Laboratory Equipment Manufacturer
www.mrclab.com

Operation Manual for

Bomb Calorimeter

CALO-40

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 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 Performance and Characteristics

Caution: There must be reliable grounding wire for the power supply socket on the site of the instrument.

1.1 Scope of Application

This instrument is applicable to measure the calorific values of solid and liquid combustibles such as coal, petroleum and so on in the industries or departments of electric power, coal, paper making, cement, agriculture & animal husbandry, pharmaceutics, scientific research and teaching.

1.2 Performance Index

Temperature-measuring range：24-42℃
Resolution： 0.0001K

1.3 Characteristics of the Instrument

1.3.1 High automation and High efficiency

Automatic water temperature adjustment and water weighing as well as automatically detecting the total water volume.

The bucket needn't to be taken out. The operation is easy and the maintenance is convenient.

Single-head oxygen bomb. Firing wire is bolted by sleeve-pressure method, which is convenient, safe and reliable.

1.3.2 Strong adaptability to the environment and high stability

The heat capacity will almost remain unchanged if the environment temperature changes slowly (It is suggested that the heat capacity be calibrated once a quarter.).

1.3.3 High precision and accuracy

The instrument's precision and accuracy can reach the requirements of precise calorimeters if the environment can comply with the environment and the operation is standard.

1.3.4 Easy Operation

a. Only one switch is used to control the whole instrument.
b. It prompts in English during the whole progress. The test can be finished just by following the operating instruction.
c. The software features good error tolerance. There is no need to worry about the wrong operations.
d. Calculation and print of high or low level calorific values can be done conveniently.
e. It allows for repeated sample testing, automatic error diagnosis and automatically averaging the effective results.
f. Rich query functions.

1.3.5 Expert diagnosis system

During testing, the instrument is provided with self-diagnosis function which can accurately diagnose whether the power, probe, control line, temperature testing card, oxygen bomb (short circuit and open circuit) and printer are connected well. It can prompt the user clearly so as to ensure easy maintenance and normal operation.

1.3.6 Asynchronous multi-control

CALO-40 calorimeter is provided with the combination of single-control, double-control and 3-control functions. The multi-control calorimeter can work independently without mutual interference and its performance equals to that of the same number of single-control CALO-40 calorimeters

1.3.7 Asynchronous balance interface

The sample weighing at any time and automatic data transmission are realized by on-line connection between the balance interface and weighing software.

1.3.8 Practical data processing

The data processing system with standard format is provided for easy calculation and printing of the coal quality assay data and reports.

Chapter 2 Instrument Composition and Working Principle

2.1 Instrument Composition

The CALO-40 calorimeter is mainly composed of CALO-40 frame (including water tank), DBY oxygen bomb, CY10 micro-type oxygen filler, SD test-control interface card and control card, SD test-control software, computer and printer (refer to Fig.2-1).

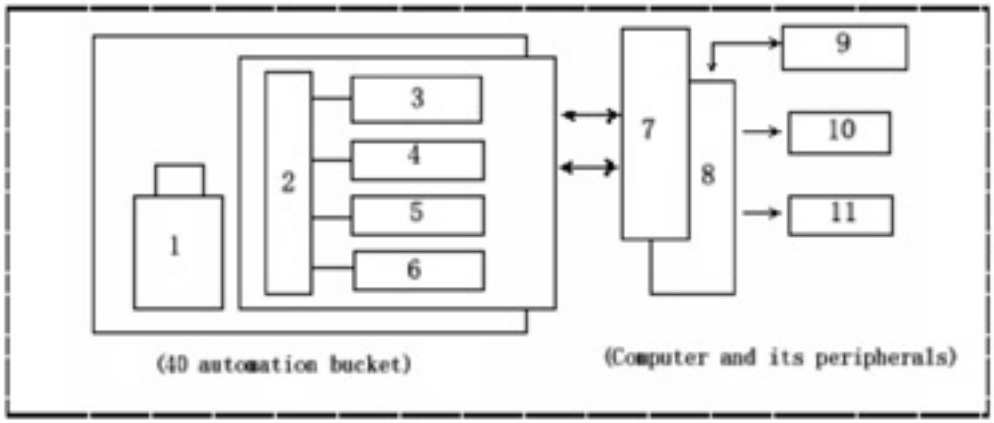

Fig. 2-1 Structure diagram

1. Oxygen bomb
2. SD Controller
3. Firing control
4. Temperature control
5. Stirring control
6. Water pump control
7. SD test-control interface
8. Computer
9. Electronic balance
10. Monitor
11. Printer

2.1.1 CALO-40 calorimeter main frame

1. Structure diagram (refer to Fig. 2-2)

CALO-40 is vertical calorimeter. Its spare water tank is inserted.

2. Characteristics:

It can weigh the water, adjust the water temperature and test the total water volume automatically. And it has the features of high adaptability to environment, easy operation and convenient maintenance.

2.1.2 CY10 Micro-oxygen filler

1. Structure diagram of the micro-oxygen filler is shown as Fig.2-3.

2. Characteristics:

Simple structure, easy operation. Gas circuit is well sealed and rubber sealing ring can be changed easily.

2.1.3 DBY Oxygen bomb

1. The structure diagram is shown as Fig.2-3 and 2-4.

2. Characteristics: Single-head oxygen bomb. Firing wire is bolted by sleeve-pressure method, which is convenient, safe and reliable.

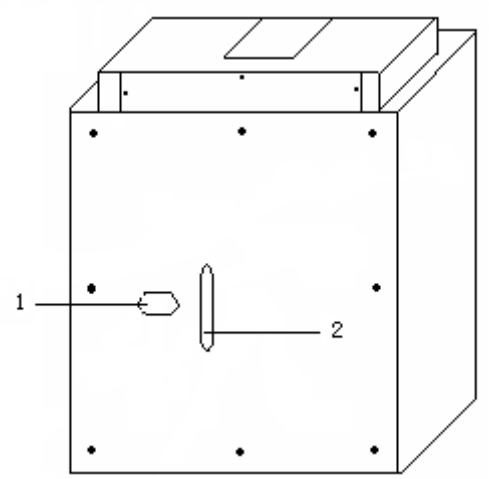

Fig. 2-2 Back view of automatic bucket

1. 220V power supply socket and fuse 2. Control signal wire

Fig. 2- 3 Oxygen bomb

Fig. 2-4 Internal structure of Oxygen bomb

2.2 Instrument Working Procedures

Start the computer to enter the test-control software for the test. After the preparation for the test is completed (the oxygen bomb is properly connected and the test parameters are correctly input), the system will automatically finish weighing bucket water volume and adjusting the water temperature, then it will automatically enter the test status. The temperature data is accurately obtained through the temperature probe and test-control electric circuit. The whole test procedures will be finished automatically based on the program convention and the testing results will be calculated, printed out and saved automatically. During the testing, in case of abnormal operation of some part of the system, clear prompt will be shown for easy maintenance.

Chapter 3 Instrument Installation and Debugging

Attentions:

a. During the installation and debugging of the instrument, the operator should follow the instructions strictly.
b. During the water adding, fibers or metallic wires should not fall into the bucket to avoid instrument failure.
c. When installing the instrument, the chassis should be earthed reliably.

3.1 Environmental requirements

3.1.1 Hardware environment:

a. Instrument should be placed where the sun can not irradiate directly.
b. Supply voltage: AC（220±22）V, 50HZ, and the power socket should be earthed reliably. UPS power supply with good performance and not less than 500VA power is suggested.
c. Cement table is preferred to avoid the instrument shaking.
d. The room temperature should be constant and meet the international standard requirements (The temperature fluctuate should be less than 1℃ in half an hour and less than 5℃in 1 day).
e. There should be no strong heat source, vibration source, air convection or too many people in the room.
f. In case of air conditioners installed in the room, the fan speed should be tuned to the lowest grade to prevent airflow blowing to instruments directly.

3.1.2 Software environment

a. Operation system: English version Windows XP
b. Basic configuration:

CPU: ≥ 1G
Memory: >128MB;
Video card: standard VGA 800×600 display model;
Hard disc: ≥20G
Drive: CD-ROM and 1.44M floppy drive;
Other device: Mouse, keyboard, etc.

3.2 Installation procedures

3.2.1 Preparation before the installation

a. The lab environment should coincide with the requirements described in Chapter 3.1.
b. Compare the instrument configuration with the packing list to check whether it is complete.
c. Prepare 30 ~ 40 Kg distilled water or demonized water.
d. Provide proper drying vessel and analysis balance with sensibility which is not lower than 0.1 mg.
e. Provide oxygen cylinder in which the oxygen and pressure is up to the requirements.
f. Provide the basic tools such as nippers, scissors, spanners, screw drivers, pincers and angle scoops, etc.

3.2.2 Hardware installation

1. Layout and connection

a. Typical Layout：Place the computer (mainframe, monitor and keyboard) in the middle, printer

on the left and the calorimeter on the right for convenient operation;

b. Open the computer back cover. Insert the interface card into the computer main board slot. Fasten the tab of the main board by screw to avoid the interface card loose. After checking carefully, cover the computer.
c. After checking the signal wires between the calorimeter, the printer and the computer, fasten all the bolts of all signal connecting wires.
d. Place automatic bucket stably;
e. Check whether the fuse tube is installed in the power socket fuse box of the thermostatic tank and whether there is any short circuit between the shell, the live wire and the zero line. And check whether the voltage on the site of the instrument is normal and whether the instrument shell is earthed reliably.
f. Switch on the power to start the computer and begin to install the test-control software.

2. Install the PCI card driver

a. PCI interface card needs no jumper and the address can be assigned automatically. The bucket number is defined as follows: the first interface card close to the display card is 1# bucket, the second interface card close to the display card is 2# bucket, and so on. If there are sufficient PCI slots, generally the first PCI slot close to the display card is not to be used.
b. If there are many PCI interface cards, it is suggested to install the cards one by one, i.e. first insert one interface card → boot the computer → install the driver following the prompt of the system→ power off the computer → insert another interface card → boot the computer → install the driver following the prompt of the system.
c. In case that PCI card and ISA card are simultaneously inserted into the computer mainframe, the system will preferentially identify the ISA card. For example, when ISA card means 1# bucket, the first PCI card close to the display card means 2# bucket.
d. After the driver is installed, check according to the following procedures:
e. Start → Setting → Control panel → System → Device manager → MRC → click "+" to view the card identification name.

3.2.3 Software installation

The software of CALO-40 calorimeter is saved in a CD-ROM. For installation, please insert the CD-ROM marked with "Software of CALO-40 Calorimeter" into the CD-ROM drive. Find the CD-ROM drive through "Resource Manager" and open it. After that, you can start the installation either manually or automatically as follows:

1. Automatic installation

● Run the file of MRC.exe, the computer will be automatically rebooted several times during the installation. During the procedures, the MRC.exe has to be run repeatedly until the shortcut of "CALO-40 Calorimeter" is generated on the desktop.

● After the installation of the database desktop engine MSDE, right click the icon "MSSQL Server" on the lower right of the taskbar → open SQL Server service manager → click Star/Continue → select "When start OS, automatically start service".

2. Manual installation

The test-control system of CALO-40 calorimeter consists of test-control software main program and data management which are two independent parts and whose details are described in Chapter 4 and 5. In case of installing by manual, the necessary components and main program of the test-control software need to be separately installed as following:

● Install the necessary components

Attention: When manual installation is selected, "Necessary Components" should be installed

firstly. During the components installation, if it is prompted to "Reboot the computer", please permit rebooting to enter next step.

a. Run "CD-ROM: \ product test-control software \ install the necessary components \ IE60SPl \ ie6setup.exe" file.
b. Run "CD-ROM: \ product test-control software \ install the necessary components \ dotNet Framework \ dotnetfx.exe" file.
c. Run "CD-ROM: \ product test-control software \ install the necessary components \ dotNet Framework\ langpack.exe" file.
d. Run "CD-ROM: \ product test-control software \ install the necessary components \MSDERe\setup.exe" file. After that, reboot the computer.
e. Right click the icon MSSQL Server on the lower right of the taskbar→ open SQL Server service management → click Start/Continue → select "When start OS, automatically start service".
f. For the Windows 98 Operating System, you also need run "CD-ROM: \ product test-control software \ install the necessary components \dcom98.exe" file.

● **Install the test-control software**

If the above components are installed previously, directly run "CD-ROM: \ product test-control software \ install the necessary components \MRC.exe". During the installation, you only need select "Next" or "YES" to set the installing option, then the program can automatically finish the whole process.

The requirement of software operating environment: Windows XP with memory ≥ 128Mb and basic frequency ≥ 1GHz.

3.3 Operating method

3.3.1 Water filling

Before opening the CALO-40 Calorimeter bucket cover and filling water, check the following items carefully:

a. Whether there are any foreign matters in the bucket.
b. Whether the inlet and outlet of the water pump have been connected properly and whether they are out of shape or not.
c. Whether the screw-cap of water outlet has been tightened and whether the spillway has been opened.

After checking, operate the test-control software, the system will automatically test the water level of the water tank. If the system prompts "Water insufficient", add distilled water or deionized water into the water tank. The water will be filled into the jacket automatically from the bucket until "water insufficient" is not prompted or water overflows from spillway. At this time, the total water weight is about 28 kg. After finishing filling water, the test can be started 24 hours later, when the water temperature has kept equilibrium with the room temperature.

Attentions:

a. **Every time when the test-control program is started, the computer will automatically test total water weight of the system. If the total water weight can not meet the specified requirements, please start the expert diagnosis. And at this time, automatic or manual method to fill water from the bucket to the jacket should be selected. At the same time, please pay attention to controlling the adding water volume, or else the instrument can not carry out the tests of heat capacity and calorific value.**
b. **The water is suggested to be changed once half a year.**

3.3.2 Installation and use of Micro-oxygen filler

1. Installation and inspection

a. Before the installation, carefully check the components to see if they are fastened, which should be free of appearance damages or crashes.

b. Connect pressure-reducing valve, oxygen cylinder and the oxygen filler. Then fasten the lock nut.

c. Turn on the master valve of the oxygen cylinder, regulate the pressure-regulating screw to make the low pressure gauge reading be 2.8~3Mpa. Be sure of no leakage throughout the gas circuit, otherwise it should be re-installed until normal pressure is indicated.

d. Carry out oxygen filler at a trial basis. Be sure of no leakage and easy operation at this stage. Pressure indication on oxygen filler should be the same on the whole as low pressure gauge indication on pressure-reducing valve.

2. Usage

a. Rotate the switch of the oxygen filler anticlockwise till it couldn't be rotated to ensure that it is closed absolutely.

b. Align the oxygen bomb head with the oxygen filler and then press the head gently down to the end. During this process, the self-locking mechanism will lock the oxygen bomb head automatically.

c. Rotate the oxygen filler switch clockwise slowly. After the oxygen filler is uplifted gently, rotate the switch faster to make it be opened absolutely, then you can begin to oxygen filling.

d. After finishing oxygen filling, rotate the switch anticlockwise to make it be closed absolutely.

Attentions:

a. Oxygen filling should be followed as above steps strictly, and the oxygen filler should be handled carefully.

b. This oxygen filler must to be matched with the calorimeter oxygen bomb whose valve core and valve body are marked with "X" or "Y".

c. Only when the oxygen filler automatically locks oxygen bomb head that oxygen filler switch can be opened.

d. Each day when the test is over, close the oxygen filler master valve and release residual oxygen from the circuit (Method: close the oxygen cylinder valve and turn on oxygen filler switch to release the residual oxygen till all the gauges indicate zero, then close the oxygen filler switch finally.).

e. Fire and smoke are prohibited in the area where the oxygen filler and oxygen cylinder are put.

f. Bending and twisting the oxygen filler conduit are forbidden.

g. Inspect the pressure gauge on the oxygen filler and low pressure gauge on the relief valve to see if their indicated values are in line with each other at regular interval.

h. No grease is permitted to be used in the connecting nuts of the whole oxygen circuit.

i. Never force to rotate the oxygen filler switch to prevent damaging the oxygen filler. Please obey the manual of CY10 micro-oxygen filler when operating it.

3.3.3 Usage of oxygen bomb

1. Pre-use Check

Strict quality inspection is done for the oxygen bomb before delivery. There is no need for the user to dismantle the oxygen bomb. But re-inspection is essential. Please inspect it as following:

a. Check if the oxygen nozzle is loosened.

b. Check if the two electrode rods are loosened and if the fire baffles (round stainless steel sheet)

are tightly fixed. And make sure that the fire baffles are not short connected with the two electrode rods.

c. Check if the crucible support is properly fixed.
d. Check if the oxygen inlet hole of the bomb core is smooth.
e. Check if there is any foreign matter on the threads of the oxygen bomb cylinder and bomb cover or on the sealing rings.
f. After oxygen is filled, put the bomb into the water and see if there is any bubble going up. If the bubbles go up, it indicates that the bomb leaks and the sealing ring should be replaced.
g. Check the appearance to see if there is any collision trace.

2. Use the oxygen bomb correctly

a. Hang the oxygen bomb core onto the bomb support;
b. Put the dried crucible onto the weigh tray of the balance to weight the mass. Tare and reset it to zero if the balance is an electric balance.
c. Put the thoroughly mixed sample into the already weighed crucible with clean spoon (Coal sample should be uniformly mixed). Record its mass. (2 pieces of benzoic acid; coal sample 1g±0.1g; oil sample: 0.3g～0.7g).
d. Put the sample-containing crucible onto the crucible support of the oxygen bomb;
e. Connect the firing wire to the crucible support (oxygen bomb electrode rod) and tighten the nut to keep the firing wire close to or slightly touch the sample surface;
f. The firing wire is prohibited to contact the crucible. In case of coal sample, the firing wire should not be inserted into the coal. It should be bent in the circular form and kept close to the sample surface.
g. After the sample is placed and firing wire is properly installed, stably place the bomb core into the oxygen bomb cylinder with 10ml of distilled water, then fasten the oxygen bomb cover and put it stably onto the oxygen filler for oxygen filling.
h. After filling the oxygen by regulation, stably place the oxygen bomb into the bucket of the instrument.
i. After finishing the test, release residual oxygen from the oxygen bomb through the release valve.

Attentions:

a. Fire baffle short circuiting to the two electrode rod is prohibited.
b. Before installing firing wire each time, completely clean the firing wire and other foreign matters remained on the electrode rods and inside the gland ring.
c. Over-pressure oxygen filling (normal pressure is 2.8~3Mpa) is prohibited, the oxygen filling duration should be relatively similar (generally 15~60 seconds).
d. Oxygen bomb cover should not be over-tightened. After rotating it to the right position, slightly fasten it.
e. After the test is over, clean the bomb cylinder and cover. Then dry them up in the air.
f. Regular quality inspection for the oxygen bomb should be done. Carry out hydraulic test at least once a year. (You can send them to MRC for inspection and testing.)

3.3.4 Online test

After the hardware and software are installed completely, you can carry out the online test. If there is nothing abnormal, the installation will be regarded as completion. Otherwise, carry out itemized inspection for the hardware and software installation according to the troubleshooting methods to solve the problem correctly or reinstall in case.

Attention:

After finishing the instrument debugging, components movement and pulling of the signal

wire are prohibited to avoid any failures.

Chapter 4 Instrument use and Operating Instructions

4.1 Starting and Exiting of the Test-Control Software

4.1.1 Start

There are two ways to start the test-control software of CALO-40 Calorimeter.

Way 1: After the software is properly installed, a shortcut on the Windows desktop and menu item in Windows program group are generated automatically Directly click the shortcut icon named “CALO-40 Calorimeter”, or start up from “Start-up→ Program →CALO-40 Calorimeter”.

Way 2: Choose “Run the program when entering into the WINDOWS” item from the “System Setting” of the test-control software to automatically start the test-control software of CALO-40 Calorimeter the next time when you boot the Windows.

4.1.2 Exit

The test-control software should be closed before exiting the Windows or shutting down the computer to ensure the test data and parameter files not destroyed.

Choose “Shut down the Computer when Exit” in the “Parameter setting” of the test-control software to automatically shut down the computer after exiting the program.

4.2 Description of Functions of the Main Window

The main Window body of the CALO-40 Calorimeter test-control system mainly consists of headline column, shortcut icon column, windows body, status column.

The interface of CALO-40 Calorimeter test-control system after temperature balance treatment is shown as Fig. 4-1.

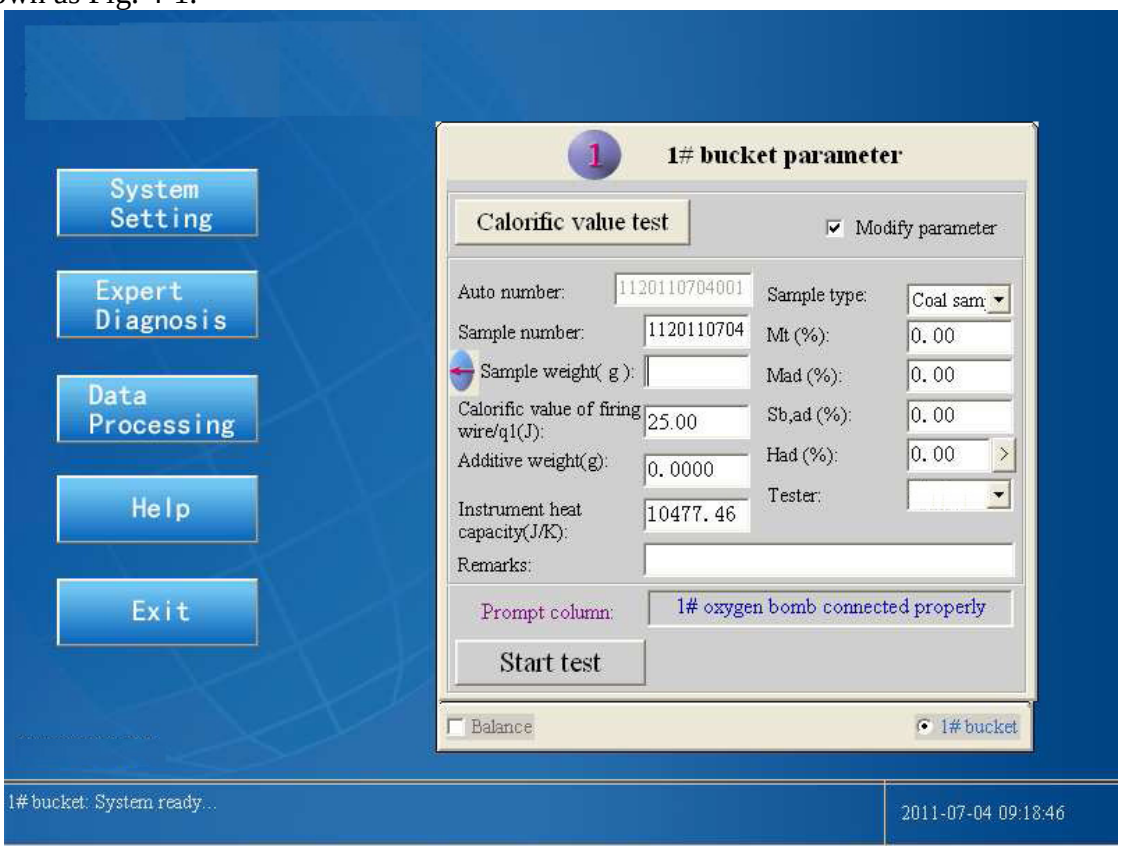

Fig.4-1 Main Frame

The working window of CALO-40 Calorimeter test-control system is shown as Fig. 4-2.

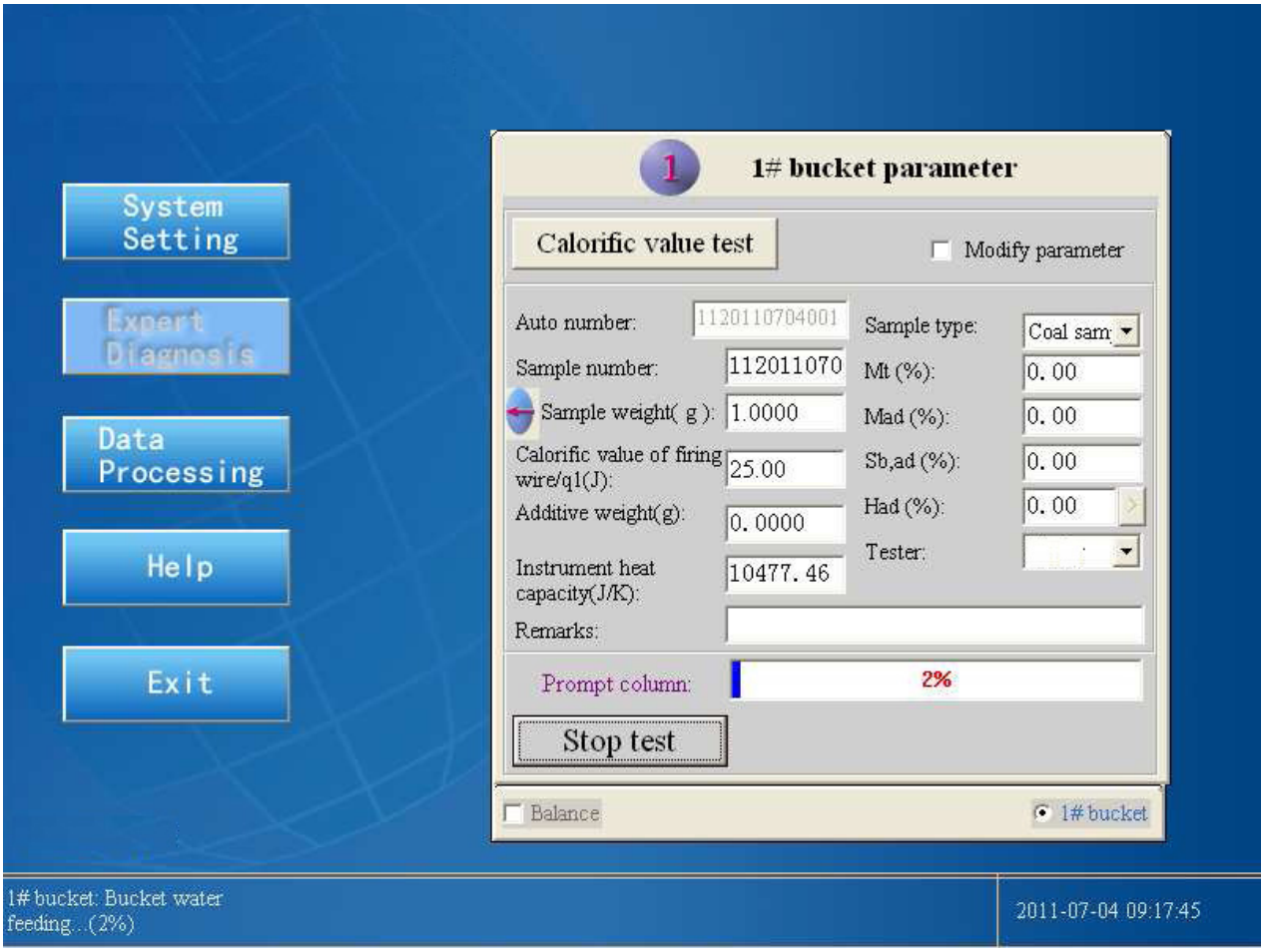

Fig.4-2

4.2.1 System menu

1. **System setting** (shown as Fig.4-3 for Setting Login Window, Fig.4-4 System Basic Setting Window and Fig.4-5 System Advanced Setting Window).

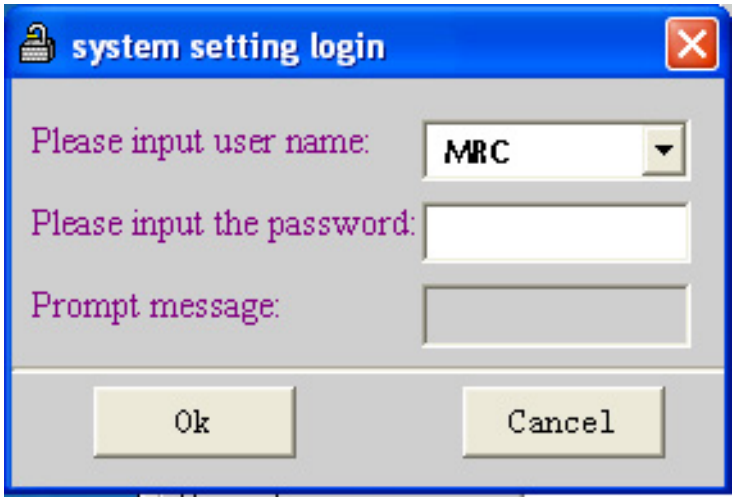

Fig.4-3

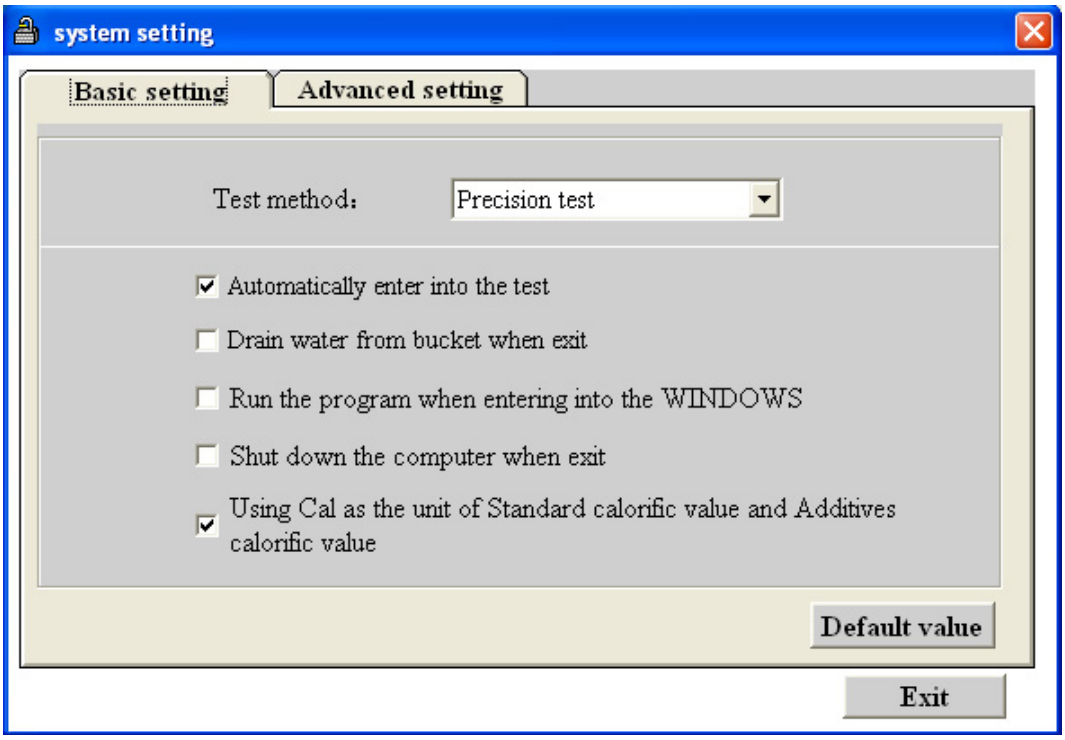

Fig.4-4

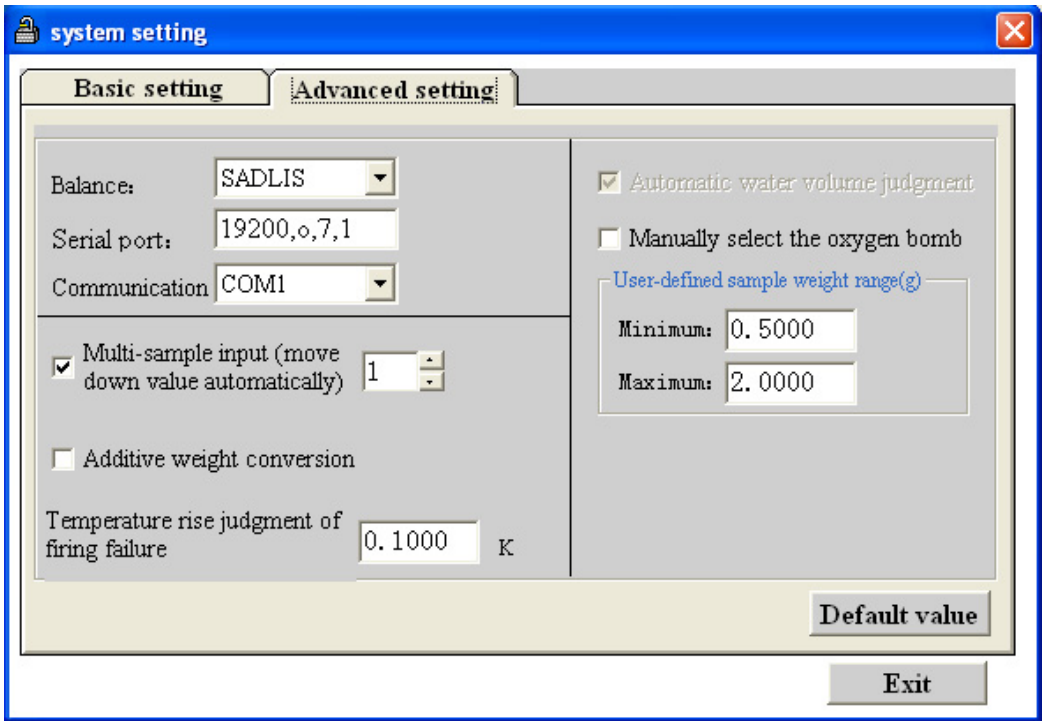

Fig.4-5

Click “System Setting” button to login and enter the system parameter setting window.

2. Expert diagnosis (shown as Fig. 4-6 Expert Diagnosis)

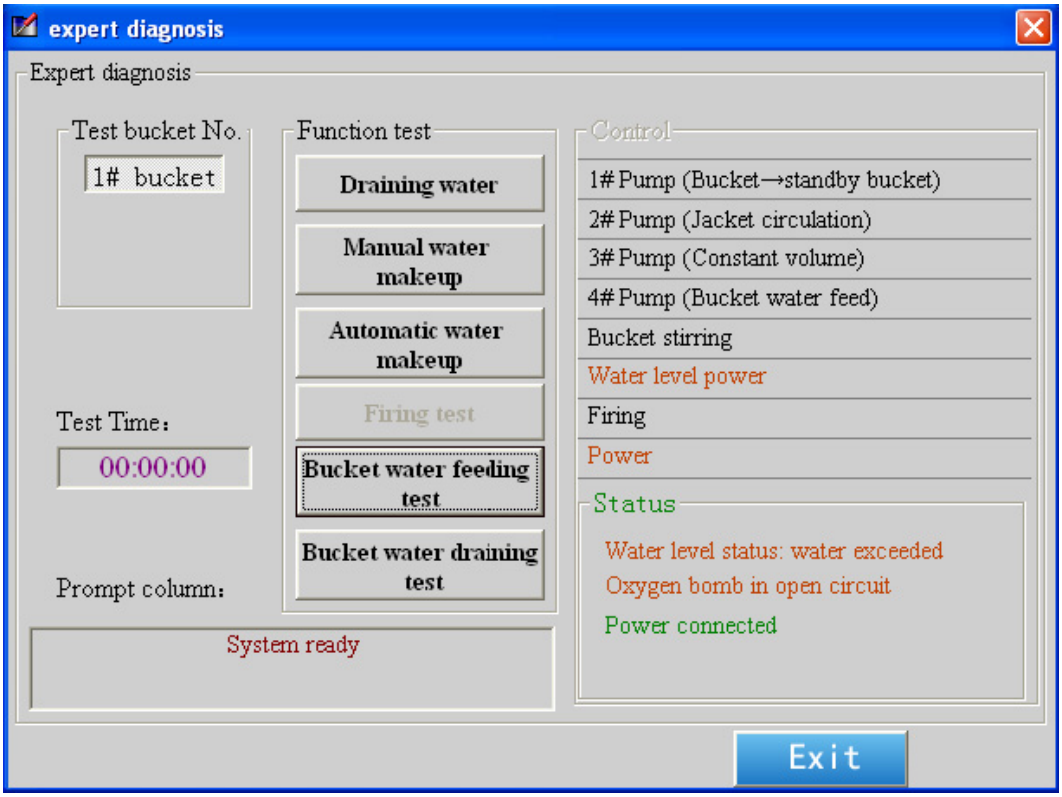

Fig.4-6

Click “Expert diagnosis” button to enter this window.

3. **Data processing**

Click “Data processing” to login and enter this window.

4. **Help**

Click “Help” button to enter the helping system.

5. **Exit system**

Click “Exit system” and “Yes” button to exit the test-control system.

Attention: When the computer is on state, never pull out the plug board card to avoid damage to the computer and the corresponding line CRD cards.

4.3 System setting

● **Description of the logging in System Setting**

After entering the user name and correct passwords (It can also be called Permission), you can enter the system setting. The Ex-factory user name is defaulted as “MRC”, and the password is defaulted as “1234”. If the user administrator does not set the password, one can automatically log in the “System setting”.

● **Description of the system basic setting options**

1. Test methods: There are 3 test methods: precision test, fast test and ordinary test. The test time of precision test and ordinary test includes bucket temperature equilibrium time (5 minutes), initial stage time (5 minutes), main stage time (7 minutes). The fast test time just includes bucket temperature equilibrium time and main stage time (The precise test method is

defaulted).

2. Automatically enter into the test: Select this item and exit setting window. Only when the weight is effective and the oxygen bomb has been connected properly will it enter into the test automatically (it defaults to be pitched on). Otherwise “Start Test” button should be clicked to enter into test.
3. Run the program when entering into WINDOWS: Select this item and exit setting window. Next time when you start up the computer, the test-control system will be run automatically and the system initialization will be done (It defaults to be not pitched on).
4. Shut down the computer when exit: Select this item and exit setting window. The computer will be automatically shut down after exiting the test-control system (It defaults to be not pitched on).

● **Description of the system advanced setting options**

1. Balance, serial port and communication port: it should be correctly set up so as to ensure normal on-line communication of the balance (The default value of serial port is “1200, o, 7, 1”).
2. Multi-sample input: After selecting this item and exiting, you can input multiple samples weight in advance (shown as Fig. 4-5-1). After the test is finished, the system will automatically transmit current data into the weight input box. When setting the automatic move-down value as 0, the next sample weight needs to be appointed, or else it will move to the next data according to the move-down value.
3. Additive weight conversion: Select this item and input the additive calorific value. You just need to input additive weight in the main form parameter input box, and the system will automatically convert the weight to calorific value.
4. Automatic water volume judgment: When there is something wrong with water-level test, it can shield the water-level judgment through this item. Only technology support engineers can use this item (It defaults to be pitched on.).
5. Manually select the oxygen bomb: After selection, you can define oxygen bomb manually during the heat capacity test. The heat capacity of the corresponding oxygen bomb will be called out automatically in case of manual selecting the oxygen bomb during the heat capacity test.
6. User-defined sample weight range（g）: This item is effective only when the “Sample type” of the main form parameter input box is “user-defined”.

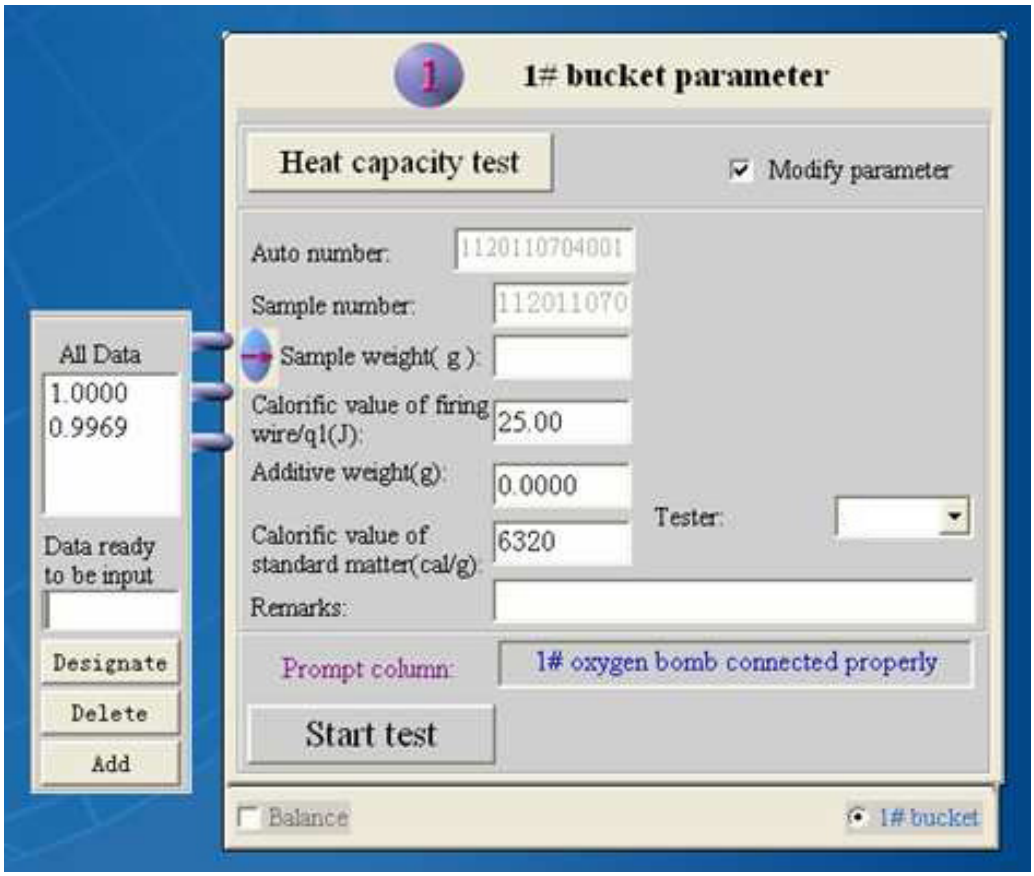

Fig.4-5-1

● Description of multi-sample input window

Select “Multi-sample input” in “System setting”, then exit and return to the main interface. Click the red arrow near the “Sample Weight”, and then the multi-sample input window will be displayed (shown as Fig. 4-5-1). All the function keys are introduced as following:

1. Add: Move the cursor to “Data ready to be input” column to input the sample weight. Then click “Add” button and the input data will be added to “All data” column. (Data can be added for many times during the test.)
2. Designate: Select one data from the “All data” column and click this button, then the selected data will become the current sample weight.
3. Delete: Delete incorrect data. Select one data from the “All Data” column and click this button to delete it.
4. Attention: After starting the test, if the designated sample weight is wrong, you can modify the data only by selecting “Modify Parameters” and entering correct passwords.

4.4 Expert diagnosis

The expert diagnosis (shown as Fig. 4-6) is specially designed for the hardware test of CALO-40 calorimeter. It can carry out independent tests for each function of instruments, display test time, and prompt users to maintain in time.

- Draining water

When distilled water in the instrument needs to be changed, screw off the water discharge hole and click this key, then the water will be drained automatically according to the designed program.

- Manual water makeup

When the instrument prompts “water insufficient”, click this key and add water to the bucket until overflow.

- Bucket water feed test

This function is to pump water from jacket to bucket. It makes water to be drained from bucket firstly, then it simulates the last water feed process of normal test to judge whether the water quantity of the inner bucket is suitable. This process needs about 2 minutes.

- Bucket water draining test

This function is to pump water from bucket to standby bucket, and this process needs about 1 minute.

4.5 Data processing

The data processing system is designed for managing the testing data in a more efficient way. It consists of data management of the heat capacity and calorific value. During the test, accessing the database is permitted. For details, please refer to Chapter 5.

4.6 Help

Click “Help” button, the information on the version of the test-control software will be displayed. Press “YES” button to enter the help file of the test-control software for CALO-40 Calorimeter, and press “Cancel” to return to the main form.

4.7 Test operating process

In order to introduce the calorific value and heat capacity testing process of CALO-40 Calorimeter test-control software, we will take the calorific value test as an example to describe the process.

1)System start

For details, refer to 4.1.1 of Chapter 4. Now suppose that we have already entered the test-control system.

2)System setting

For details, refer to 4.3 of Chapter 4 and 5.2.2 of Chapter 5.

3)Sample preparation

Weighing samples, installation of oxygen bomb, oxygen filling, and putting the oxygen bomb into the bucket as required.

4)Data input

a. Input sample weight, calorific value of firing wire and calorific value of additives (The default value is 0J) as Fig.4-2.The content of inherent moisture and total sulfur air dry basis needs to be input when testing the gross calorific value of coal sample dry basis. If your computer has been connected with the electronic balance and their communication is normal, the sample weight will be input automatically by the balance.
b. During the heat capacity test, manual number will be generated automatically by system. It does not need to be input by hand. The generated value is “bucket (1 digit) + Oxygen bomb number (1 digit) + Year (4 digits) + Month (2 digits) + Date (3 digits). The max manual number digit of calorific value is 20 characters (a Chinese character or a letter is defaulted as one character).
c. During the calorific value test, manual number is the precondition of parallel sample judgment. Only the samples with the same manual number that can the average value and qualification be displayed.
d. Click “Start test” button or select “Enter into the test automatically” in the “system setting”. If the input parameters are false, select “Modify Parameter” and enter the correct passwords, then you can modify it. (If the hardware errors happen, such as the power or oxygen bomb or probe not been connected properly, the system will display prompt information in the status column. Until

all errors are solved that you can continue to do the test.)

e. After finishing inputting the parameters, press “enter” or move cursor up and down to switch to other columns.

5)Test process

After all parameters of sample are input, the system begins to enter test status, it will automatically start stirring, firing, calculating and saving the test results. During the whole process, you will see the window shown as Fig.4-2.

If it fails to fire or the test result comes out, the system will alarm to remind the tester.

6)Result display

a. After finishing the sample test, please login data processing. The current result and result with current date as well as repeated sample test results will be displayed in the database.

b. When parallel samples are qualified, the prompt “qualified” and the average value will be displayed. If the printer is connected correctly, the result will be printed out according to the setting contents, sheet form, and copies.

c. When the prompt “Test ready” is displayed in status area, you can begin the test again.

7)Interrupt test

If you want to quit the test anytime during the process, click “Stop test”, then a warning window will be displayed (shown as Fig. 4-7). Click “Yes” in “Exit system confirmation” window and enter the correct passwords, then the current test will be quit and the system will return to the main window of the test-control system. If you click “Cancel”, then the test will be continued.

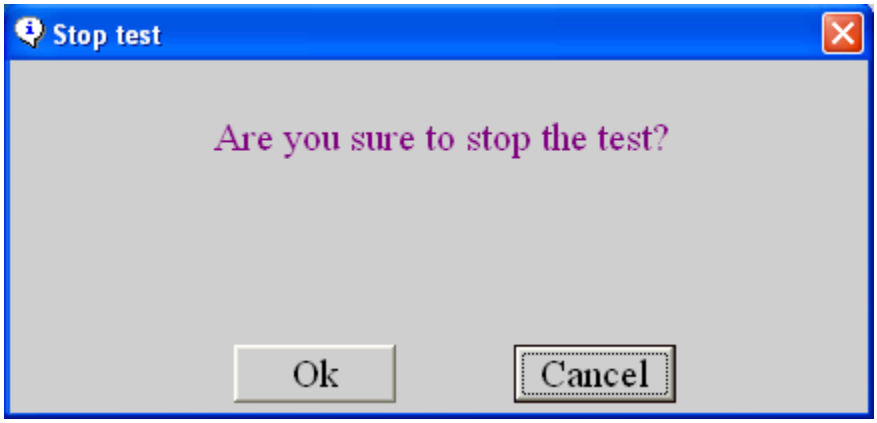

Fig.4-7

Chapter 5 Data Management for the Test-Control Software

5.1 User Login

Fig.5-1

● **Description of Database login:**

a. A database login window will be popped up as Fig. 5-1 as soon as the CALO-40 Calorimeter test-control program is run.

b. After inputting the user manually or selecting from the dropdown list, press “Enter”, then a password input window will be popped up. The “User login” window will be closed automatically, if wrong passwords are input for 3 times. No password is set before leaving factory，so the “Data Management” will be logged in automatically when you start the test-control software.

c. Click “Exit” to return to the main window. Click “login” to enter the data management main window as Fig. 5-2 or Fig. 5-3.

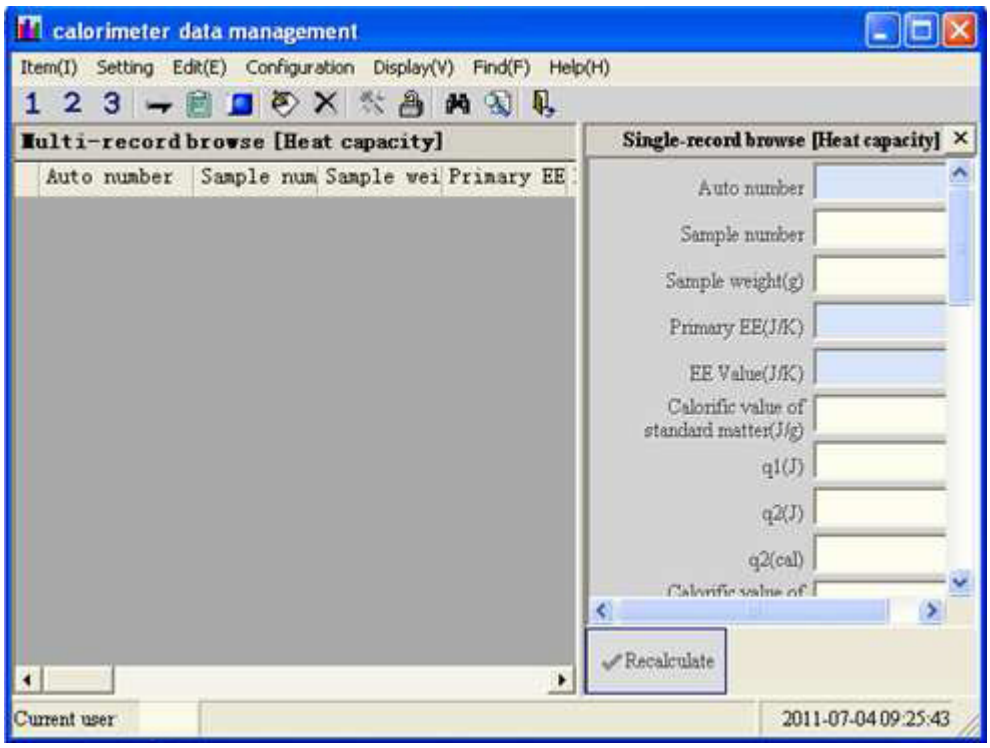

Fig.5-2

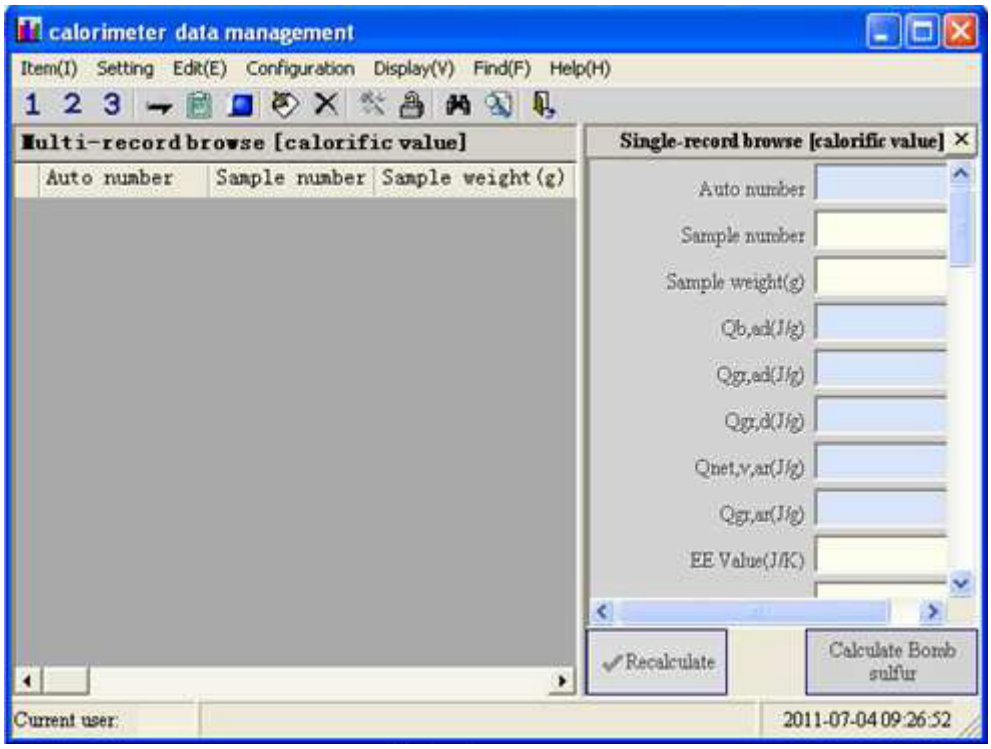

Fig.5-3

5.2 Main Form

The main window of the data management system of the CALO-40 Calorimeter consists of headline column, menu column, shortcut column, data display column, etc. The details of menu column are described as following:

5.2.1 Main Menu

The main menu includes the conversion of the calorific value and heat capacity. After converting, the heat capacity data window or calorific value data window will be shown respectively as Fig. 5-2 or Fig. 5-3.

5.2.2 Main Menu Setting (as Fig. 5-4)

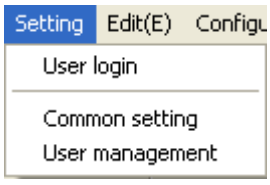

Figure 5-4

1. User login: Different users can login according to their authorities through this menu.
2. Common setting: Test company information, the printing copies, the database backup strategy can be set. For details, please refer to Fig. 5-5 Basic Setting, Fig. 5-6 Advanced Setting and Fig. 5-7 Database Backup Strategy.

● Basic Setting

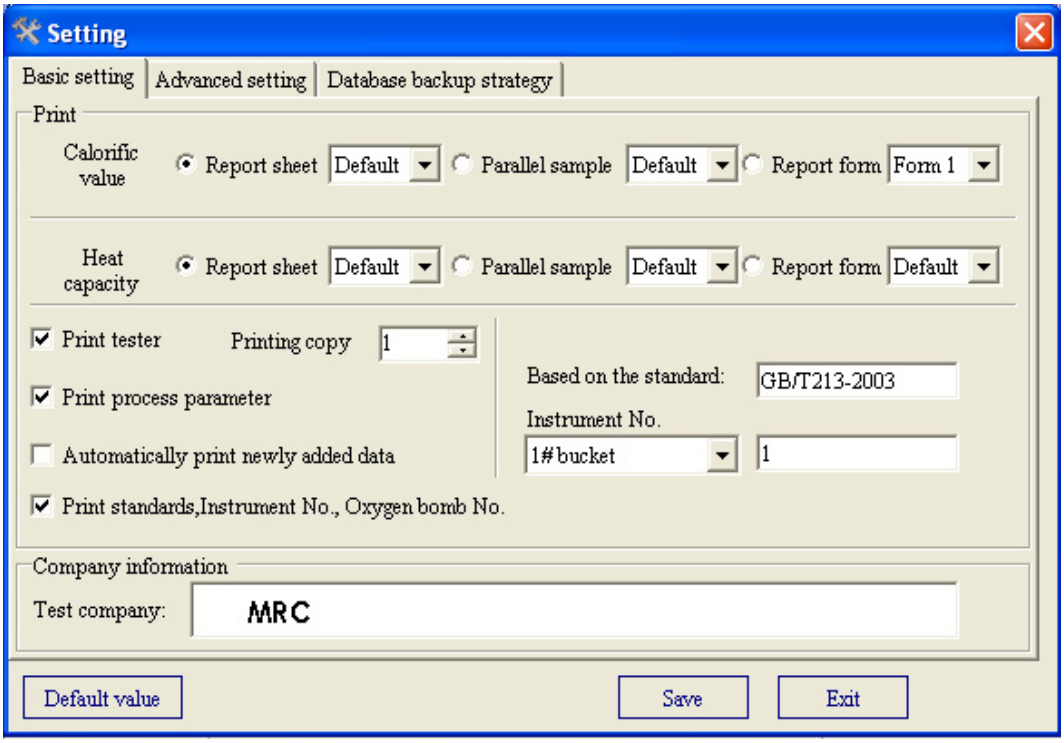

Fig.5-5

The information on this page is mainly about the setting of the print content, the report forms, etc.

a. Print report sheet: It is printed in the single-record form.

b. Print Parallel sample: If the manual numbers of the current selected records are the same and not null, and that the parallel sample judgment conditions can meet the test requirements, then the selected records will be printed in the parallel sample form, otherwise the selected records would not be printed..

c. Report form: It is displayed according to the report form during print preview. Two kinds of calorific value reports are provided while only one kind of heat capacity report is provided. During the heat capacity print preview, no matter the report is set as “Default” or “Form 1”, it would be printed according to the default print.

d. Print tester: If you choose this, it will print the tester name while print preview and automatic print, otherwise the tester name would not be printed.

e. Print Process Parameter: If you choose this, the system test process parameters will be printed while print preview and automatic print.

f. Print newly-added data automatically: If you choose this, it will automatically print out the report sheets and parallel sample, when test results of the calorific value or heat capacity come out. For the printer without Paper Setup function (such as laser printer), it is recommended to cancel this option in order to save papers.

g. Print standard, instrument No and bomb No: If you choose this function, it would print out the standard, Instrument Number and Oxygen Bomb Number, when the calorific value report form is set to “Default” or parallel sample pattern is set to “Form 2”.

h. Print Copies: During the printing, it will print according to the printing copies you set.

● Advanced setting

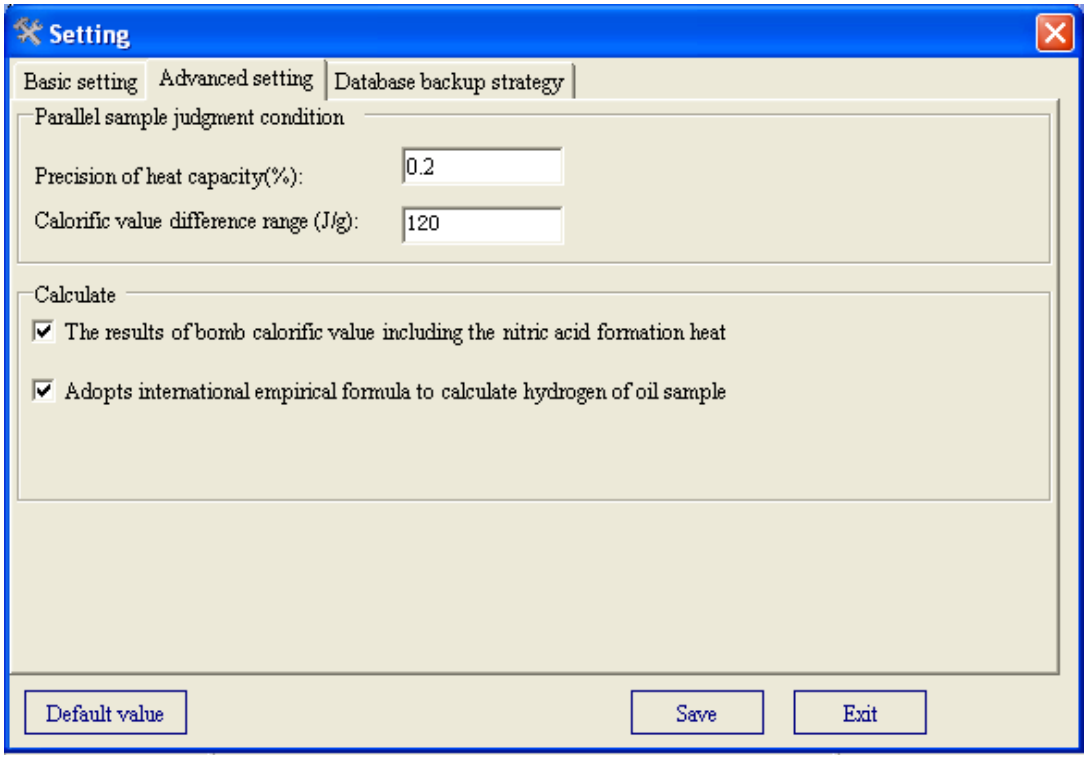

Fig.5-6

a. Parallel sample judgment condition: Generally default value is used to decide if the parallel sample is qualified;

b. The results of bomb calorific value including the nitric acid formation heat: If this option is not selected, heat from nitric acid will be automatically deducted from the bomb calorific value according to the formula "Qb,ad *a*m" ,in which Qb,ad stands for the bomb calorific value, a stands for the factor of heat from nitric acid and m stands for the sample mass.

c. Adopts international empirical formula to calculate hydrogen of oil sample: If this option is selected, during the light oil or heavy oil testing, the hydrogen value will be automatically calculated.

● **Database backup strategy (as Fig. 5-7)**

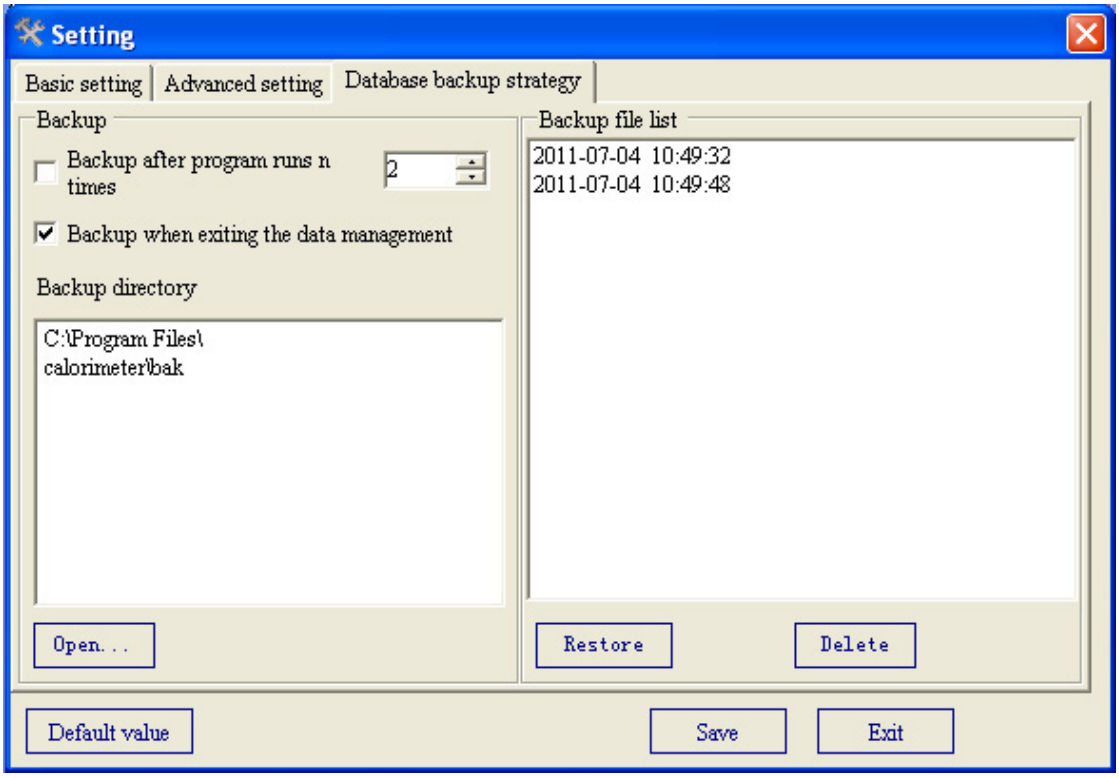

Fig.5-7

a. Backup after program runs n times: when data management program runs for the setting times, backup should be carried out while exiting database program.
b. Backup when exiting data management program: If you choose this option, a backup copy will be generated automatically each time when you exit the data management program.
c. Backup directory: Click “open…” to select a valid directory, and the backup copy of the required data will be saved under this directory.
d. Backup file list: Firstly select a record from the “Backup file list”, then click “Restore”. After restoration, the data management program has to be restarted. Otherwise all modifications to the database will be invalid before restarting the data management program.

3. User management: This option is used to add, modify and delete the user and determine the authority level of usage. For details, please refer to Fig. 5-8.

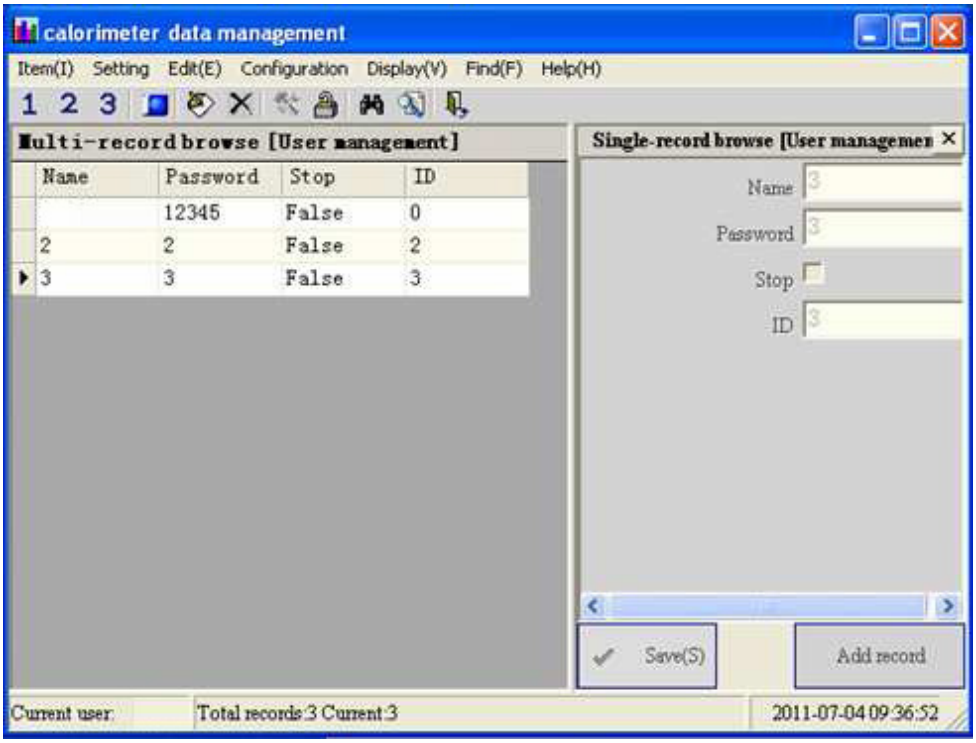

Fig.5-8

a. The user with ID 0 cannot be deleted or modified to inactive status which is also called as False Status.
b. ID can't be modified or data with the same user name can't be added.
c. The current logging in user cannot be deleted;
d. The user who is selected and being tested by the main program cannot be deleted, otherwise the data saving will fail.
e. The user with ID more than 9 cannot login to "System Setting" of the main program.

5.2.3 Edit main menu (shown as Fig. 5-9)

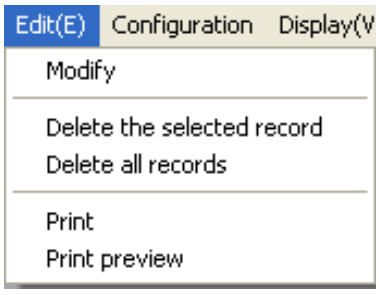

Fig.5-9

- Modify: After clicking, the Single-record browsing will be automatically opened and then it will enter the edit status.
- Delete the selected record(s): Delete all the selected records during the multi-records browsing.
- Delete all record(s): Delete all displayed records during the multi-records browsing.
- Print: Print the selected records during the multi-records browsing.
- Print preview: Preview the selected records during the multi-records browsing (shown as Fig.5-10).

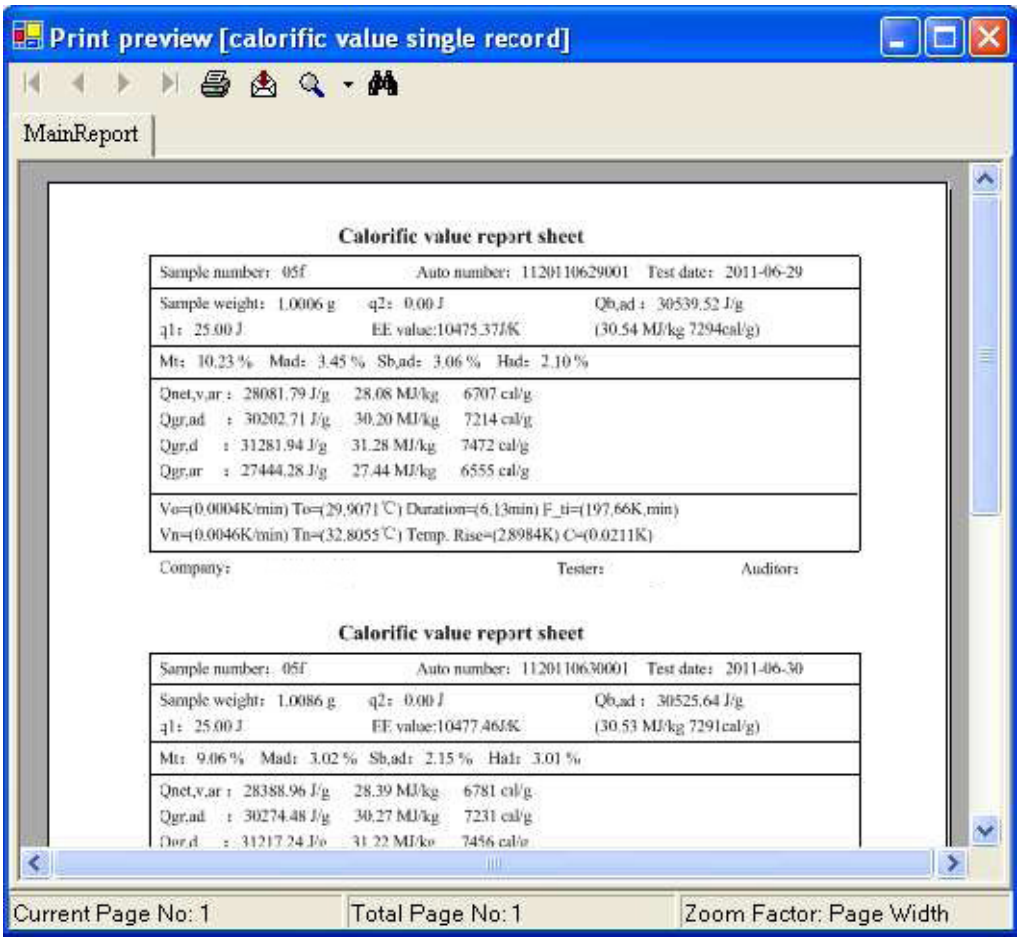

Fig.5-10

5.2.4 Configuration main menu(as shown in Fig. 5-11)

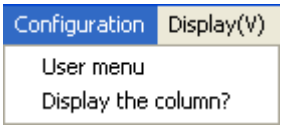

Fig.5-11

- User menu: Authority allocating for the current logging in user (shown as Fig. 5-12).
  a. It is used to allocate authority for the current logging in user.
  b. Directly select or cancel the menu item in “Configuration user menu”, then click “Update display” to update the user menu immediately;
  c. “Setting”, “User Login”, “Configuration” and “User Menu” are always visible;
  d. Selecting “User menu” means that this user can directly allocate his or other users’ passwords and menu authorities. Thus, “User menu” authority can only be assigned to the system administrator generally.
  e. If “User menu” is cancelled and “Configuration user menu” is needed, the identity should be confirmed by the system administrator’s authority.
  f. The “-” stands for the menu column separator, and it is only used for displaying.

- Display the column?: It is used to allocate the columns allowed to be displayed in the current Multi-records browse window (shown as Fig. 5-13).
  a. It is used for allocating which column to be displayed in the current “Multi-records browse” window and “Single-record browse” window.

b. It is applicable for allocating the calorific value, heat capacity and the subsequent form.

c. The column configuration can not be aimed at every user.

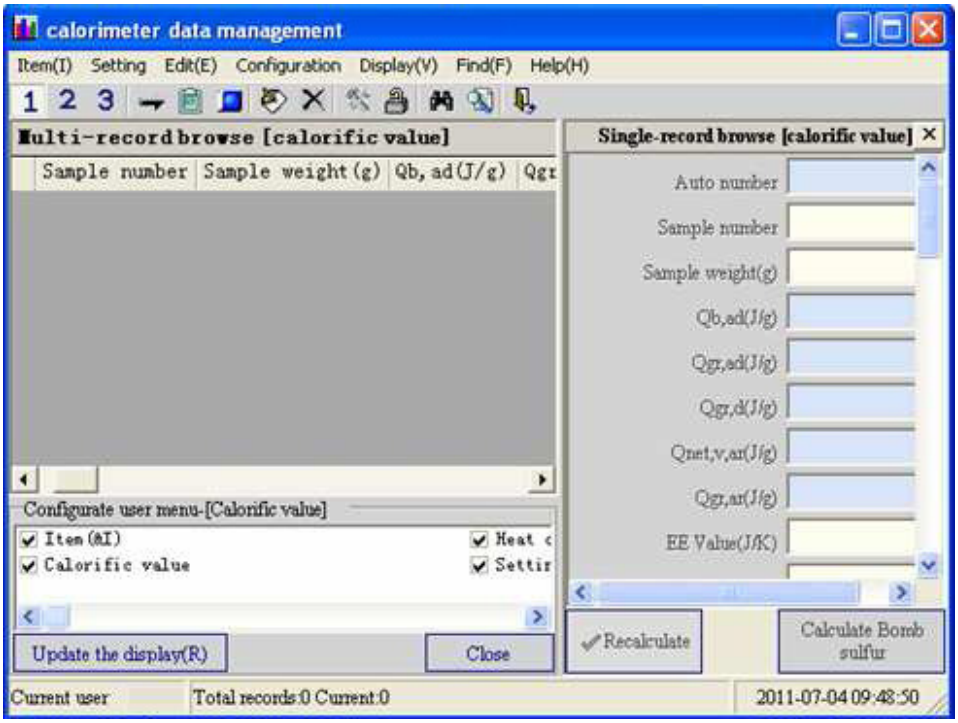

Fig.5-12

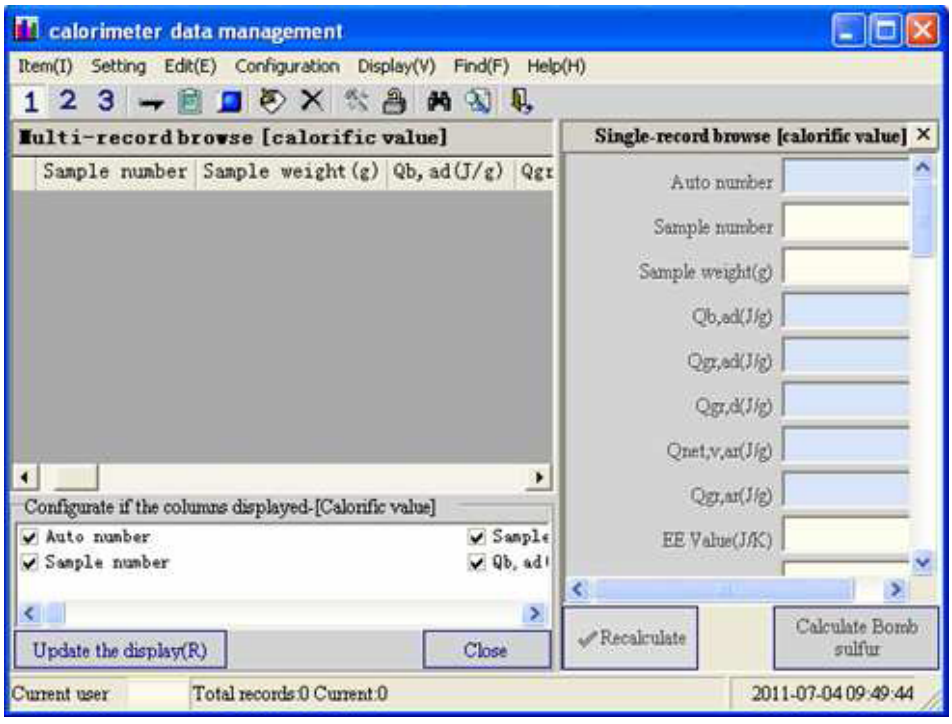

Fig.5-13

5.2.5 Display the main menu (shown as Fig. 5-14)

Fig.5-14

● Display single record:

a. Double click it to Open or Close the single-record browsing in the data window.

b. When selecting this item, the single record browsing window will be opened (shown as Fig. 5-14), otherwise the single record browsing window will be closed.

● Save current column-width: It is used to save the column width in the current multi-record browsing window after adjusting.

a. It is used to save the column width of the current form.

b. It is applicable for allocating the calorific value, heat capacity and the subsequent form.

c. The width setting will not be aimed at every user.

d. Special users can be limited to use this function by “User management”.

5.2.6 Find the main menu (shown as Fig. 5-15)

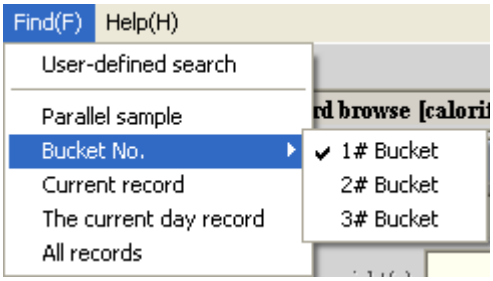

Fig.5-15

● Parallel sample: Display all the records whose numbers are the same with manual numbers at the current day, and display the corresponding parallel sample message, such as average value and precision.

● Bucket No.: Display all data of one bucket at current day.

● Current record: Display the data whose manual number and testing date are the same with those of the current selected record.

● Current day record: Display the data whose testing date is the same with that of the current selected record.

● All records: Display all the records in the database;

● Advanced search: Provide several ways for searching by self-defining (shown as Fig. 5-16);

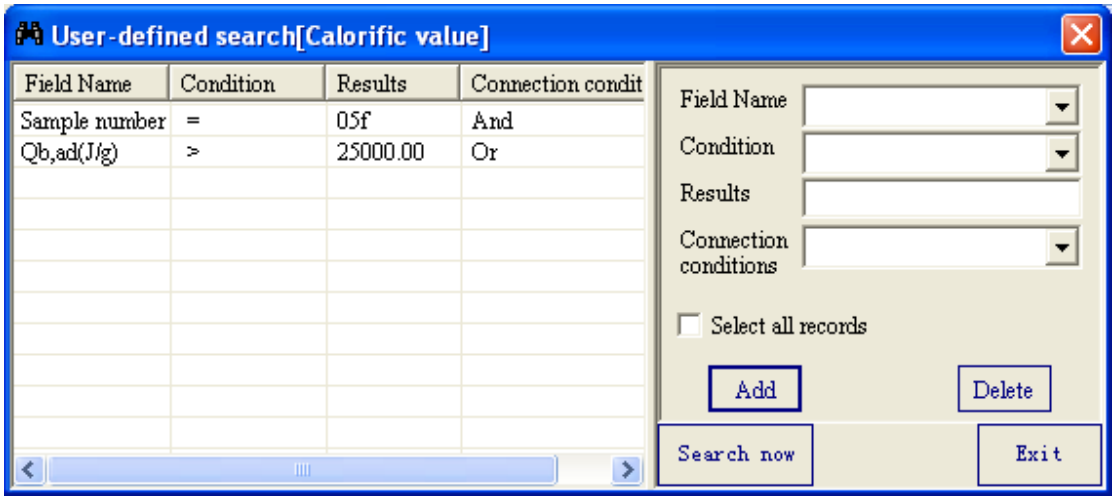

Fig.5-16

a. Field name: The field names of all columns in the current form;

b. Condition: “like” stands for similarity.

c. Connection condition: “And” stands for meeting two connected conditions at the same time. “Or” stands for only meeting one of the two conditions.

d. Add: After entering all the query conditions, click “Add” to transfer them to the left condition list.

e. Delete: Select one condition from the left condition list and click “delete” to delete it.

f. Select all records: After selection, click “Start to Find”, all records in the current multi-record browsing window will be displayed.

5.2.7 Help

- About: Display message, such as the database revision number;
- Help documents: The use of the database is described in details.
- Calculator: Call out the system calculator to facilitate other calculations;
- Always in the foremost: After selection, this window will be always kept in the foremost. If the window is minimized, this function is invalid.

Chapter 6 Instrument Maintenance

6.1 Maintenance of the instrument

a. The CALO-40 instrument must be reliably ground.
b. Foreign matters or impurity are prohibited to be put into the bucket to avoid water pollution and pipe blockage which would cause damage to the instrument.
c. After finishing the test, uncover the bucket to avoid corroding the instrument components;
d. Water should be changed at least once a year.
e. Diagnosis can be carried out by the expert diagnosis system in case of any abnormality of the instrument

6.2 Maintenance of the Oxygen Bomb

a. Every day before the test, be sure to fill adequate oxygen into the empty oxygen bomb and immerse the filled oxygen bomb in water for several minutes so as to observe its sealing performance to ensure reliable test results.
b. After test completion each time, be sure to flush bomb components with distilled water and wipe them dry with special towel.
c. Change the sealing ring by backup ring if oxygen leakage from bomb has been found, otherwise the oxygen bomb cannot be used any longer.
d. Never use the oxygen bomb when its screw threads have failed.
e. Inspect oxygen bomb at regular interval. Carry out hydraulic test at least once a year. (You can send it to MRC for such test).
f. Be sure to take out and put the oxygen bomb from and into bucket carefully to avoid bucket damage due to the collision or drop.
g. After use, the crucible should be cleaned. And it would be better to bake it at high temperature of electric oven for 3~5 minutes.

6.3 Maintenance of the Micro-type Oxygen filler

a. The oxygen used for test must satisfy Chinese Standard GB213-96. The use of the electrolytic oxygen is prohibited. The oxygen cylinder should be placed at the site up to the safety regulation.
b. The oxygen filler should be placed on stable work bench.
c. It is forbidden to let the oxygen filler (incl. oxygen filling conduit and pressure reducing valve) contact with various oil and greases;
d. The oxygen conduit of the oxygen filler should be protected against bending and twisting.
e. Open fire around the oxygen filler is prohibited;
f. If the oxygen pressure in the oxygen cylinder is lower than 4MPa, the oxygen should be renewed. If the filling pressure of the oxygen bomb is higher than 3MPa, release the oxygen from oxygen bomb, reinstall the bomb and refill the oxygen.

6.4 Maintenance of the Test-Control Software

If the test-control software is destroyed, delete it and reinstall it as the following procedures:

Click “Start” in the task bar →Open “Control Panel” → Click “Add/ Delete program” → select “CALO-40 Calorimeter Test-Control System” in the program list → Click “Delete” to perform the delete function. And the destroyed software can be deleted safely and quickly if you follow the prompt message.

For the details of the software installation, please refer to 3.2.3.

Chapter 7 FAQ and Solutions

In this chapter, we will introduce some knowledge for the maintenance and malfunction solutions. If the user cannot solve it, please contact MRC

Failures	Reasons and Solutions
7.1 Power failure	1. The controlling wire of the calorimeter is not connected properly. It should be connected well and fastened. 2. The power supply panel may be damaged. It should be replaced. 3. The fuse is burnout. It should be replaced（5A）.
7.2 Probe failure	1. The controlling wire of the calorimeter is not connected properly. It should be connected well and fastened. 2. The probe is damaged or disconnected. It should be replaced or ask professional technician for repairing.
7.3 Interface card failure	1. The interface card is not properly inserted. Insert it after cutting the power off. 2. The interface card driver is not installed.
7.4 Oxygen bomb poor contact	1. The power is not properly connected. Check the circuit and connect the power properly. 2. Let the two electrodes on the bucket cover be short circuit with tweezers. If the screen displays “bomb short circuit”, please check if the firing wire is properly connected or the electrodes in bomb are in open circuit. If the screen displays “Bomb Connected”, please check if the controlling wire is properly connected.
7.5 The stirrer cannot stir	1. The power is not properly connected. Please connect it properly. 2. The motor of the stirrer is damaged. Please ask the professional people for repairing. 3. The stirrer is stuck. Please ask the professional people for repairing.

7.6 Ignition failure	1. The probe is damaged. Please replace it or ask the professional people for repairing. 2. The external and inner electrodes of oxygen bomb are in short circuit. Please repair it. 3. The oxygen is not filled or insufficient or the samples are not put in. Please fill the oxygen or put the samples according to the operating instructions. 4. The firing wire is not properly installed or the contact resistance is too high. Please install firing wire according to the operating instructions. 5. If the stirrer cannot stir or work with low efficiency. Please replace it or ask the professional people for repairing. 6. If the external power voltage appears big fluctuation. Please take measures to ensure the power voltage stable.

7.7 The test result is not ideal.	1. The test environment and power cannot meet the requirements. Please ensure the environment to conform to the requirements. 2. Check if the balance is in normal status, if the weighing is accurate, if oxygen is sufficiently filled, and if the oxygen bomb is leaked. 3. The sample is not uniform or not up to the China national standard. Please test with standard samples. 4. The sample is deflagrated or spilled out from the crucible. Please pay attention to your operating method. 5. The tightness of the bucket cover is poor or the stirring is not at normal status. Please replace or repair them.
7.8 Abnormal temperature rising	1. The environment temperature changes greatly or the tightness of the bucket cover is poor. Please ensure the environment to be more stable. 2. Check if the controlling wire is properly connected.

7.9 Failed to print or print abnormally	1. The power and the power cable are not properly connected. Please connect and fasten them. 2. The printer is not ready. (The on-line indicator light is off). Please turn on the printer power after installing the printer driver. 3. There is virus or the software has been destroyed. Please kill the virus or reinstall the software.
7.10 No display on the screen	1. The computer power wire, display power wire and display signal cable are not properly connected. Please connect them properly. 2. The buttons of monitor are not adjusted properly. Please adjust them to a proper status.

7.11 Unable to enter the test-control status	1. The computer is unable to carry out self-test. Please contact MRC. 2. If the balance time of the temperature is more than 1 hour after entering the program, please contact MRC. Otherwise please wait till the temperature achieves balance.
7.12 Keyboard failure	1. Check if keyboard cable is damaged. Connect it and restart computer. 2. For other troubles, please contact MRC.
7.13 Prompt water insufficient	1. The water is insufficient, please add water. 2. If the judging water level of 12V is abnormal, please ask the professional people for repairing.