Drift record must be standard samples or substances and all of them can be checked in standard substance storage.**

  - **More than 2 records of the same standard samples or substances must be selected as drift records, and their sample number must be the same with that of the standard substance storage.**

  - **Accuracy of the drift record must satisfy the requirement of the national standard.**

- Recalculating the selected records: when modifying correction curve, drift coefficient, Mad %, sample weight, the selected records will be recalculated and the latest results shall be updated and stored into data base by the software automatically.

- Calculate the relative standard deviation (RSD) of selected records: to calculate the relative standard deviation index of the selected records.

- Insert rows: to insert blank rows before the selected record for users to adjust test sequence conveniently.

- Add 50 rows: to add new 50 blank rows automatically at the end of data sheet of the main interface.

- Delete the selected rows: to delete the selected record row

- Hide selected column: to hide the selected column

- Display all columns: to display all the most original data sheet columns.

- Automatically adjust column width: all data columns' width will be adjusted to be suitable.

4.3 Functions of Each Menu

4.3.1 System setting
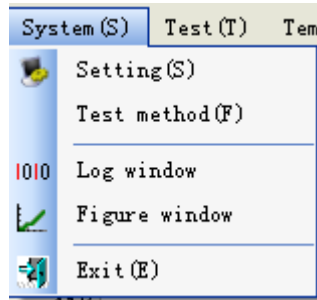
As shown in Fig. 4-3-1:

Fig. 4-3-1

4.3.1.1 Settings

Select this item or Click on "System Setting" icon in shortcut icon bar, the setting window as Fig. 4-3-2 will popup.
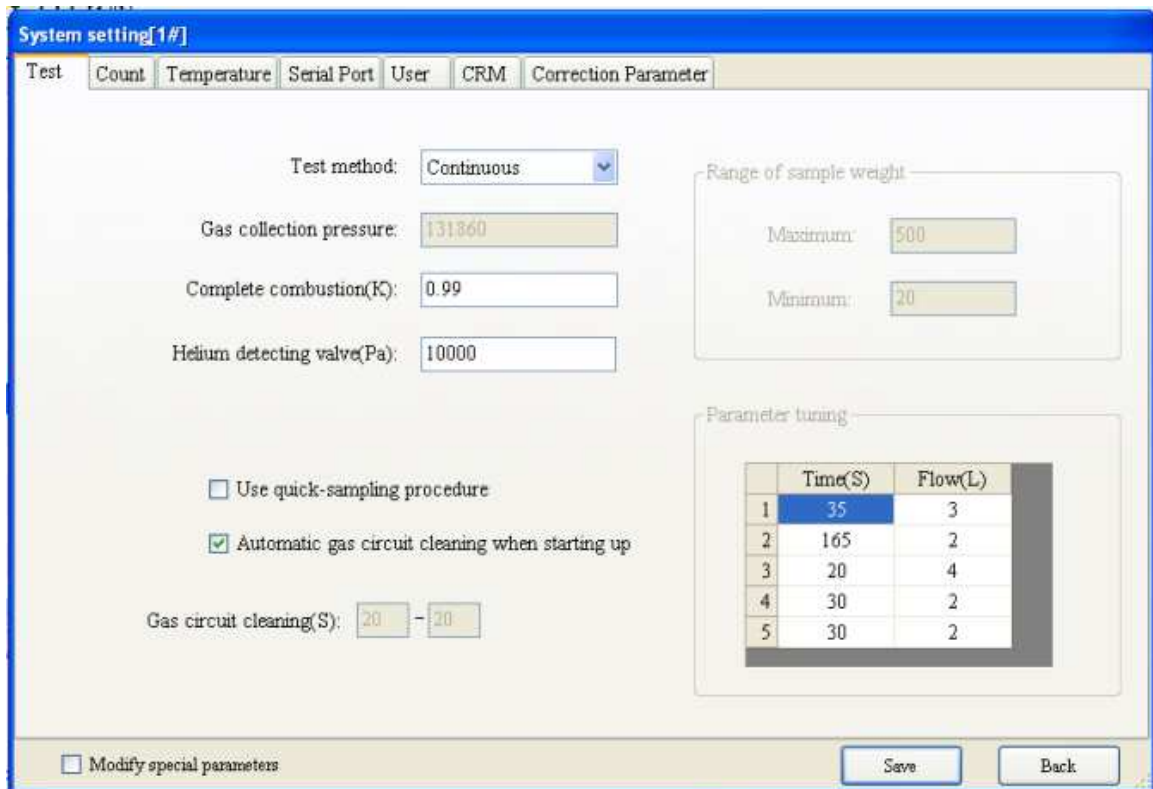

Fig. 4-3-2

➢ Save: save modified parameters.

➢ Back: exit the current window and back to main interface window of the program.

➢ Modify special parameters: After selecting it and inputting passwords, the advanced parameters in the window can be edited and modified.

➢ Test method: consist of successive and single test method. The default method is successive method.

Successive test: Click on "Start test" to start automatic analyzing of multi-samples based on the entry sequence.

Single test: Click on "start test" to start automatic analyzing of one sample.

➢ Helium detecting valve value (Pa): set the valve value of judging whether there is Helium flow when detecting the Helium gas tightness.

➢ Gas collection pressure: set maximum pressure controlled by gas collection bottle during the test. The default pressure is 131860.

➢ Complete combustion (K): set coefficient of judging whether the samples fully combusts or not.

➢ Gas circuit cleaning: separately set the cleaning time for gas collection circuit and analysis gas circuit.

➢ Automatic gas circuit cleaning when starting up: select it, after the system rises to the constant temperature, the 5min gas circuit cleaning of the system will be implemented automatically.

➢ Gas circuit cleaning: separately set the cleaning time for gas collection circuit and analysis gas circuit.

➢ Range of sample weight: set the valid range of the sample mass.

➢ Parameter tuning: set oxygen flow rate and time for parameter tuning.

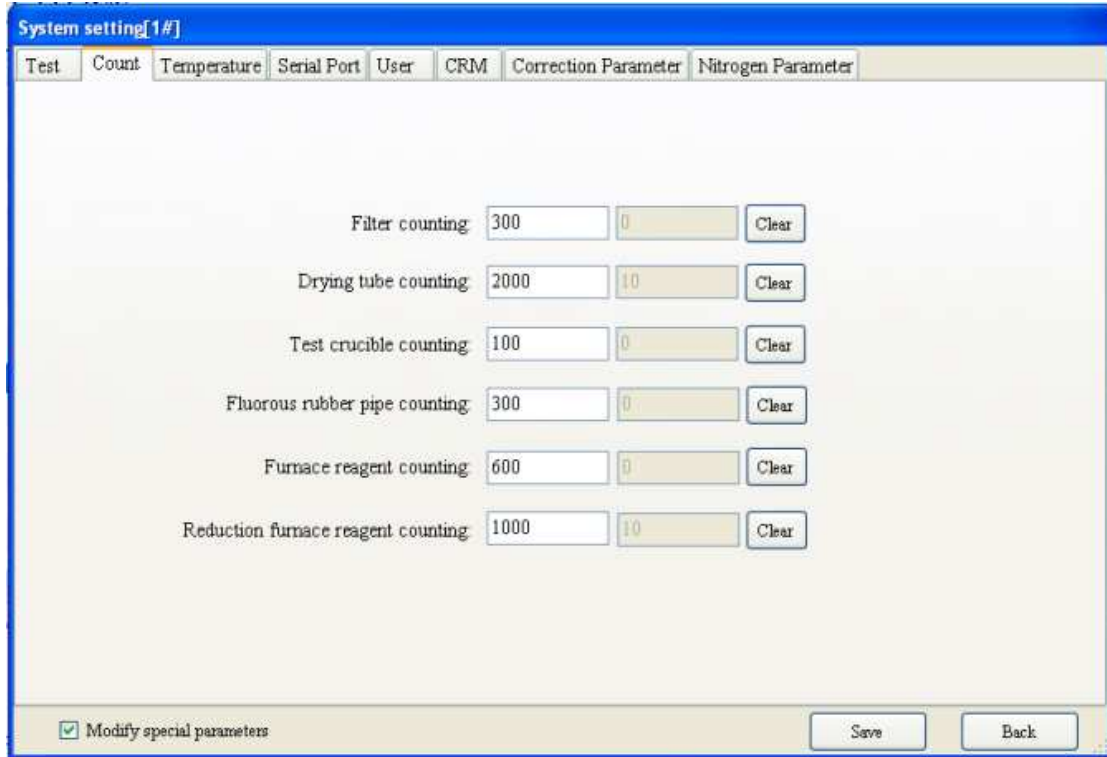1. Count: Click on "Count" tab in "System Setting" window, the window as Fig 4-3-3 will popup.

Fig4-3-3

➢ Filter counting: In the first text box, you can set the maximum counting valid number of sample. In the second text box, the number of samples done will be recorded. Click on "Clear" on the right, then the counting will be reset and restart to count. Its default value is 300.

➢ Drying tube counting: In the first text box, you can set the maximum counting valid number of sample. In the second text box, the number of samples done will be recorded. Click on "Clear" on the right, then the counting will be reset and restart to count. Its default value is 2000.

➢ Test crucible counting: In the first text box, you can set the maximum counting valid number of sample. In the second text box, the number of samples done will be recorded. Click on "Clear" on the right, then the counting will be reset and restart to count. Its default value is 100.

➢ Viton tube counting: In the first text box, you can set the maximum counting valid number of sample. In the second text box, the number of samples done will be recorded. Click on "Clear" on the right, then the counting will be reset

and restart to count. Its default value is 300.

➢ Furnace reagent counting: In the first text box, you can set the maximum counting valid number of sample. In the second text box, the number of samples done will be recorded. Click on "Clear" on the right, then the counting will be reset and restart to count. Its default value is 600.

➢ Reagent of reagent counting: In the first text box, you can set the valid maximum number of samples. In the second text box, the number of samples analyzed will be recorded. Click on "Clear" on the right, then the counting will be reset and restart to count. The default value is 1000.

Note:

♦ **After replacing or cleaning, the counting of the above items should be reset manually. Or when replacement and cleaning are prompted by the software, replacement and cleaning should be done timely to avoid influence to the test results.**

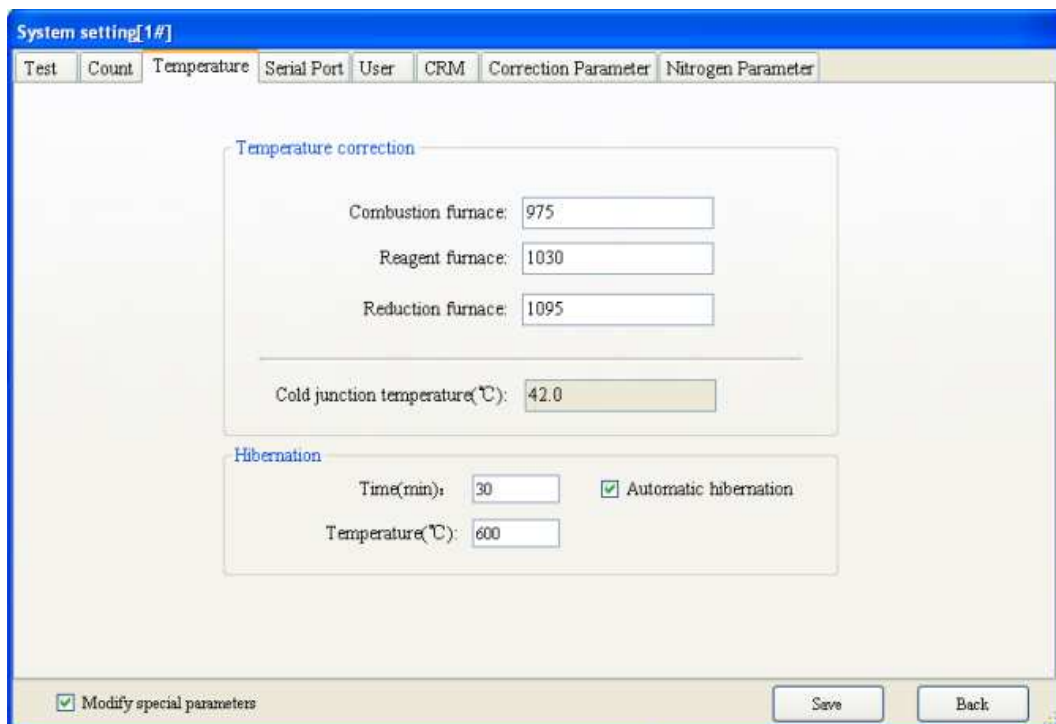2. Temperature: Click on "Temperature" tab in "Test setup" window, window as Fig 4-3-4 will popup.

Fig. 4-3-4

➢ Temperature correction tab bar：

◆ Combustion furnace: set thermocouple coefficient of combustion furnace

◆ Reagent furnace: set thermocouple coefficient of reagent furnace

◆ Reduction Furnace：set thermocouple coefficient of reduction Furnace

Note:

✧ **It's not permitted to modify parameter value of the combustion, reagent and reduction furnace if the thermocouple is not changed. Otherwise the instrument may be damaged.**

➢ Hibernation tab bar: if samples to be analyzed by the instrument are few and the waiting time is long, it's suggested to apply this function for prolonging instrument using life.

◆ Time: set hibernation time

◆ Temperature: set hibernation temperature

◆ Automatic hibernation: after selecting it, the instrument will enter into hibernation state according to the set time.

3. Serial port setting: Click on option tab "Serial Port Setting" of "test setting window", the window as Fig. 4-3-5 will popup.
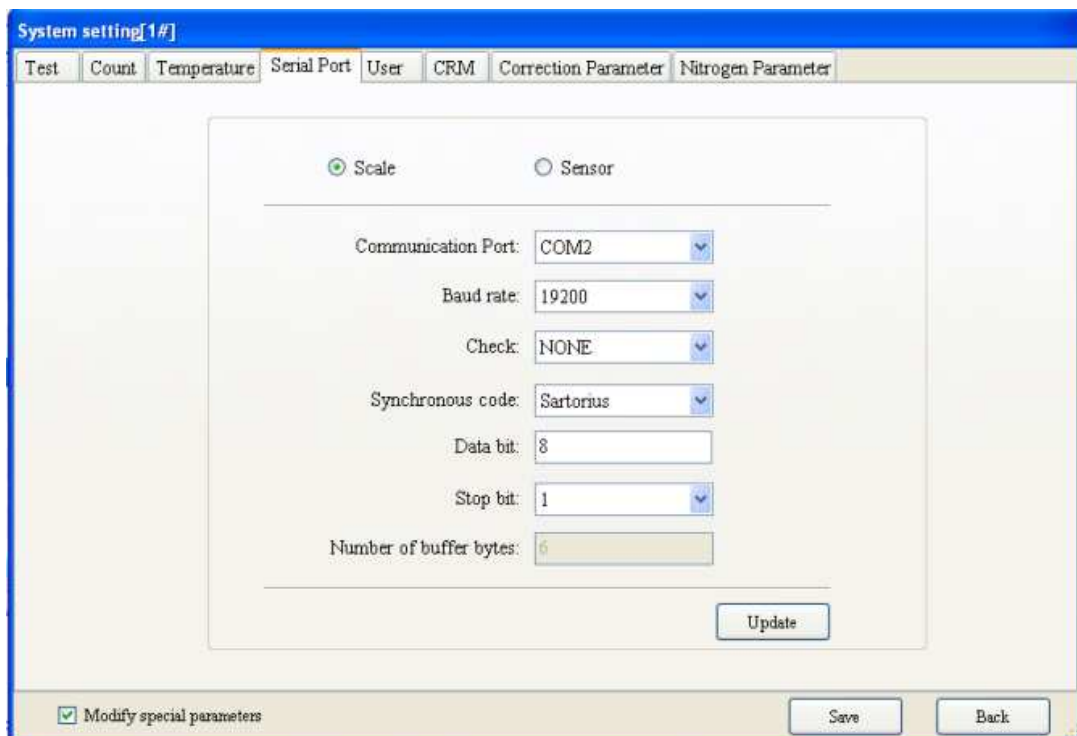

Fig 4-3-5

- ➢ Balance tab: set communication parameter of the balance:
  - ◆ Communication mouth: 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.
  - ◆ 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.
  - ◆ Data bit: 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.
  - ◆ Update serial port parameters: after modifying the above parameters, it's necessary to click on this icon and the parameters can be saved and take effect, otherwise it can't be saved and take effect.
- ➢ Sensor tab: set communication parameter of the sensor.

4. User: Click on "User Information" at "System Setting" window, window shown as Fig. 4-3-6 will popup.
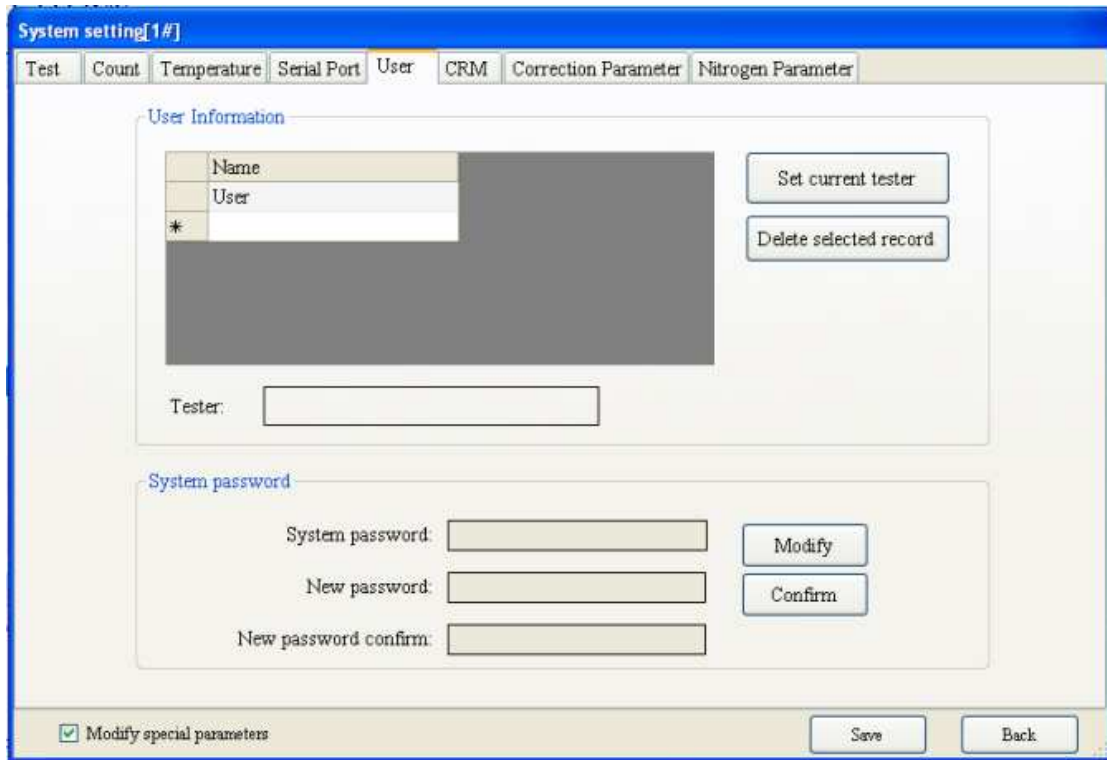
Fig. 4-3-6

➤ User information tab bar：

◆ 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 on this icon, the program will automatically display the selected record on the tester's label.

◆ Delete selected records: Click on 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 of the program main interface.

➤ System password tab bar:

◆ Original password: input original password

◆ New password: input new password.

◆ New password confirm: confirm new password.

◆ Modify: click on the button, the above input field will be cleared and you

can set new password.

◆ Yes: click on the button to save new password.

5. Standard substance: Click on "Standard Substance" option tab of "Setting window", the window shown as Fig. 4-3-7 will popup.
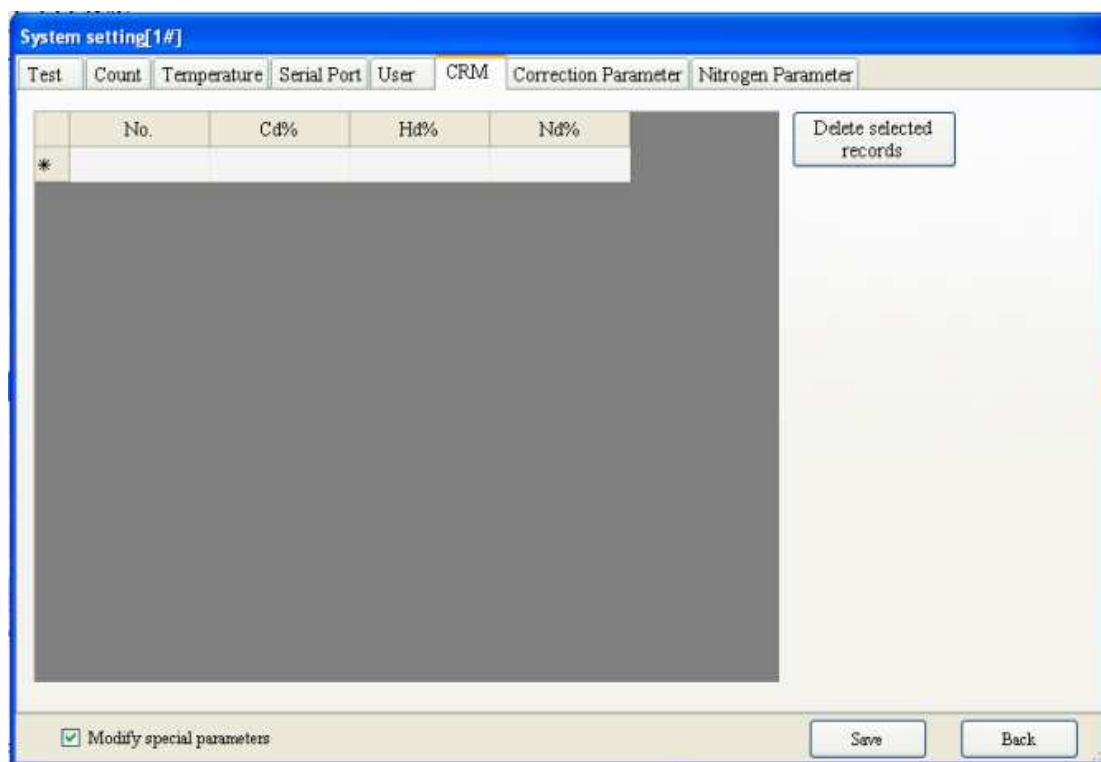

Fig. 4-3-7

➤ Delete selected records: Click on this icon, the selected record row in table on the left will be deleted automatically.

➤ Add standard sample: directly input related parameter in the table, and the program will automatically add blank record row.

◆ Number: input number of standard sample into text box on the right.

◆ Cd (%): input carbon standard value of the standard sample into text box on the right

◆ Hd%: input hydrogen standard value of the standard sample into text box on the right.

◆ **Nd%:** input nitrogen standard value of the standard sample into text box

on the right.

4.3.1.2 Test method

Selecting this menu or click on "Test Method" icon in the shortcut icon bar, the window shown in Fig. 4-3-8 will popup.
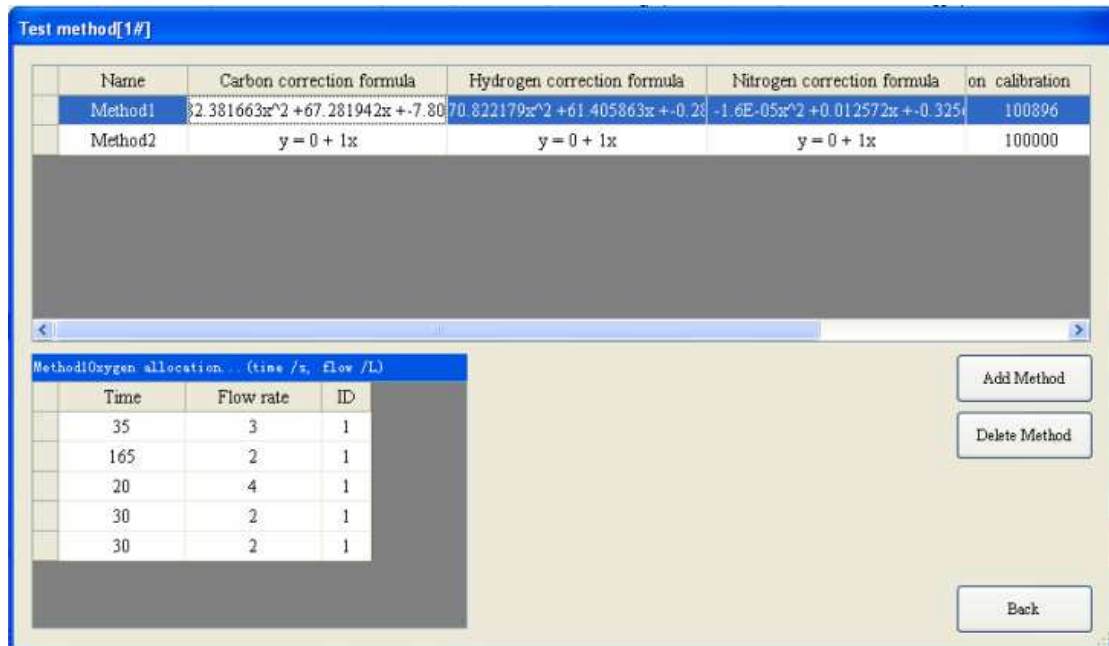

Fig 4-3-8

➢ Add test method: click on this icon, the program will automatically add blank record row, and user can edit this blank record row.

➢ Delete test method: Click on this icon, delete the selected record.

➢ Oxygen allocation: set corresponding combustion flux and time of the relevant method.

4.3.1.3 Log window

Opening command window, see Fig 4-1.

4.3.1.4 Figure window

Opening figure window, see Fig 4-1.

4.3.1.5 Diagnosis login

Click on this item, window as shown in Fig 4-3-9 will popup.

Fig. 4-3-9

> Input the password "debug", click on "Login", and then the functions of "diagnosis" and "figure" will be added to the "detection" menu bar. For details, please refer to 4.3.4

4.3.1.6 Exit

Click on this item or "X" at the top right corner of the program's interface, window as shown in Fig 4-3-10 will popup.
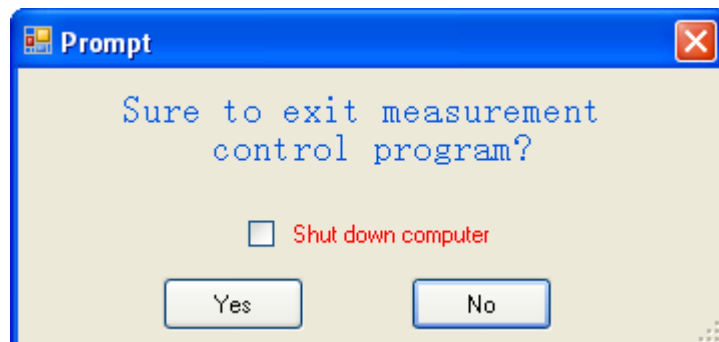

Fig. 4-3-10

> Shut down Computer: after selecting it, ELan-35 infrared carbon hydrogen and nitrogen analyzer program will exit firstly. Then the computer will be shut down automatically.

> Yes: to exit ELan-35 infrared carbon hydrogen and nitrogen analyzer program and back to Windows desktop.

> No: not to exit ELan-35 infrared carbon hydrogen and nitrogen analyzer program.

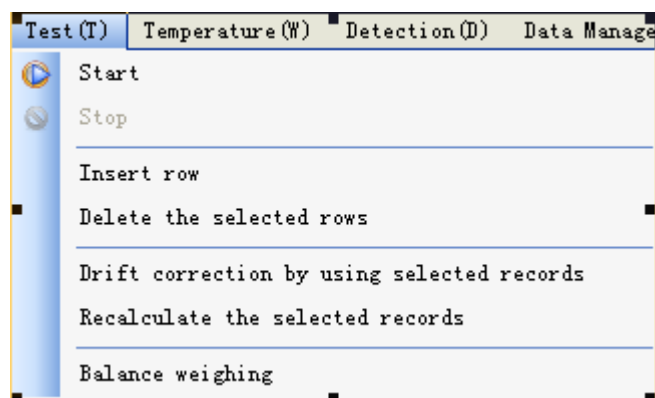**4.3.2 Test Menu**

As shown in Fig. 4-4-1:

Fig. 4-4-1

4.3.2.1 Start

Click on this menu or shortcut icon on the shortcut icon bar, the system will automatically enter test state.

4.3.2.2 Stop

Click on this menu or shortcut icon on the shortcut icon bar, the system will stop the next test, but the current test will be continued to completion.

4.3.2.3 Insert row

Insert blank rows before the selected record for users to adjust the test sequence conveniently.

4.3.2.4 Delete the selected rows

Delete the selected record line.

4.3.2.5 Conduct drift correction with a selected record

Select a record at the data bar of the program main interface, and create drift coefficient to conduct drift correction for the instrument. The sample number of the selected record should exist in the standard substance database

4.3.2.6 Recalculate the selected records

When modifying correction curve, drift coefficient, Mad %, sample weight, the selected records will be recalculated and the latest results shall be updated and stored into data base by the software automatically

4.3.2.7 Balance weighing

Click on this item, the program realizes online weighing; otherwise, online weighing would not be realized.

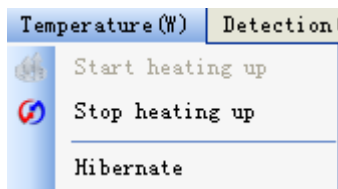**4.3.3 Temperature Menu**

As shown in Fig. 4-5-1:

Fig. 4-5-1

4.3.3.1 Start heating up

Click on this menu or shortcut icon of shortcut icon bar, the program will automatically make the instrument heating and keep constant temperature.

4.3.3.2 Stop heating up

Click on this menu or shortcut icon of shortcut icon bar, the program will automatically make the instrument cool.

4.3.3.3 Hibernate

Click on this menu, the program will make the system hibernate according to the given parameter to protect the instrument

4.3.4 Detection Menu
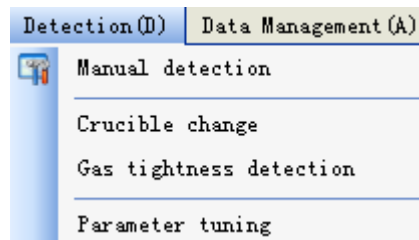
Shown in Fig. 4-6-1:

Fig. 4-6-1

4.3.4.1 Manual detection

Click on this item or "Manual Detection" icon, the detection window shown in Fig. 4-6-2 will popup.
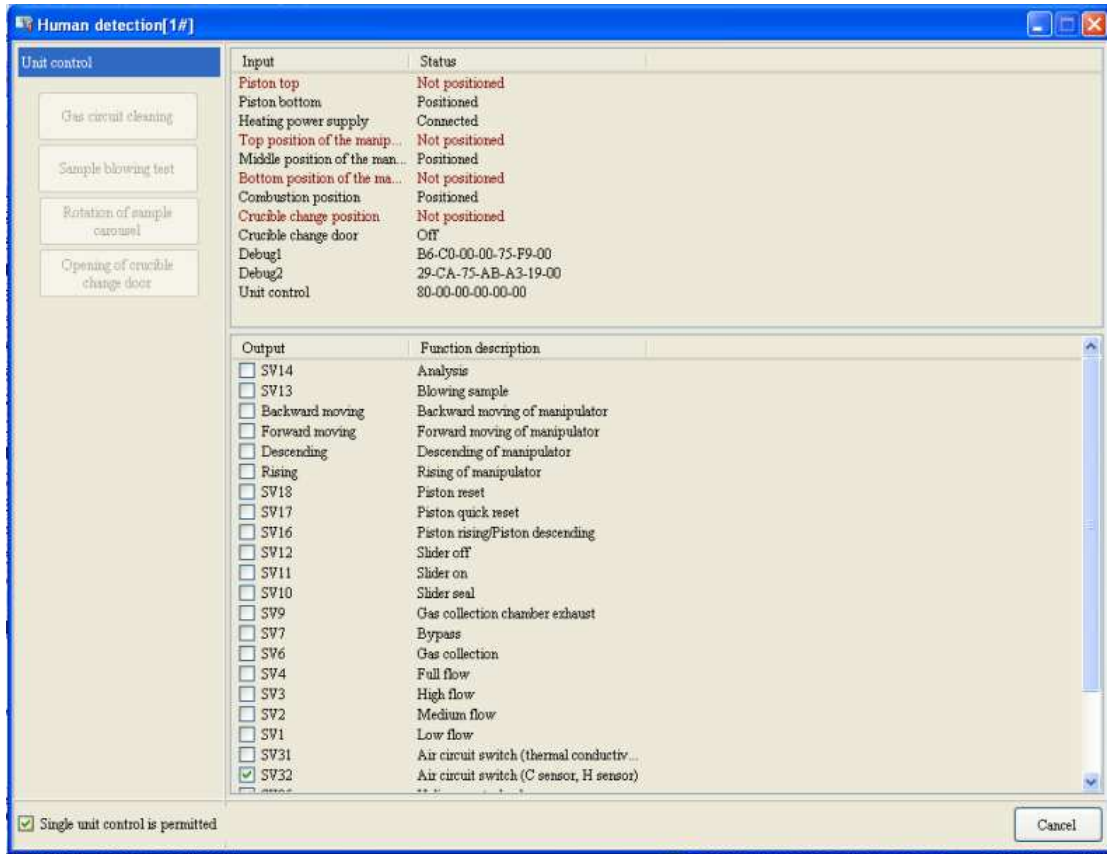

Fig. 4-6-2

➤ Gas circuit cleaning: Click on this item, the program will start gas circuit cleaning automatically, and default time for cleaning gas circuit is 10minutes and the cleaning also can be stopped manually.

➤ Sample blowing test: test the sample blowing situation for convenience to observe whether the samples drop into combustion furnace reliably or not when debugging.

➤ Opening/closing of crucible change door: open or close crucible change door

➤ Rotation of sample tray: test rotate angle of sample plate for convenience to observe sample dropping situation.

➤ Single unit control is permitted: after selecting this item and inputting password, you can control some parts independently.

Note:

✧ **Only service technicians from MRC Company can do this operation.**

4.3.4.2 Crucible change

Click on this item, window shown in Fig 4-6-3 will popup. The program will prompt window as shown in Fig 4-6-4 after the manipulator move to crucible changing hole. And at this moment, use tweezers to lift the crucible out and place another new crucible, and click on "Reset of crucible change" icon in window as shown in Fig 4-6-4, then the manipulator return to normal place automatically.

Fig. 4-6-3

Fig. 4-6-4

Note:

✧ **Avoid hand scalding when changing crucible under high temperature.**

✧ **Dust the manipulator or the sampling sending rod regularly according to prompts.**

✧ **After changing crucible, it's suggested to conduct gas circuit cleaning and gas tightness detecting operations to ensure the stability of the instrument.**

✧ **After finishing 100 samples or the program reminding it needs to change crucibles, the crucibles must be changed, otherwise the combustion tube**

will be damaged and then the test result will be affected.

4.3.4.3 Gas tightness detection

Click on this item, window as shown in Fig 4-6-5 will popup and the program will automatically detect gas tightness of the system (the gas tightness of oxygen, driving gas and helium circuit) according to specified method. Click on "Stop detection" icon in window as shown in Fig 4-6-5, then window as show in 4-6-6 will popup and the current tightness detection process will be stopped.
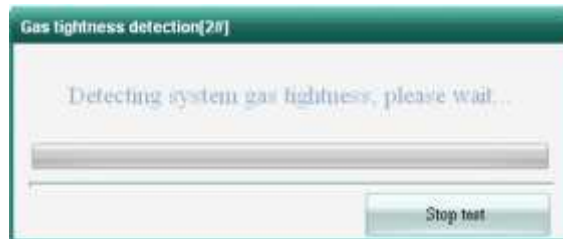

Fig. 4-6-5

Fig 4-6-6

Note:

◇ **After changing crucible, furnace reagent and seal ring, it's necessary to conduct gas tightness detection operation.**

◇ **When the program prompts "System is unstable", please extend preheating time and conduct gas tightness detection again.**

◇ **When the program prompts "gas circuit leakage in gas collection bottle section", please inspect and repair.**

◇ **When the program prompts "gas circuit leakage in high temperature furnace section", please inspect and repair.**

◇ **When the program prompts "gas circuit leakage in carbon and hydrogen**

sensor section" please inspect and repair.

✧ **When the program prompts "Oxygen gas tightness detection failure" or "Helium gas tightness detection failure", please conduct gas tightness detection operation or inspect and repair once again.**

✧ **Helium gas tightness**：**To detect the gas tightness of the helium circuit only.**

✧ **Oxygen gas tightness**：**To detect the gas tightness of the oxygen circuit only.**

4.3.4.4 Parameter tuning

Click on this item, window as shown in Fig 4-6-7 will popup. Click on "Yes" to start parameter tuning operation shown as Fig 4-6-8. Click on "No" to cancel parameter tuning operation and back to interface of the program. Click on "Stop tuning" in the window as shown in Fig 4-6-8, window as shown in Fig 4-6-9 will popup and the current parameter tuning process will be stopped.
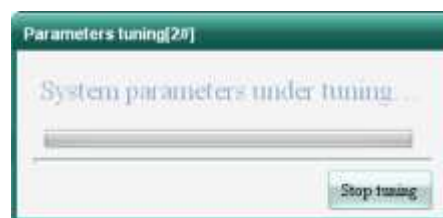

Fig. 4-6-7

Fig. 4-6-8

Fig. 4-6-9

Note:

◇ **Using the instrument for the first time, it's necessary to conduct parameter tuning so as to conduct precision and accuracy test.**

◇ **When parameter losing because of changing software or updating software, it is necessary conduct parameter tuning so as to conduct precision and accuracy test.**

◇ **It generally needn't conduct this operation after the instrument being debugged well.**

◇ **It's necessary to conduct this operation after changing gas transmission conduit between high temperature furnace and gas collection chamber.**

◇ **It's necessary to conduct parameter tuning after adjusting gas flow and pressure of oxygen cylinder or gas collection bottle.**

◇ **If the program prompts "Failed to tune the parameters", please tune the parameters or inspect and repair again.**

4.3.4.5 Diagnosis

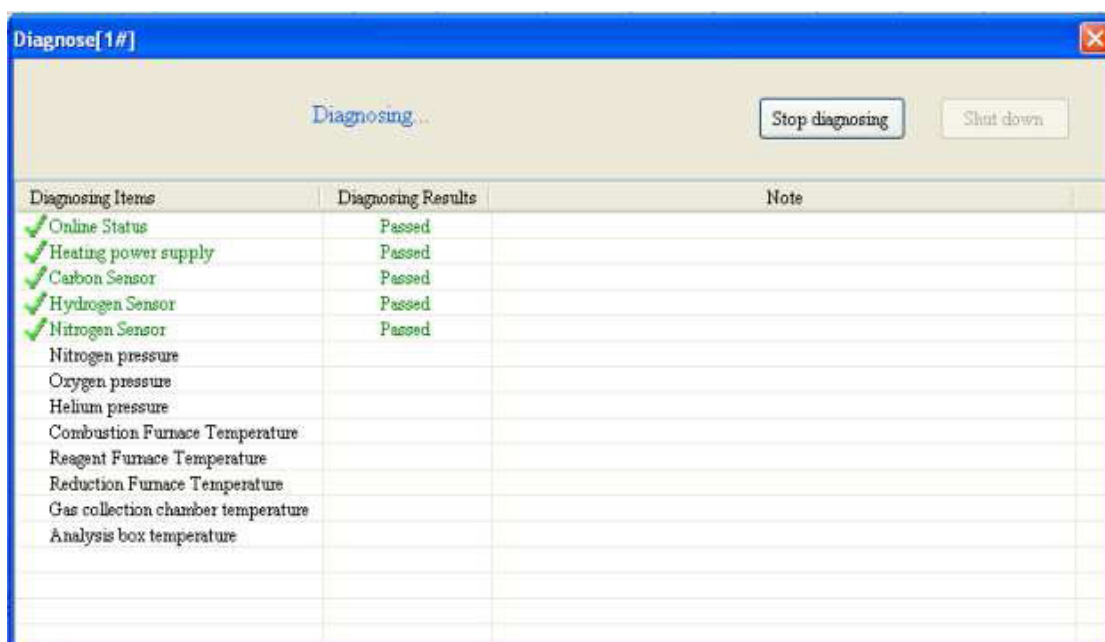Click on this item, window as shown in Fig 4-6-10 will popup.

Fig4-6-10

> Start diagnosing: Click on this item, the program will detect all items on the "Diagnosing Items" column by sequence. And the results will be displayed on the "Diagnosing Results" or "Note" column.

> Stop diagnosing: Click on this item, the instrument will stop diagnosing all items.

> Shut down or "X": Click on this item to exist the "diagnosis" window.

4.3.4.6 Figure

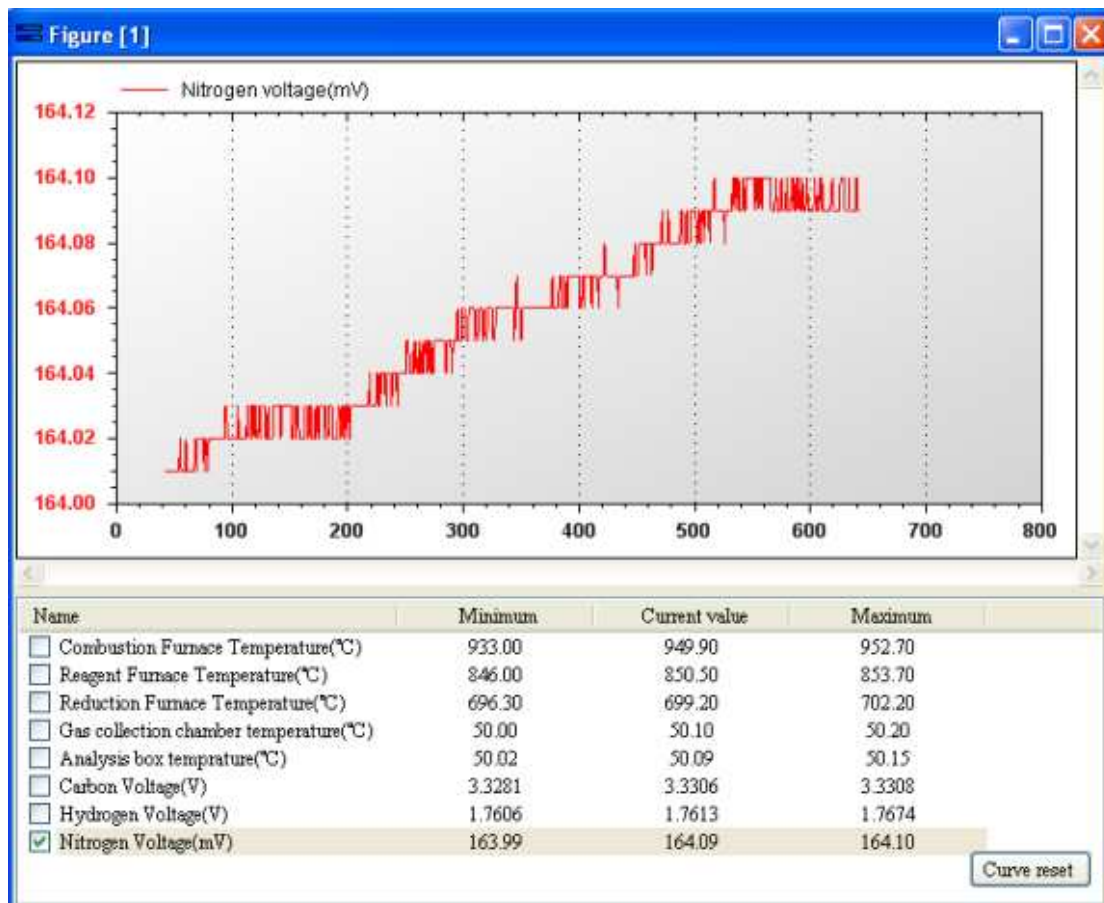Click on this item, window as shown in Fig4-6-11 will popup to show the curve chart and signal value of all items.

Fig4-6-11

4.3.5 Data Management Menu

Details refers to Chapter 5

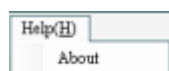### 4.3.6 Help Menu

Shown in Fig. 4-7-1:

Fig. 4-7-1

4.3.6.1 Help file

Click on this item, and then you can get the online help file of ELan-35

Infrared Carbon Hydrogen and Nitrogen Analyzer.

4.3.6.2 About

Click on this item, and you can get the program's version information. Click on

"Yes", back to main interface of the program

Chapter 5 Data Management

Click on "Data Management" on the main interface menu of ELan-25 infrared carbon and hydrogen 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-35 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.
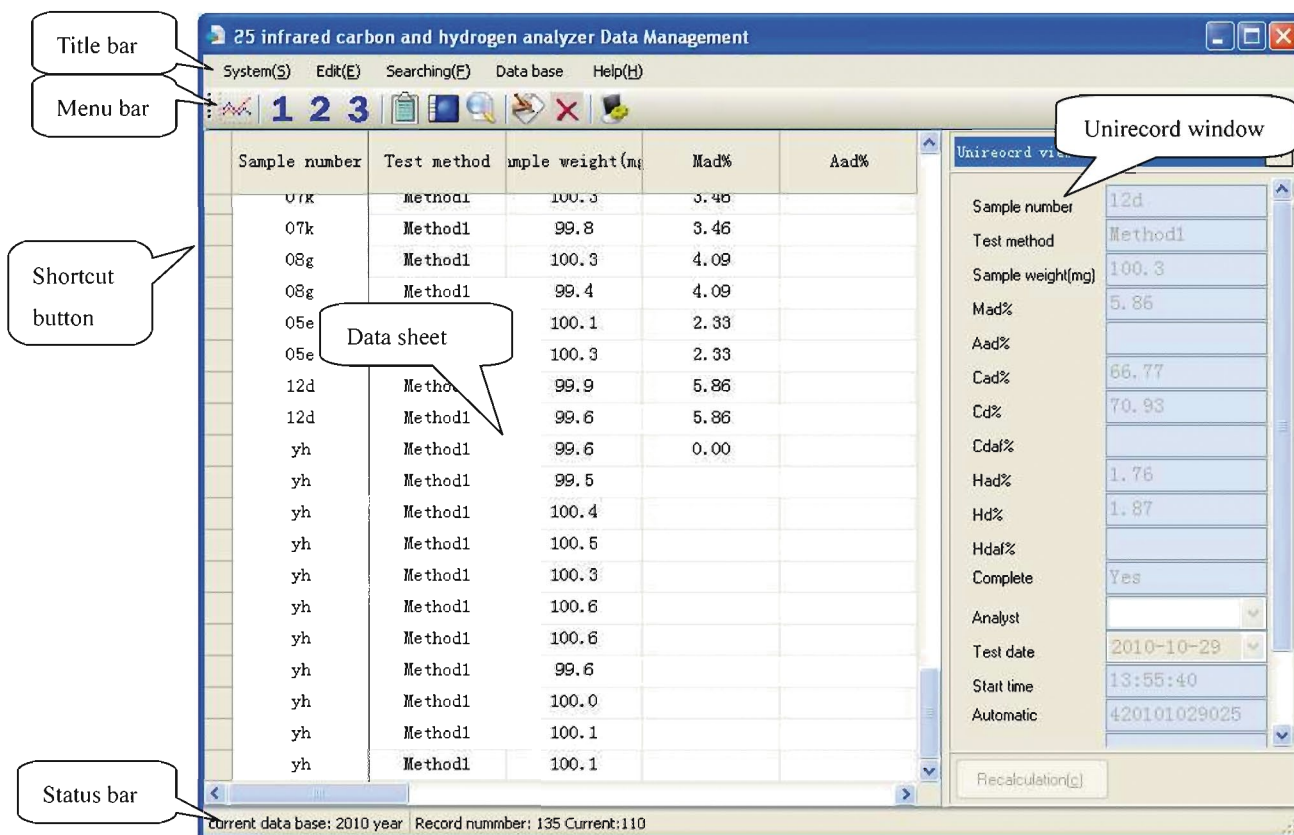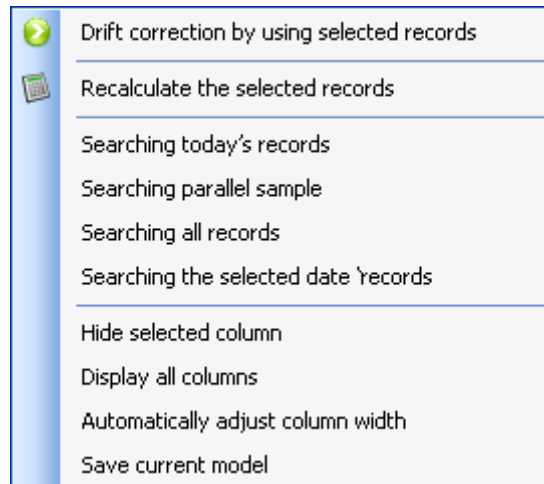
Fig. 5-1

5.2 Functions of Each Menu Bar
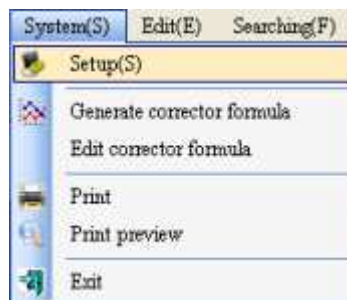
5.2.1 System Menu

As Fig.5-1-1:

Fig. 5-1-1

5.2.1.1 Settings

Click on this bar, window as Fig.5-1-2 will popup.

Fig. 5-1-2

➢ Print type

◆ Report: Select the item, then print the selected records in the report form

◆ Report table: Select this item, and then the selected records will be printed in the report table form.

➢ Calculation condition of the parallel sample.

◆ Cad% less than or equal to: Set the condition of judging whether the repeatability of carbon value is qualified or not.

◆ Had% less than or equal to: Set the condition of judging whether the repeatability of hydrogen value is qualified or not.

◆ Nad% less than or equal to: Set the condition of judging whether the repeatability of nitrogen value is qualified or not

◆ Whether the parallel sample is out-of–range or not: Select this item, the note

that the parallel results are out-of-range or not will be marked when printing the report or report table

➢ Others: Set up related device card No. as No.1 Device, No.2 Device or No.3 Device to facilitate data searching.

➢ Print tester column: Select this item, and then the tester name will be printed on the under side of the form.

➢ Print audit column: Select this item, and then the audit column will be printed on the under side of the form.

➢ Display blank sample or not: Select this item, and then the blank sample record will be displayed on the data sheet column.

➢ Print test company column: Select this item, and then the test company will be printed on the under side of the form.

➢ Content of report header: Input the content on the right textbox, and then the content will be printed on the report form heading.

➢ Content of report table header: Input the content on the right textbox, and then the content will be printed on the report form heading.

➢ Save: After modifying related parameters, click on the button, then the parameters can be saved; otherwise, the parameters can not be saved.

➢ Back: Click on the button to quit the window and back to the main interface of the data base.

1. Report table configuration: Click "Report table Configuration" on the Setting window, the window as Fig. 5-1-3 will popup.

The window function covers the printed fields while setting up the report form. To select some recorded line on the Print Column in the window, then print the fields while printing the report form.

Note：

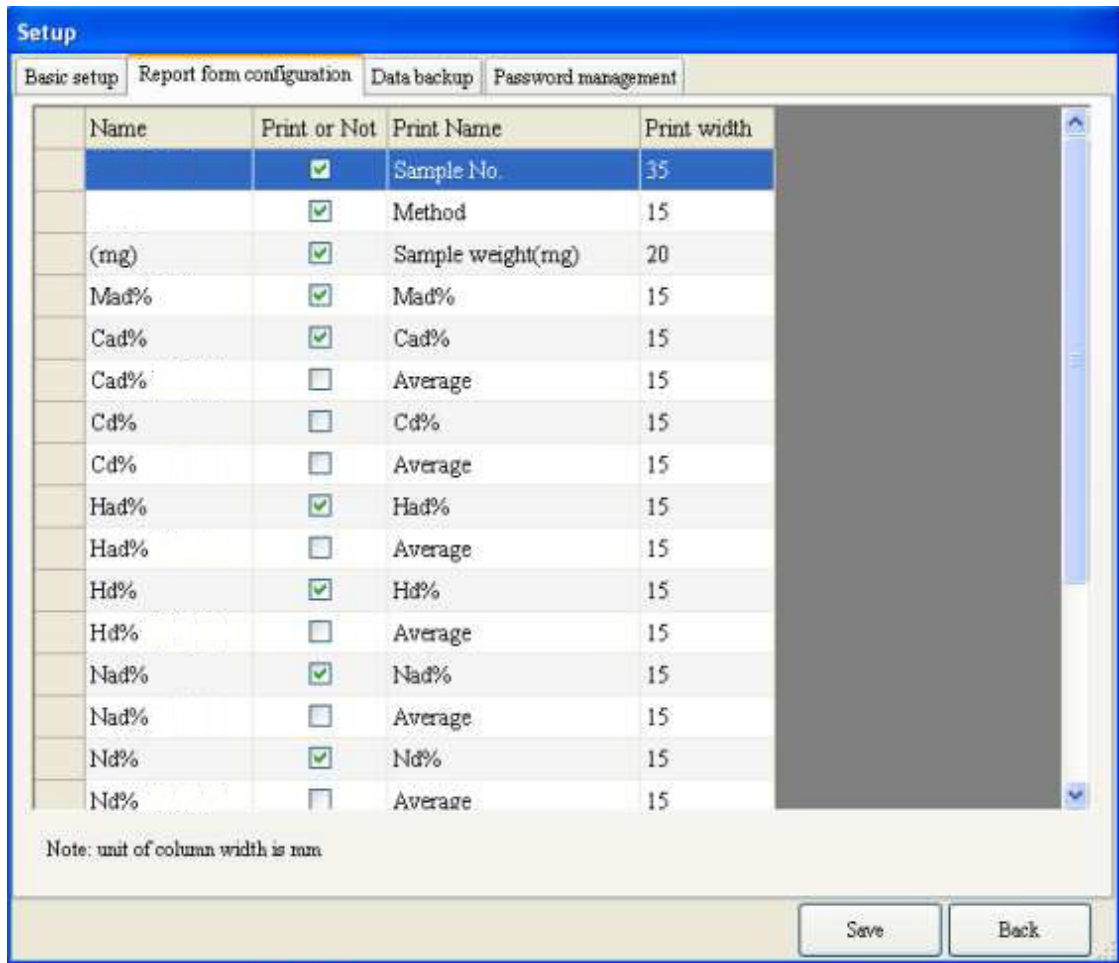❖ **The selected record lines can not exceed the printed range of A4 paper.**

Fig. 5-1-3

2. Data backup: Click on "Data Backup" on the Setting window, popup the window as Fig. 5-1-4.
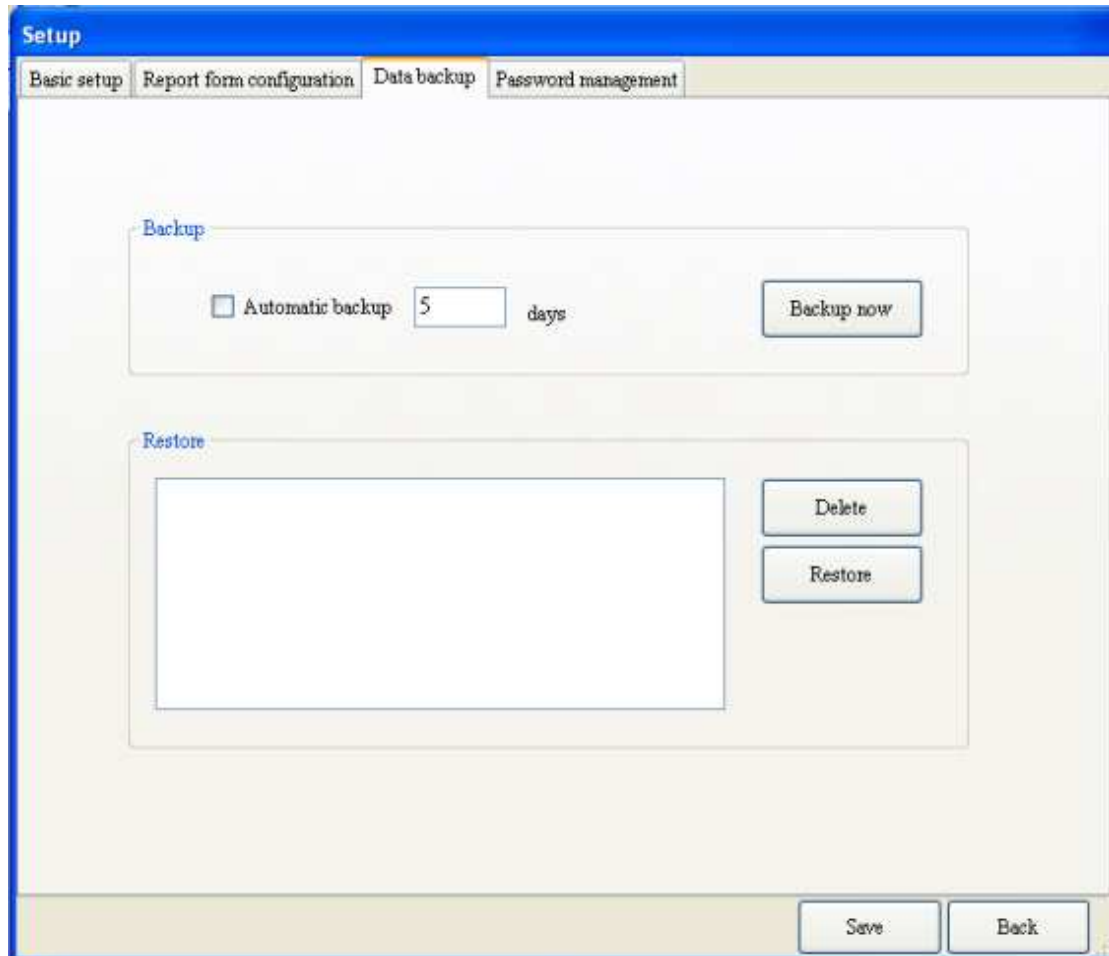
Fig. 5-1-4

➢ Backup

◆ Automatic backup: Input the content on the right textbox and select this item, then the procedure will automatically back up the data base based on the set condition.

◆ Backup now: Click on the button, the data base this time or this year can be backed up.

➢ Restore

◆ Delete: Select the records on the left textbox and click on the button, and then the backup data base can be deleted.

◆ Restore: Select the records on the left textbox and click on the button, and then the backup data base can be restored.

Note：

✧ **Please use this function with caution.**

3. Password management: Click on the "Password Management" on the Setting window, popup the window as Fig.5-1-5.

Fig. 5-1-5

➢ System password label column:

◆ Original password: input original password.

◆ New password: input new password.

◆ New password confirm: confirm new password.

◆ Modify: click on the button, and the left textbox can be activated and then it can modify.

◆ Yes: click on the button, and then save the new password.

5.2.1.2 Generate correction formula

Select the records that should take part in generating correction formula on the data display column and click on the item, then the carbon correction window as Fig. 5-1-6, the hydrogen correction window as 5-1-7 and the hydrogen correction window as 5-1-8 will popup.
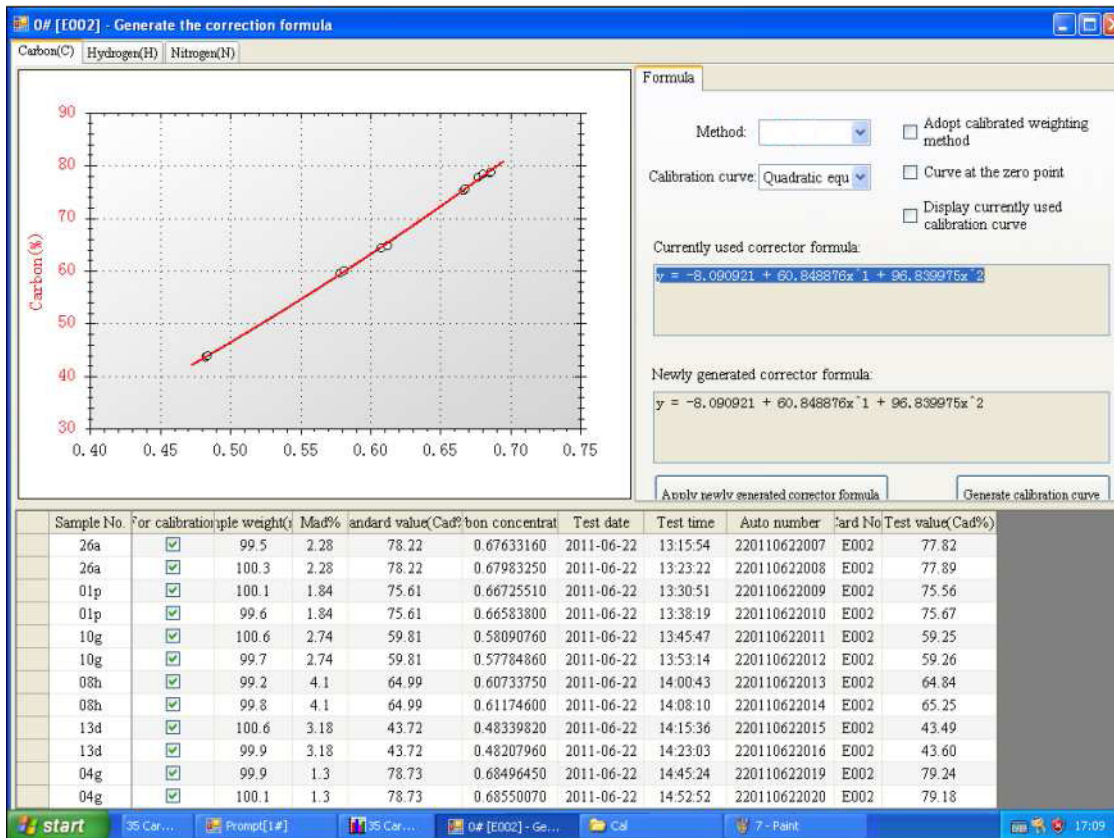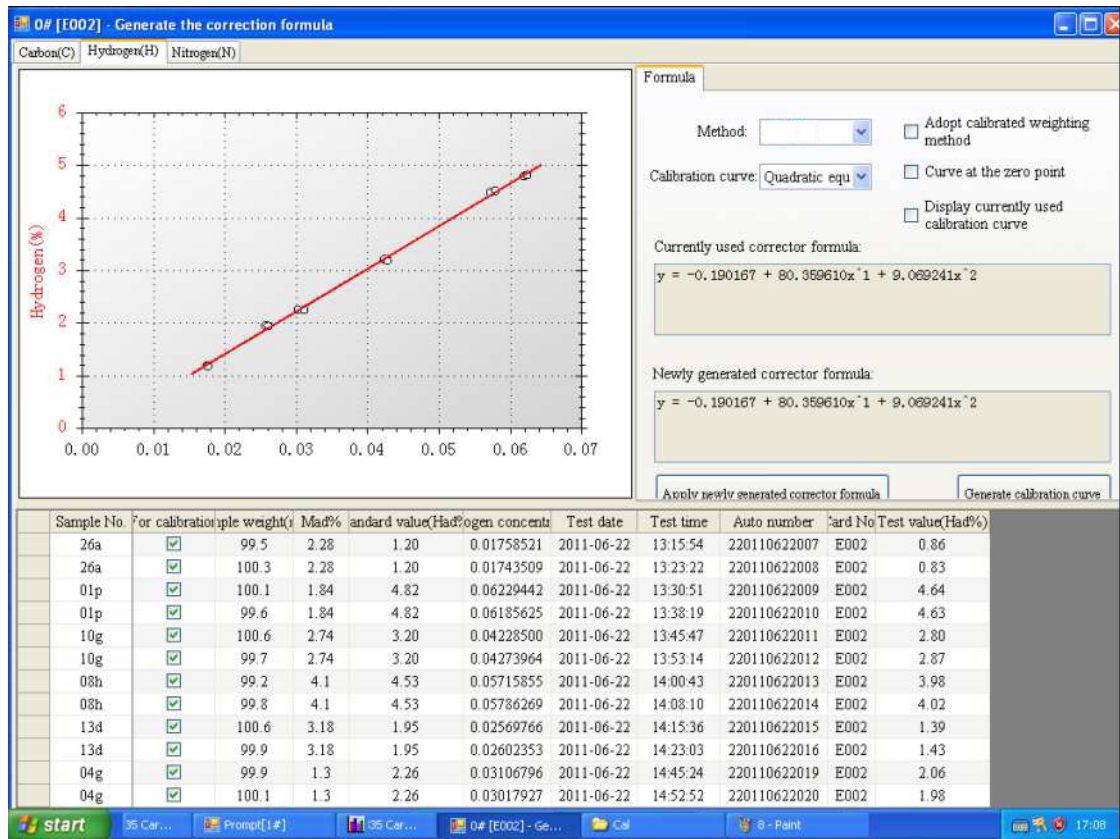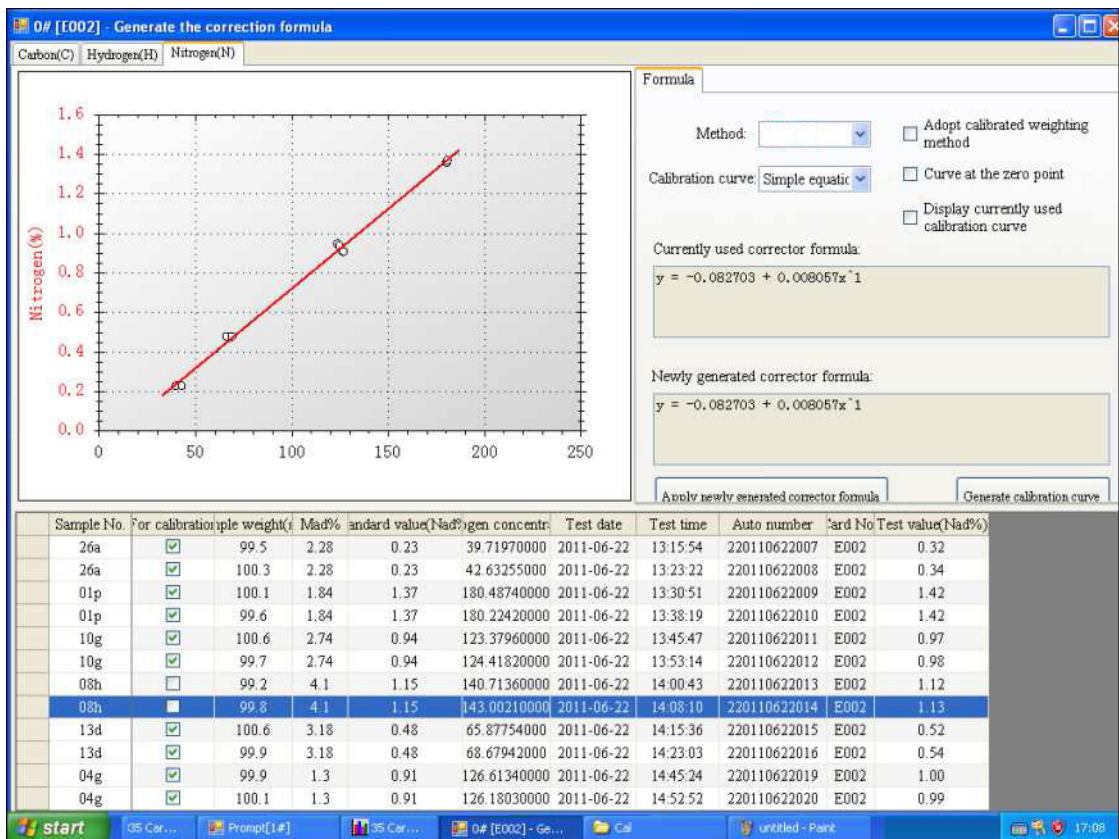

Fig. 5-1-6

Fig. 5-1-7

Fig. 5-1-8

48

Select the effective records that should take part in generating correction formula on the data sheet of the main interface window of the data base, and then click on "Generate correction formula" on the shortcut button column or click on "System" → "Generate correction formula" on the menu, the window as above Figures will popup.

➢ Test method: Select the method that needs calibration, generally, it should coincide with that of the selected records.

➢ Correction curve: Select the correction line type. Generally, quadratic curve is chosen for carbon and hydrogen, and straight line is chosen for nitrogen. For the above line types, their related coefficient (R) should be more than 0.9990.

➢ Curve at the zero point: After selecting, the correction curve will be forced to zero point.

➢ Display currently used correction curve: After selecting, the current correction curve is displayed on the left picture window.

➢ Generate correction curve: click on the button, the procedure will automatically generate correction curve.

➢ Apply newly generated correction formula: click on the button, the procedure will automatically generate new correction curve.

➢ Records on the data sheet used in the correction line: Select the records in the line, and then the selected records will take part in the correction and vise versa.

Note:

✧ **The selected records for generating correction curve should be samples in the standard substance storage. Otherwise, the unqualified records will be abandoned automatically when the correction data is being imported.**

5.2.1.3 Edit correction formula

Click on this item, popup the window as Fig.5-1-6; and Fig. 5-1-7, check and modify the correction formula and linear of some method.

5.2.1.4 Print

Print the selected records in the data sheet.

5.2.1.5 Print preview

Preview the selected records in the data sheet.

5.2.1.6 Exit Data Management

As Fig. 5-1-9, click on "×" or "×" on the top right corner of the main interface of the Data Base, and then click on (Y) and exit the data base window; back to the main program interface of ELan-25 infrared carbon and hydrogen analyzer; click on (N), it is to waive the exit.
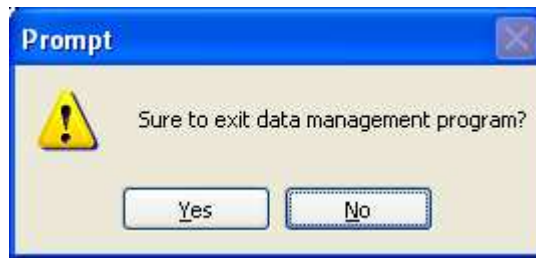
Fig. 5-1-9

5.2.2 Edit Menu

As Fig. 5-2-1
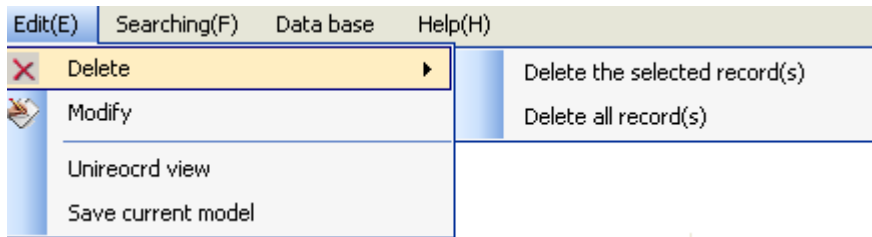
Fig. 5-2-1

5.2.2.1 Delete

Delete the selected records in the data base.

1. Selected records: delete the selected records in the data display column.

2. All records: delete all records in the data display column.

5.2.2.2 Modify

After click on, it automatically open mono record and enter into edit state.

5.2.2.3 Unirecord view

1. Double click the data window may open/close unirecord view display;

2. Click this item, it may open unirecord view window; reclick this item, the window is closed

5.2.2.4 Save current model

Save the state of current data base window.

5.2.3 Searching Menu

As Fig. 5-3-1:
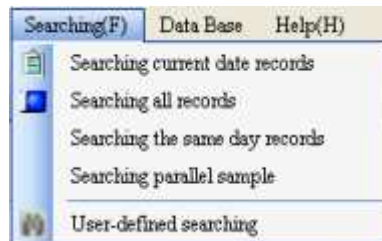
Fig. 5-3-1

5.2.3.1 Searching today's records

Click on this item, display the records in the data display column same as the computer system date.

5.2.3.2 Searching all records

Click on this item to display all records of the data base in the data display column.

5.2.3.3 Searching the selected date records

Click on this item to display the records in the data display column with the same test date as the selected records.

5.2.3.4 Searching parallel sample

Click on this item to display all records in the data display column with the similar sample and test date as the selected records.

5.2.3.5 User-defined searching

Click on this item to 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 on "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 on automatic numbering check box, making it in selected state.

➢ Setting up searching condition: click on "v" button and select one item (such as "Like"), and then input the date in the right box (such as 200908).

➢ Searching: click on this button, the system will automatically display all test records that contain 200908 automatic numbering in the data display column.

5.2.4 Database Menu

As Fig. 5-4-1, to select the year, display all records of the year selected in data

display column.

Fig. 5-4-1

5.2.5 Help Menu

As Fig. 5-7-1:
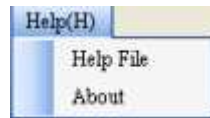
Fig. 5-5-1

5.2.5.1 Help file

Click this item. Then you can get the online help files of the ELan-35 Carbon Hydrogen and Nitrogen.

5.2.5.2 About

Click this item. Then you can get the version information of ELan-35 Carbon Hydrogen and Nitrogen. Click "Yes" to back to the main interface of the data management.

Chapter 6 Instructions to Operation

This chapter introduces how to conduct a complete test, including preparation work, system check, blank sample analysis, standard sample analysis and user sample analysis.

6.1 Preparation Work

1. Switch on the power supply of computer, instrument, printer and balance.

2. Start the computer, open the Windows desktop, and then double Click on "ELan-35 Infrared Carbon Hydrogen and Nitrogen Analyzer" shortcut icon, to enter the main program window.

3. After the program has prompted successful online, confirm whether it is needed to change the crucible, clean the filter and replace the reagent, according to the number of samples or prompt message.

Note:

   ✧ **After 100 samples having been tested, the crucible must be changed; otherwise, test result may be influenced, or combustion tube may be damaged.**

   ✧ **After 300 samples having been tested, please clean the filter, and change the silica wool and filter cartridge (For cost savings, only silica wool needs to be changed after 50 samples have been tested).**

   ✧ **After one month or 600 samples having been tested, please change the reagent in the reagent furnace. The reagent is around 32g, and the particle size is ¢ 3-4mm. Powdered reagent is forbidden. The reagent should be heated under 850℃ for 30 minutes, and then put into the drying tower for cooling.**

   ✧ **Whenever 1000 samples are tested, please change reagent in the reduction furnace. Whenever 2000 samples are tested, please change reagent in the two drying tubes.**

   ✧ **When the instrument is not used for a long time or the reagent is replaced, the gas circuit must be cleaned for 30 minutes in constant temperature state.**

4. Heating up

Click on "Heating up" icon at the tool bar of the main interface, or Click on "Temperature" at the menu bar→ "Start heating up", to start automatic heating up and thermostatic.

5. Preheat up the instrument to a stable temperature.

Note:

◇ **The instrument should be preheated for at least 3 hours**
. If the

instrument keeps 24-hour uninterrupted work, preheating is unnecessary, but we suggest starting dormant function.

◇ **While preheating the instrument, the tester can do other preparatory work.**

6. Weighing samples

a. Use tweezers to put a tinfoil cup onto the balance tray, deduct the tare weight, and then use a ladle to add about 100mg sample into the tinfoil cup, till the balance reading is stable.

b. Take out the tinfoil cup from the balance tray, twist the cup rabbet to seal up the tinfoil cup, pack the sample into a globular shape.

c. Put the packed sample onto the balance for reweighing, record the sample weight.

d. Put the weighed samples into the mobile sample tray in order.

Note:

◇ **Tester is suggested to wear gloves to prevent the tinfoil cup from sweat and ensure accurate test results.**

◇ **When using tinfoil cup to pack the sample, extrude the air out of the tinfoil cup as much as possible.**

◇ **When using tinfoil cup to pack the sample, the tester must not overexert, which may result in tinfoil cup breakage or sample spillage.**

◇ **Tinfoil cups with sand holes should not be used.**

◇ **Tinfoil cups and gloves should be kept in drying tower, and must not be stuck with other substance to keep clean.**

◇ **Keep sample placing tray and mobile sample tray clean.**

6.2 System Detection

1. Detection of gas source:

Click on "Manual Detection" icon in the tool bar of the main interface, or Click on "Detection" → "Manual detection" → "Gas circuit cleaning" icon in the menu bar, to check the followings:

- Check whether the switches of oxygen cylinder, nitrogen cylinder, and helium cylinder are on.

- Check the indicated pressures of the high pressure gauges of the reducing valves on the oxygen cylinder, nitrogen cylinder, and helium cylinder. If the pressure is below 1MPa, please change the gas.

- Adjust the indicated pressures of the low pressure gauges of the reducing valves on the oxygen cylinder, the nitrogen cylinder, and the helium cylinder to 0.18Mpa.

Click on "Stop cleaning" to exit "Manual detection" and return to the main interface of the program.

2. Detection of gas tightness of the system

Click on "Gas tightness detection" icon in the tool bar of the main interface, or Click on "Detection" → "Gas tightness detection" icon in the menu bar, to start automatic gas tightness detection of the system.

Note:

✧ **If the system indicates "Qualified oxygen tightness" and "Qualified helium tightness", the test can be done.**

✧ **If the system indicates "Gas leakage in section of …", please maintain and repair the gas section under prompt message.**

✧ **If the system indicates "Unstable system", the tester should prolong the preheating and recheck gas tightness.**

3. Sample placing

Reserve a hole for blank analysis sample, which is supposed to be placed after the last blank sample hole.

6.3 Setting the Oxygen Flow Parameter

Click on "System" in the menu bar of the software interface → "Test method". In the test method window, you can find "Bitumite" and "Anthracite" for your choice. Bitumite test method is applicable for samples easy to be combusted, while anthracite test method for samples hard to be combusted.

Test method	Bitumite	Anthracite
Oxygen flow setting	4/2/4/3/2	3/2/4/2/2
Oxygen burning time (s)	20/120/15/18/30	35/165/20/30/30

6.4 Blank Analysis

When making blank analysis, no sample will be put into the crucible. Input "Blank sample" into the "Sample number" of the data sheet bar of the main interface, input "100" into the sample weight bar, select method in the method bar, click on "Start test" icon in the toolbar of the main interface or click on "Test" → "Start" icon in the menu bar, the program will automatically do blank analysis.

Note:

✧ **The blank analysis is used to automatically balance the system baseline and ensure system stability.**

✧ **Make blank analysis till the instrument reaching balance (error≤0.1%), the blank analysis should be done at least 3 to 5 times.**

✧ **The blank analysis should be done every day, and should be executed before the test sample analysis.**

✧ **We recommend adopting continuous test method.**

✧ **After finishing blank analysis, before standard sample analysis or test sample analysis, it is necessary to do waste sample transition.**

6.5 Standard Sample Analysis

Select standard coal number or input corresponding standard coal number in the "Sample number" bar of the data sheet bar of the main interface, and then input standard sample weight into the sample weight bar, and moisture value into the

moisture bar. Finally, select method in the method bar to start automatic standard sample analysis.

Note:

✧ **The standard sample analysis is used for instrument correction and detection. For rating curve correction and drift correction, please refer to Section 4.5.**

✧ **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 to 3 standard samples, and the accuracy of carbon and hydrogen element value in the standard sample analysis should be in the repeatability allowable range.**

✧ **All the analysis must be continuous, with no interval analysis. If interval analysis occurs, it is necessary to do two waste samples for transition.**

6.6 Standard Sample Correction

Standard coal correction is executed by adjusting the instrument mathematical model according to the given standard sample. Standard coal 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 solving the slight change of the instrument hardware.

6.6.1 Rating Curve Correction

Method:

1. Method building: Click on "Setup" in the menu bar→ "Test method" → "Adding method", and then modify method name in the name bar.

2. Define standard sample in the standard substance database: Click on "Setup" → "Setup"→ "Standard substance", input Cd%, Hd%, Nd% and name of standard sample into the table of this page, and Click on "Save".

3. Analyze the standard sample in accordance with the requirements described from section 6.1 to section 6.5.

4. After the analysis, input standard sample analysis results into the database. Select standard sample analysis records for rating curve, Click on "Generate

curve". Set up relative parameters such as those of curve linear in the dialog box popped-up, and then click on "Generate correction curve" → "Apply newly generated correction formula", to finish rating curve generating of a certain method.

5. Exit the data base, and back to the main interface. Select standard sample analysis record in the data sheet bar of the main interface, right Click on the mouse, and select "Recalculate selected records", to recalculate standard sample analysis records with the newly generated correction formula.

Note:

 ✧ **The standard sample for rating curve correction must be the standard sample defined in the standard substance database. And its sample number must be consistent with the number in the standard substance database. Mad% value must be input before the analysis.**

 ✧ **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 carbon and hydrogen 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 to 3 sub-samples, and the accuracy must be in the range of national standard.**

6.6.2 Drift correction:

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

Note:

 ✧ **Drift correction for ELan-35 is needed only once in one working day or when test results with standard coal are invalid. On the contrast, products of other manufacturers in and out of China need drift correction every 4 hours.**

 ✧ **For the standard sample used for drift correction, its accuracy of carbon**

hydrogen and nitrogen element values must be in the ranges of 0.5% and 0.15% and 0.08% respectively.

- ✦ **Generally, the standard sample used for drift correction should be close to or slightly higher than routine analysis samples in property and carbon and hydrogen element values for the drift correction.**
- ✦ **The drift correction standard sample must be the standard sample defined in the standard substance.**
- ✦ **The standard sample used for reexamination must be different from drift standard sample.**

6.7 Analysis of User Sample

Input user sample number into the "sample number" bar, and sample weight into the sample weight bar. Select adopted method in the method bar. Then the program will automatically make an analysis of the user sample.

Note:

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

6.8 Recalculation

Select relevant record in the data sheet bar of the main interface and Click on "Recalculate selected records", the system will use new parameters to recalculate the analysis result.

Note:

- ✦ **The program will recalculate the analysis result automatically, based on relevant record fields (e.g. name, sample weight, method, analysis date, Mad%, and drift coefficient etc.).**

6.9 Printing

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

6.10 Dropping Temperature and Logging Out

Click on "Temperature" in the menu bar of the main interface → "Stop heating up". When the instrument temperature in under 500℃, log out of the program, and turn off the power supply of the instrument and the computer.

Note:

✧ **To directly shut down the power supply of the instrument at high temperature 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-25 carbon and hydrogen 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. The instrument is precision instrument. The lab should be equipped with air-conditioning. It should not be placed near the window, heat source or wind regime. Also, protect the instrument from dust and corrosive gases.

3. Instrument shall be ground connected reliably.

4. 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.

5. Instrument shall be maintained by special person. Each part of instrument must not be dismantled at will to avoid fault due to malfunction.

6. Test shall be strictly operated as required in Chapter 6.

7. Instrument shall be used for a special purpose to avoid affecting the normal operation of system.

8. Carefully carry instrument to avoid damaging the wearing part in instrument or displacing key part.

9. Whenever 100 samples are tested, please change crucibles and clean the dust on the sample feeding rod. Whenever 50 samples are tested, please change the silica wool in the filter. Whenever 300 samples are tested, please change the viton tube. Whenever 600 samples are tested, please change furnace reagent. Whenever 1000

samples are tested, please change reagent in the reduction furnace. Whenever 2000 samples are tested, please change reagent in the two drying tubes.

Note:

◇ **Furnace reagent should be heated under 850℃ for 30 minutes, and then put into the drying tower for cooling.**

◇ **Blow and clean the viton tube with nitrogen prior to using it.**

10. 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.

Note:

◇ **Before wiping, power supply must be cut off to avoid electric shock and damaging instrument.**

◇ **During wiping, water should be prevented from penetrating into instrument to result in fault.**

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 himself, please contact MRC Company.

Trouble	Cause and solution
1. System displays that machine is not online.	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. 2. USB-CAN card is not well connected. 3. Instrument is not powered on. Turn on power supply of instrument. 4. Drive program of USB-CAN card is not installed. Install the drive program and restart computer. 5. Program was damaged by virus. 6. Communication is abnormal. Please fix it by professional.
2. "Heating power supply not powered on" is prompted.	1. Heating power supply is not powered on or badly connected. 2. Instrument fuse is broken. Please replace it. 3. Control card has trouble. Please fix it by professional.
3. Test status can not be entered.	1. Various temperature points are out of constant temperature range. 2. Sample quality is not entered into data sheet of main program. 3. System has abnormal prompt.
4. Test results are not ideal.	1. Weighing is not accurate or operation is not correct. 2. Preheating time of instrument constant temperature is not enough. 3. Blank analysis is not made until instrument is stable. 4. Correction is not made timely. 5. Flow is too low due to leakage or blockage of gas circuit. 6. Pressure of oxygen and nitrogen is not correct. 7. Balance is not preheated for 30min. 8. Sample combustion is incomplete.
5. Samples are stuck or not timely fed into combustion	1. Sample bladder is not proper in shape or its size is too big. 2. Spiral angle of sample tray is not correct.

furnace.	3. When this trouble occurs, the test must be stopped promptly for repair.
6. Gas collection bottle cannot reach rated pressure or reach top position.	1. Oxygen and nitrogen is not open or their pressure is not high enough. 2. Leakage or blockage of gas circuit. 3. Fault of electric circuit.
7. Indication of "overpressure of gas collection bottle"	1. Blockage of gas circuit. 2. Damage of SV16 and SV9 valves.
8. Printing can not be made or printing error occurs.	1. Check whether signal cable of printer is well connected or damaged. 2. Printer program has problem. Reset printer. 3. Measuring control software has problem. Replace the software. 4. Printer has problem. Hold warranty to contact local maintenance agent.
9. Computer is halted.	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.