Tri-Functional Tester Manual
S2020RHR

NOTE: THIS MANUAL IS NOT TO BE SEPARATED FROM METER!

S2020RHR Tri-Functional Tester

The S2020RHR Tri-Functional Tester kit measures surface resistivity, resistance, temperature and humidity. It is designed to test conductive, anti-static, and static dissipative surfaces for electrical resistivity/resistance according to EOS/ESD, CECC, ANSI, ASTM and UL test procedures.

The internal parallel electrodes comply with DIN EN 100 015/1 & ANSI/ESDA-S11.11. The five pound electrodes can be externally connected for tests according to IEC 61340-4-1, ANSI/ESDA S4.1 & ANSI/ESDA S7.1. NIST Certified.

S2020RHR Tri-Functional Tester Includes:

Tester
Two 5lb probes
One alligator clip
One metal plate (size 142x67mm)
One ground cord
Two accordion cables (monaural to banana)
9 volt battery
Foam lined carrying case
Certificate of calibration

Limits

Resistivity: 10^3-10^{12} ohms/sq
Resistance: 10^3-10^{12} ohms
Relative Humidity: 10% - 90% RH
Temperature: 0℃- 37.7℃
Measuring voltage: 10v and 100v

INTRODUCTION

The S2020RHR Tri-Functional Tester is a dependable and easy to use audit kit for conductive and dissipative surfaces. This meter is designed to be used in all facets of material production including engineering, maintenance, quality control, incoming inspection, manufacturing, research, or sales departments for testing of anti-static mats, floor finishes, paints, wrist straps, smocks, foot wear, bags and containers.

When using the built-in electrodes, the meter's test values for surface resistivity are in ohms per square. When using the external five pound electrodes, the meter's test values for resistance are in ohms (although they are displayed in ohms/sq).

DECADE SCALE

10^3	=	1 kilohm
10^4	=	10 kilohms
10^5	=	100 kilohms
10^6	=	1 meg ohm
10^7	=	10 meg ohms
10^8	=	100 meg ohms
10^9	=	1000 meg ohms
10^{10}	=	10,000 meg ohms
10^{11}	=	100,000 meg ohms
10^{12}	=	1,000,000 meg ohms

The test value is indicated on the LCD display. Unlike meters with LEDS that indicate only the decade the measured value falls within, the S2020RHR will show the actual value.

27 ohms ($2.7x10^7$) is displayed as **2.7 e07 ohms/sq**

TEST VOLTAGE

The test voltage ranges are 10v and 100v. According to ESDA standards S4.1, S7.1, and S11.11 one should choose 10v for conductive surfaces less than 10^6 and 100v for materials 10^6 or greater. If the meter cannot apply the correct voltage automatically, it will advise you to change to the proper setting manually. Use the switch in front of the meter to change voltage setting.

As defined by the ESD Association, values indicate the following:

Voltage	Range	Definition
10 volt	< 10^6 ohms per square	Conductive
100 volt	10^6-10^{11} ohms per square	Dissipative
100 volt	10^{12}> ohms per square	Insulative

A NOTE ABOUT VOLTAGE

In previous years, people desiring to measure resistivity or resistance followed the ASTM D264, ASTM 991, NFPA 56A or NFPA99 test standards. These procedures required people to test at either 500 or 1000 volts. This caused concern regarding safety to the person doing the tests. The ESDA standardized the test procedures so that lower volts could be used at specific ranges.

The S2020RHR meter uses a 9 volt battery. Some meters with 9 volts batteries do not give the accuracy that you need to perform the tests especially at values higher than 10^7. The S2020RHR is built with a transformer that converts the 9 volt charge from the battery to 10 volts or 100 volts (whichever value is selected). The meter applies a constant charge over the complete voltage range. Accuracy is depends on applied voltage, temperature, and humidity.

TEMPERATURE AND HUMIDITY

The humidity and temperature affect the electrical properties of the material being tested. The combination of low humidity and low temperature will give the highest electrical resistance results or slowest dissipation times. At high humidity a thin layer of water is condensed or absorbed on or in the material being tested. This is true of hydroscopic additives that are added to a material to increase the electrical conductivity. These additives will allow moisture to be absorbable in the materials they are added to.

At elevated temperatures the mobility of free electrons is increased thereby increasing the materials conductivity. This is especially true for carbon black, metallic oxides, metals, and other materials added to a material. When the material is at a lower temperature, built in stresses occur which might increase the resistance due to increased distance between the conductive additives. Thus, humidity and temperature must be known.

RECORDING DATA

ANSI/ESD Association and European CECC recognize the environmental effects to test measurements and specify in their standards that they measured and recorded. It is possible to test or manufacture a material at high humidity and pass all the test specifications, but when the customer receives the material and uses it at a lower humidity or temperature the material fails to pass the specifications. This can cause rejects and loss of product.

Both ESD S4.1 ESD Protective Worksurface section 6.2.4 and ESD S7.1-1994 Resistive Characterization of Materials Floor Materials sections 5.2.4 and 5.3.3 require reporting of temperature and humidity at the time of testing. ANSI/EOS/ESD-S11.11-1993 Surface resistance measurement of Static Dissipative Planar Materials section 11.0 B states, “report the conditioning period, relative humidity, and temperature.”

CALIBRATION

Calibration is recommended annually. The S2020RHR meter comes with a NIST certificate when ordered. After one year the meters can be sent back to STATICO for a new NIST certificate for a lab fee or it can be sent to a certified calibration lab. The meters also come with a CE mark approval.

MEASURING WITH INTERNAL ELECTRODES

The parallel resistivity probe method, complies with EOS/ESD-S11.11. It is used to give fast electrical resistivity measurements on flat homogeneous materials. It may be used on multilayered materials, but this should be noted along with the temperature and humidity value on the data report.

When the measurement is taken between the tester’s two conductive rubber rails under the tester, the tester will indicate the surface resistivity of the material being tested.

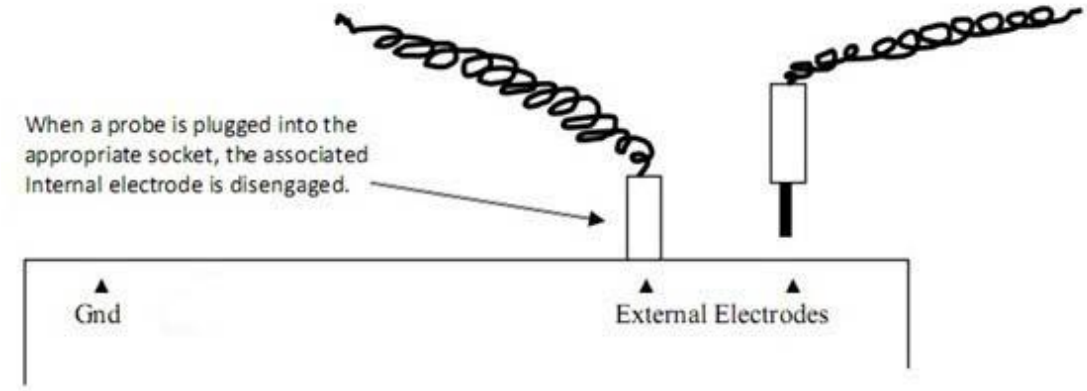
A. Prior to testing, make certain that surfaces to be tested are clean and free of contaminants.
B. Allow the meter to equilibrate to the atmosphere the meter is to be used in. It may take a half hour for the meter to adjust to new environment conditions.
C. Place the meter on the desired surface to be tested.

D. Move switch to desired test voltage position, either 10 or 100 volts, depending on the target range of the material.
E. Press and hold the test button with approximately 5 pounds of applied force. The display will show the humidity and temperature. After approximately 10 seconds, the meter will display the surface resistivity in ohms per square.

The meter will keep updating the display while the button is held down. The last reading will display for approximately 20 seconds after the button is released.

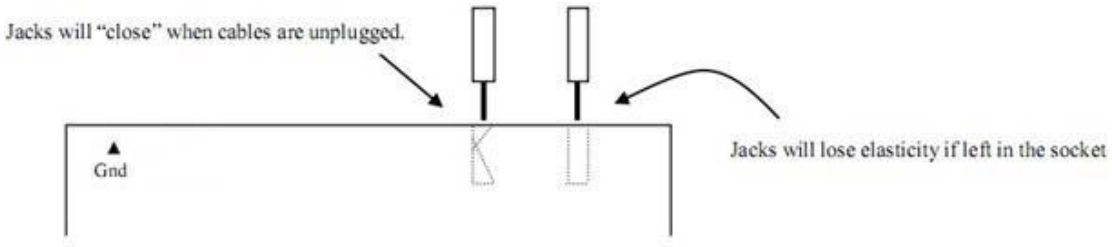
MEASURING WITH EXTERNAL ELECTRODES

When the measurement is taken using the 5lb external probes, the tester will indicate the resistance of the material being tested once the button is depressed (value is in ohms, though the display says ohms/sq).



By utilizing these probes to the S2020RHR's sockets it is possible to measure Point to Point (RTT) Resistance, Surface to Ground (RTG), and Volume Resistance. Using these probes will allow compliancy with various standards including ANSI/ESDA S4.1 for Worksurface – Resistance Measurements, ANSI/ESDA S7.1 Resistive Characterization of Materials – Floor Materials.

When auditing is finished, unplug the cables and store probes in the protective case. If cables are left in the tester, the jacks will lose their elasticity as shown below:



If jacks are damaged or left in the open position, the internal probes will not engage when testing for surface resistivity.

Resistance Between Two Points (RTT)

RTT measurements can be used for the evaluation of floors, chairs, carts, work surfaces and other ESD controlled materials and products. Procedures vary regarding sample preparation, probe preparation and

spacing of the 5 pound probes. Select and read the correct test procedure or standard for the desired measurement.

A. Connect one end of each of the banana test leads into the sockets of the meter.
   Connect the other end of the test coil cords into the 5 pound probes.

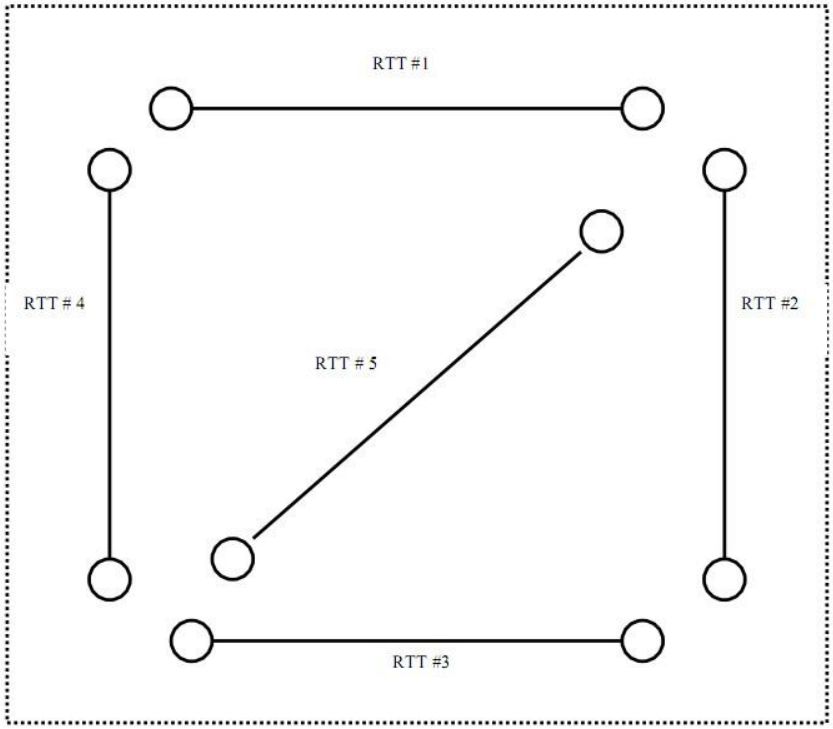
B. Place both probes on the material according to test procedures or standard being used.
C. Press the “TEST” button and the value will be displayed on the LCD. The meter will apply the correct voltage (10v or 100v) according to the value of what is measured.
D. When performing test do not touch lead wires or probes. Avoid overlapping of lead wires. This will ensure accurate readings.

AN EXAMPLE OF MEASURING RTT ON DISSIPATIVE FLOORING:

Taking routine measurements of tiles with dissipative floor finish will insure proper maintenance routines and will indicate any problems that may arise. Keeping a record of test results for temperature, humidity and electrical properties will provide a reference and will point toward a blueprint of traffic patterns on the floor. Good record keeping will insure success when developing and maintaining a maintenance program.

To get an average measurement of a floor, map out a 4”x4” section and conduct five tests (one at a time) within the square. Conduct a test for each side of the square and a final test diagonally through the center as shown in the drawing below.

Each RTT test utilizes the 5 pound probes placed 3 feet apart (36 inches). Connect the test leads to the meter. Attach a 5 pound probe to the end of each lead and place 3 feet apart as indicated above. Press and hold the “TEST” button on the S2020RHR meter until a value is displayed.



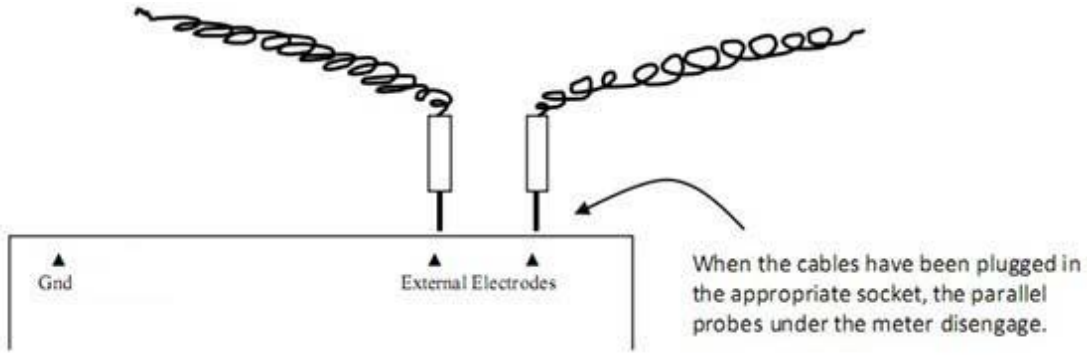
4' x 4' Section
(not to scale)

MEASURING RESISTANCE TO GROUND (RTG)

Resistance to ground measurements can be used for the evaluation of floors, carts, work surfaces and other ESD controlled materials and products. Keeping a record of test results for temperature, humidity and electrical properties will provide a reference.

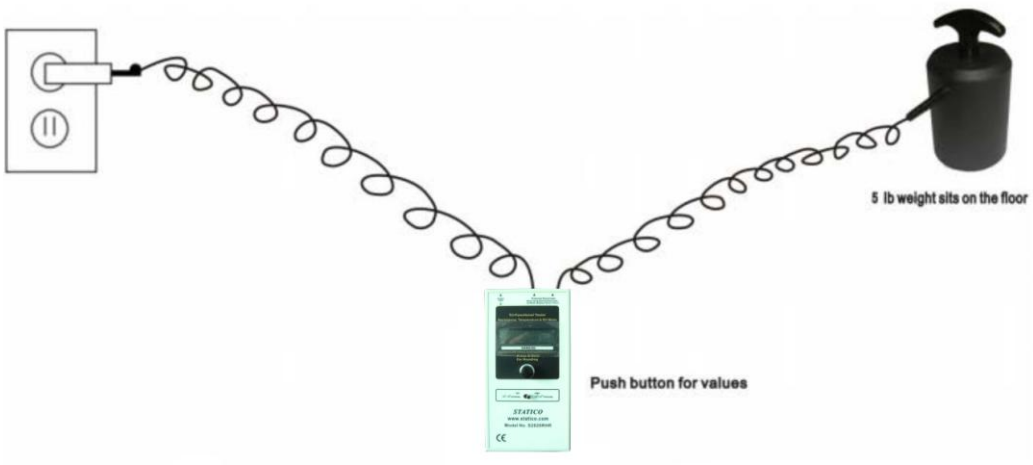
AN EXAMPLE OF MEASURING RTG DISSIPATIVE FLOORING:

For Testing Resistance on Floors, S7.1 requires a minimum of 5 RTG tests per 5,000 SqFt. Connect the leads for the external electrodes to the meter.



Attach one lead to a 5 lb probe and place probe on the floor that's being tested.

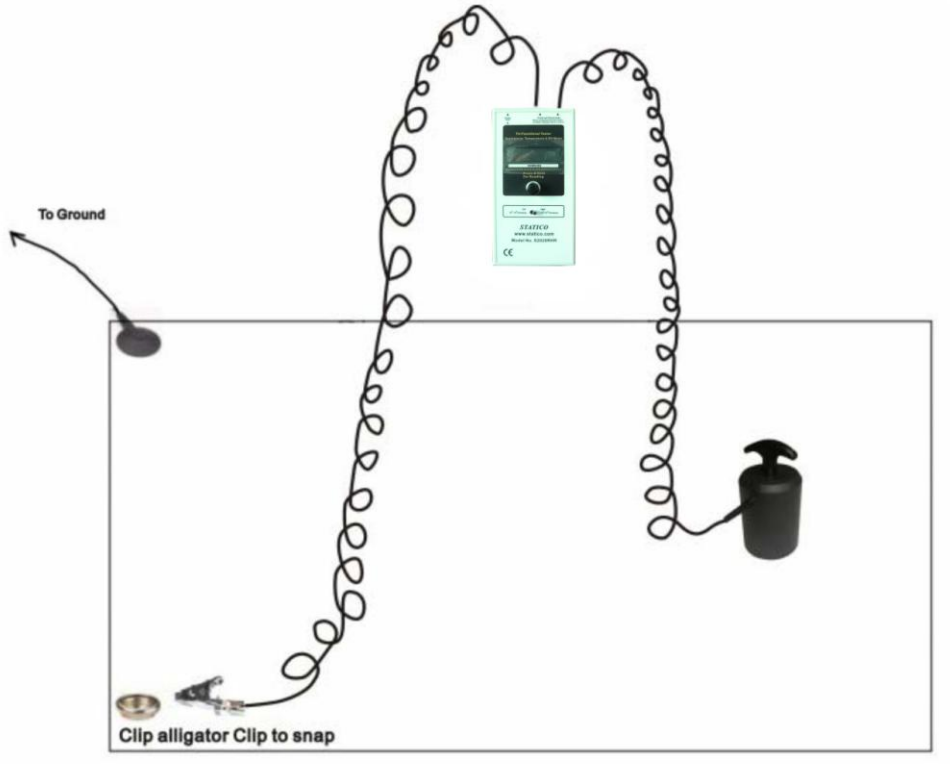
Attach the other lead to an alligator clip and connect to a groundable point (RTGP). If using a ground adapter plug, plug the banana lead into the adaptor after the adapter is plugged into the receptable.



AN EXAMPLE OF MEASURING RTG ON DISSIPATIVE TABLE MATS:

A. **To test RTG for a workstation, connect the first lead to the meter and to a 5lb probe and put probe on work surface. Connect the 2nd lead to the meter and to a groundable point (RTGP). Use the alligator clip if necessary.**
B. Press the "TEST" button and the value will be displayed on the LCD. When performing test do not touch lead wires or probe. Avoid overlapping of lead wires. This will ensure accurate readings.
C. Resistance values are in ohms. Record temperature, humidity and resistance.

If the range of your work surface is 10^6 to 10^9, measure at 100v. The EOS standard says the dissipative range is 10^6-10^{11} but most people look for 10^6-10^9 for a pass.

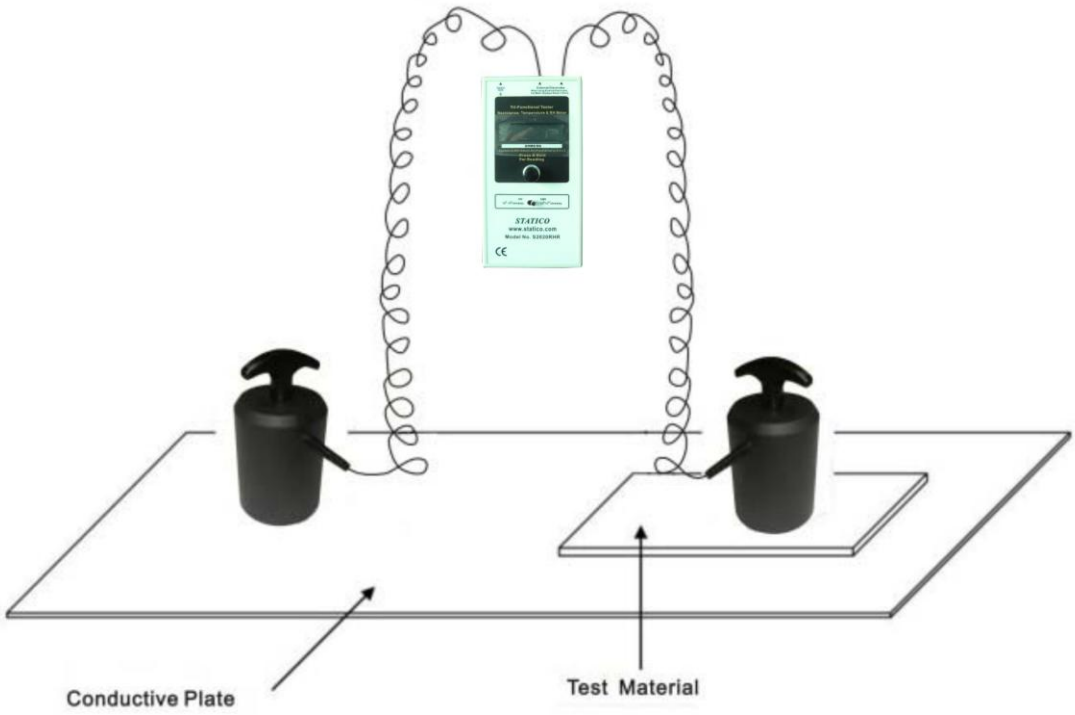


Attach the alligator clip to the lead and connect it to the ground snap or connect the banana plug to a common point ground plug:

Volume Resistance Measurement MAESURING RESISTANCE TO GROUND (RTG)

Volume Resistance measures the electrical path through a material.

A. Connect one end of each of the banana test leads into the sockets of the meter.
   Connect the other end of the test coil cords into the 5 pound probes.
B. Place sample material on a conductive metal plate (such as stainless steel). Place one of the 5 pound probes on the material so that the material is sandwiched between the probe and metal plate. (see below)
C. Place the second 5 pound probe on the conductive metal plate.
D. Press the "TEST" button and the value will be displayed on the LED. Volume Resistance is in ohms-cm.



S2020RHRCALIBRATION INSTRUCTIONS

The S2020RHRmeter is calibrated to be most accurate in the most widely used range (10^6-10^8). The lab calibrates meters between 30-40%RH at 65-73°F. If you are using the meter in atmospheres different than above, it is strongly advised to recalibrate the meter to your conditions.

1. Purchase 1% 10^3-10^{12} ohm resistors, high accuracy relative humidity hygrometer, and high accuracy thermometer.

2. Open meter being careful not to disturb or break the two wires connecting the power button to the circuit board.
3. Observe on the right lower side of the meter printed circuit board four (4) calibration pots.
4. **ALLOW THE METER TO EQUILIBRATE AND NORMALIZE IN THE ENVIRONMENT FOR 2 HOURS BEFORE TESTING.**
5. Using the supplied coil cords, attach alligator clips to the banana plug ends of the cords.
6. Insert the 3.5mm ends into the meter jacks.
7. Attach the ends of the resistors to the ends of the alligator clips.
8. The top pot is for humidity. The next pot under the top is for resistivity. The third pot is for temperature. The last pot on the bottom is to fine tune resistivity. Adjustment is done with a small screw driver. Clockwise is to increase the value, counter clockwise to decrease the value.
9. Press the power button and compare the resistor value, humidity, and temperature to the parameter to be calibrated.
10. Release the power button and slowly turn the correct adjustment pot.
11. Re-press the power button, and observe the LCD screen.
12. Re-press and adjust the pot if necessary.
13. Close case and tighten the 4 screws.
14. Press the power button to verify that the meter is working.
15. Test at **10** volts for values **under** $1x10^6$ ohms. Test at **100** volts for values **over** $1x10^6$ ohms.
16. Tolerance from 10^3-10^8 ohms is 10%
    10^9-10^{10} ohms is 15%
    10^{11}-10^{12} ohms is 25%

17. When testing at high resistance values, ground the meter with a ground cord in the “grounding” jack. Electrical interference and ESD can affect the tolerances and accuracy.
18. The tolerance for temperature and humidity are:
    ±3°Fahrenheit up to 70°F
    ±3% RH up to 70%
    ±5°F over 70°F
    ±5% RH over 70%RH

To increase the accuracy adjust the calibration at the temperatures and humidity the meter will be used. For example, if you were using the meter at 70°F and 70 RH you would calibrate the meter exactly at those conditions using a 1% accuracy standard thermometer and relative humidity meter.

*****Should calibration traceable to the NIST be required, please call STATICO, directly arrange for calibration.**