Labotronics

Thermal Conductivity Tester

LB-10TCT

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1. Safety Measures

1) The power sockets of instruments and computers must have grounding wires.
2) During the testing process, the cooling water should not be interrupted, otherwise it may damage the instrument.
3) Test software parameter modification username "xt" and password "808".
4) Due to the heat flow detection range of 100-2000W/m2, the sampling rule for sample thickness is: thin the sample with low thermal conductivity or small temperature difference between cold and hot; Take thick samples with high thermal conductivity or large temperature difference between cold and hot.
5) For non-rigid specimens with a surface flatness that meets the requirements of the panel and a thermal resistance greater than 0.5m2 * k/w, the temperature of the cold and hot surfaces can be measured by temperature sensors permanently embedded in the hot and cold plates.
6) For soft samples with a thermal resistance of less than 0.5m2 x k/w, a thermocouple with a diameter of 0.2mm or less needs to be placed between the surface of the sample and the measuring plate for measurement.
7) High thermal conductivity or hard materials (materials are relatively hard so that the shape of the hot and cold surfaces does not change under pressure) must meet the flatness requirements on their surface.
8) Thermocouples with a diameter of 0.2mm or less are placed on the surface of the sample (or thermocouples are installed in the grooves on the sample surface), and then appropriate homogeneous soft sheets are inserted between the sample and the measuring plate. Measurements are made using a thin sheet rigid sample thin sheet method.
9) When the hot surface temperature is greater than 100 ℃, the sample needs to be covered with an insulation pad to reduce heat dissipation.
10) For example, sample 250 × 250 (mm), making overall dimensions of 320 × 320 internal air 250 × 250 insulation gasket is placed on the sample (sample 300 × 300 (mm), production overall size 380 × 380 internal air 300 × 300), adjust the thickness of the gasket to match the height of the sample.

2. Introduction

Thermal Conductivity Tester LB-10TCT is a high precision and intelligent machine adopted with flat plate heat flow meter method to detect thermal conductivity and thermal resistance. Features imported sensors and advance computer technology for high measurement accuracy with reliability. Designed with ASTM C518-04 configuration standards, it can provide measurement of low thermal conductivity with in 15 to 20 min.

3. Features

1. A high precision and intelligent Thermal Conductivity Tester
2. Adopts flat plate heat flow meter method for reliability and accuracy
3. Automatic detection and report generation for reliable operation
4. Imported sensors and advance computer technology ensure stability
5. Measurement time of 15 to 20 mins with up to 0.1 mw of accuracy
6. Designed with ASTM C518-04 configuration standards

4. Specifications

Model No.	LB-10TCT
Sample size	50×50 to 300×300 mm
Thermal conductivity range	0.00001 to 3 W/mk, can measure up to 0.1 mw/mk
Accuracy	0.001 to 300 W/mk
Measurement accuracy	0.01
Pressure range	0 to 1000 N
Resolution	0.1 N
Sample thickness	0 to 50 mm
Thickness resolution	1 μm
Measurement time	15 to 20 min
Hot surface temperature	RT to 199.9°C
Cold surface temperature	0 to 99.9°C
Temperature control accuracy	0.1°C
Packaging dimension (W×D×H)	1060×870×1350 mm
Gross weight	259

5. Applications

Thermal Conductivity Tester is used for testing plastics, rubber, insulation materials, etc., across colleges and universities, scientific research institutes, quality inspection, factories and mines etc.

6. Installation

1) The instrument is placed on a flat and sturdy ground. For instruments with electric configuration, please adjust the foundation screws of the instrument so that the upper and lower measuring surfaces are parallel.
2) Connect the water pipe for instrument cooling water (tap water or constant temperature water tank) and tighten it with a pipe clamp. Turn on the cooling water, adjust the flow meter, and check whether the inlet and outlet water are normal.
3) Connect the power cord of the instrument (220V 50Hz) and ensure that the power supply is well grounded. Connect the instrument communication cable to the computer COM port.
4) Install the thermal conductivity testing software in the calculation meter (place the random CD into the CD drive, find the application folder, open the folder, find the "**Setup**" file, double-click on the Setup file with the mouse, and follow the prompts to install it to the custom folder or system default folder.)
5) If the user needs to print a report, the user also needs to install a printer. The software requires one COM serial port of the computer to communicate with the instrument. If the computer does not have a COM serial port, a PCI serial port card or USB to serial port hardware and corresponding drivers need to be installed.
6) Turn on the instrument power switch and start the thermal conductivity testing application.
    1. The first time the software runs, it will prompt to configure the instrument specification parameter library. Select a parameter library that matches the instrument. If the user selects the wrong instrument, it will not function properly. To change the parameter library, press "**Thermal Conductivity Testing System Interface → Menu → Parameter Settings → Instrument Configuration**" to reselect the instrument specification parameter library.
    2. Run the software (with the instrument powered on and connected to the communication line), and the "**Communication Port Settings**" interface may pop up. Please select the port connected to the instrument and enter the thermal conductivity testing system interface after the test is correct.
    3. If communication failure is displayed on the interface of the thermal conductivity testing system, press "**thermal conductivity testing system interface → menu → communication settings**" to enter the "**communication port settings**" interface and reconfigure the communication port.
    4. If communication is still not working properly, please check if the communication line and interface are working properly, or follow the computer prompts to find the fault.
    5. The default user name is "xt" in the "**User Authentication**" interface; The default user password is 808 '. Press "**Thermal Conductivity Test System Interface → Menu → Parameter Settings → Basic Parameters**" to enter the parameter setting interface, input the instrument calibration coefficient into "**Heat Flow Meter Coefficient**", and then confirm.

7. Working Principle

This instrument adopts the protective heat flux meter flat plate method. The hot plate is controlled by a high-precision temperature control meter to provide a stable hot surface temperature by an internally heated flat plate heater in the hot plate. The cold surface measurement plate is composed of a central calorimeter plate and a heat shield plate. The heat flow meter in the calorimeter detects the heat flow Q passing through the sample, and a constant temperature water tank (or semiconductor refrigeration control) provides a stable temperature as the reference temperature for the heat flow meter. The semiconductor cooling sheet in the protective hot plate is controlled by the temperature controller of the protective hot plate to ensure that the temperature of the protective hot plate is equal to that of the calorimeter, ensuring that the heat flow under the area A of the calorimeter is one-dimensional. Clamp the sample with a hot plate and a cold plate, and measure the hot surface TA and cold surface TD temperatures of the sample with a hot surface thermocouple and a cold surface thermocouple, respectively. The thermal conductivity of the sample can be calculated using the following formula.

Thermal conductivity calculation:

$$\lambda = \frac{Q \times L}{A \times (T_A - T_D)}$$

Thermal resistance calculation:

$$R = (T_A - T_D) \times \frac{A}{Q}$$

R: Thermal resistance,km^2/w
T_A: Sample hot surface temperature, k
T_D: Cold surface temperature of the sample, k
A: Sample cross-sectional area, m^2
Q: Heat flux, w
L: Sample length, m

The instrument with an electric configuration has added a sample thickness measurement device, a pressure measurement system, and an electric pressurization system. The sample thickness measuring device consists of a displacement sensor and a digital display instrument, which can detect the thickness of the sample in real-time. The pressure measurement system consists of a pressure sensor and a digital display instrument, which can detect sample pressure in real-time. The electric pressurization system consists of a motor, a linear reducer, an electronic governor, and a control circuit to achieve automatic pressurization and unloading. The computer system completes data collection, data processing, instrument control, and fully automated testing.

8. Operations

8.1 Preparation before experiment

1) Open the cooling water valve and adjust the flow meter to approximately 60l/h.
2) Turn on the power switch of the instrument host.
3) Start the computer.

8.2 Test steps

1) **Run the thermal conductivity testing system software:** If user open it for the first time, the "**Communication Port Settings**" interface may appear. Please select the port corresponding to the instrument communication line from the communication port drop-down list box, and press the "**Test**" button to test the communication status. After the communication channel is normal, press the "**Enter**" button to enter the " **thermal conductivity testing system**" interface. When the communication port remains unchanged in the future, it will directly enter the " **Thermal Conductivity Test System**" interface. If there is a communication status error, please press "**Menu → Communication Settings**" to enter the "**Communication Port Settings**" interface, ensure that the communication status is normal, and then proceed with other operations and tests.
2) **Pressure reset:** This step is required when the instrument is in an electric configuration. When the test head (hot plate) is not under stress, press "**Menu → Reset Operation → Pressure Reset**" to complete the pressure reset.
3) **Lower limit of displacement:** Lower the lower limit of the test surface to the frequently used lower limit position, press "**Menu → Zero operation → Lower limit of displacement**", and the computer will record the lower limit of displacement.
4) **Thickness reset:** Press the test head (hot plate, hot plate temperature below 50 ℃) directly onto the cold plate and load it to the required pressure for the experiment. When the instrument is in an electric configuration, press "**Menu → Reset Operation → Displacement Reset**" to complete the thickness reset; When the instrument is manually configured, use a vernier caliper to measure the distance between the test head and the platen at four points, and then calculate the average value as the thickness zero point data.
5) **Hot surface temperature control:** Enter the desired hot surface temperature value in the temperature setting, press the "**Start**" button, and the hot surface temperature control will enter the heating state. After reaching the set temperature, maintain a constant temperature.
6) **Calorimetric temperature control:** When the instrument uses a constant temperature water tank to control the reference temperature of the calorimeter plate, set the constant temperature water tank temperature to be about 5 ℃ lower than the cooling water temperature. When the instrument uses a semiconductor refrigeration chip to control the reference temperature of the calorimeter plate, input the set temperature value (about 5 ℃ below the cooling water temperature), press the "**Start**" button, and the calorimeter temperature control will enter the cooling state. After reaching the set temperature, it will remain constant.

7) **Measurement and protection temperature difference control:** Set the temperature difference to 0, press the "**Start**" button, and the temperature control of the heat protection plate will enter the cooling state, automatically controlling the measurement and protection temperature difference to 0. If there is a negative temperature difference in the measurement and protection, it is necessary to reduce the reference temperature of the calorimeter plate.
8) **Input sample thickness:** When the instrument is in an electric configuration and "**Auto Measure Sample Thickness**" is selected, the instrument will automatically measure the sample thickness; When selecting "**Input Sample Thickness**" or when the instrument does not have an electric configuration, use a vernier caliper to measure the distance between the test head and the platen at four points, and then calculate the average value. Calculate the difference between the average value and the thickness zero point as the sample thickness value, and then input it into the software "**Sample Thickness**".
9) **Pressure setting:** When the instrument is in an electric configuration, the pressure value required for the experiment needs to be entered in the "**Set Loading Pressure**" field. This operation is not available when the instrument is manually configured. Press' Menu → Display Curve 'to display real-time detection curves. On the "Detect Curve" interface, press "**Menu>Output Data**" to generate a "**Curve Data**" report, which can be saved, printed, and other operations.
10) After loading the sample, press the "**Start Test**" button to enter the automatic testing state of the instrument (the electric configuration instrument will automatically load the pressure, while the manual configuration instrument needs to manually add the pressure and measure the sample thickness first).
11) After the automatic completion of the test, the "**Enter Report Information**" interface will pop up. Enter the relevant information and press the "**Confirm**" button.
12) The "**Thermal Conductivity Test Data Report**" pops up, which can be saved, printed, and other operations.
Note: Repeat steps 9, 10, and 11 to test other samples.

8.3 Post-experimental work

1) Stop testing and separate the hot and cold test plates.
2) Stop the temperature control of the hot plate, the temperature control of the heat protection plate (measuring temperature difference), and the temperature control of the heat measurement, and exit the program.
3) Turn off the power switch of the testing host.
4) Turn off the constant temperature water tank or cooling water.
5) Protect the contact surface of the test head and frequently clean it with anhydrous alcohol.

9. Accessories

Standard Accessories

- Software
- Low-temperature constant temperature sink
- Computer