



RESISTIVITY MEASURING SYSTEMS

Resistance & Resistivity





The conductivity meters from Nittoseiko Analytech enable simple calculation of the resistivity correction factor for precise resistivity measurement.

The Hiresta-UX, Loresta-GX II and the Loresta-FX handheld devices can be used to accurately measure both surface resistivity and volume resistivity.

The Hiresta series covers the high-resistance range (10^3 - $10^{14}\Omega$), while the Loresta series serves the low-resistance range (10^{-4} - $10^7\Omega$). These systems are supplemented by the Powder Resistivity System for measuring the conductivity of powdery substances.

Nittoseiko Analytech

As the exclusive representative of Nittoseiko Analytech in the German-speaking countries (DACH), the Benelux region and the United Kingdom, we offer you comprehensive advice and first-class technical support.

YOUR ADDED VALUE WITH NH INSTRUMENTS:

- Pre-Presentations and Device Demonstrations.
- Sample Measurement in Advance.
- Receive expert consultation and personal assistance from our experienced team based in Germany.
- Benefit from professional customer support tailored to your needs in both German and English.
- Ensure seamless operation with expert installation and personalized training for your team.
- All our devices come with a comprehensive 12-month warranty for your peace of mind.
- Enjoy long-term device reliability through customized maintenance contracts, regular calibrations, and technical support.
- We handle customs clearance and offer free delivery of your devices.
- All devices are delivered with CE marking or a UK Declaration of Conformity (DoC).

RESISTANCE AND RESISTIVITY

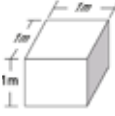
As science and technology advance, demand has increased for simple, quick and precise classification of material properties in diverse fields such as research and development, production engineering and quality control.

According to the conventional method, resistance (Ω) was used for this purpose. However, resistance does vary depending on the type, shape and size of the material and also the measuring point. Therefore, the approved measuring method uses resistivity ($\Omega\cdot\text{cm}$) which expresses absolute and real material values.

Resistivity is simply calculated by multiplying the measured resistance (Ω) with a Resistivity Correction Factor (RCF). The resistivity measuring systems of Nittoseike Analytech have been designed to ensure easy RCF calculation and thus resistivity is measured in a simple test procedure.

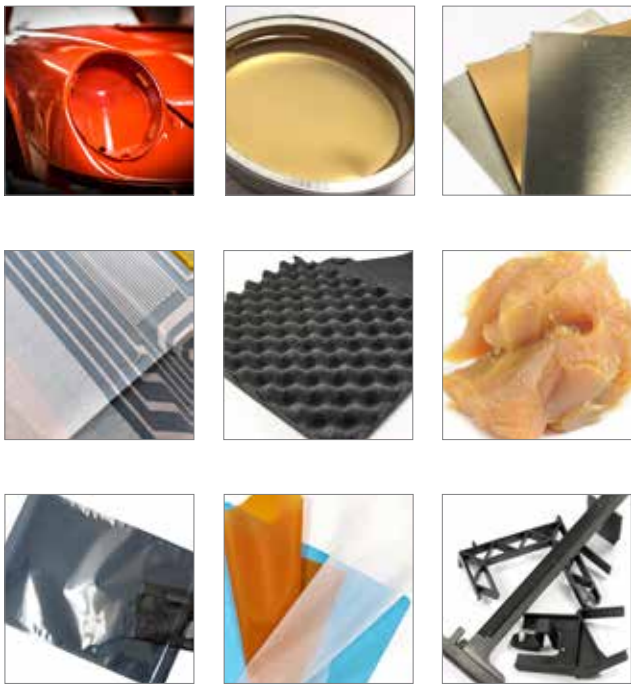
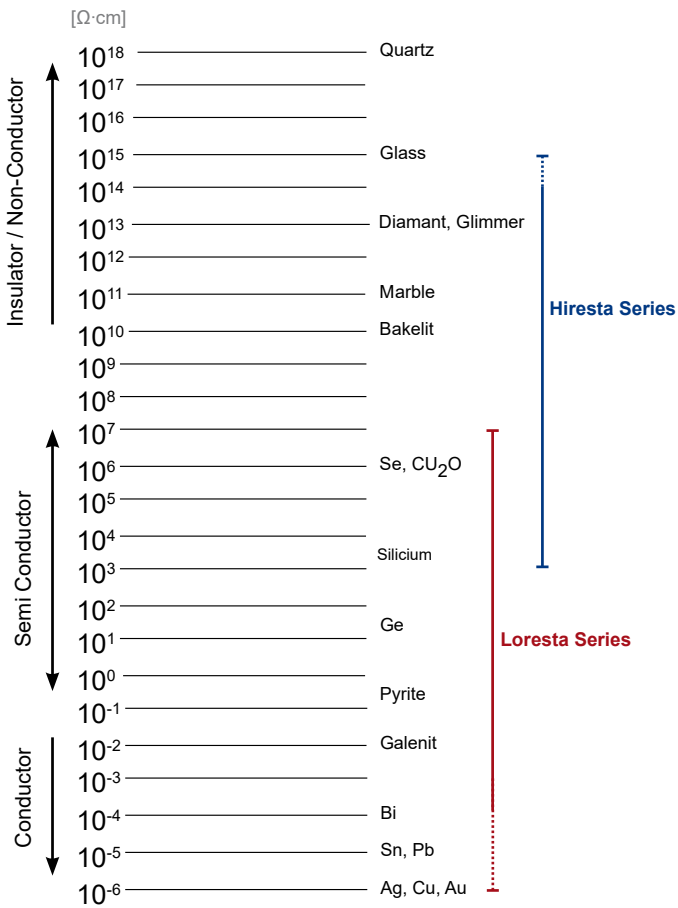
Resistivity is an absolute value

A short test proves this:

Material	Au (Gold)		
Dimensions			
Resistance [Ω]	$2.4 \cdot 10^{-8}$	$2.4 \cdot 10^{-6}$	$2.4 \cdot 10^{-2}$
Resistivity [$\Omega\cdot\text{cm}$]	$2.4 \cdot 10^{-6}$	$2.4 \cdot 10^{-6}$	$2.4 \cdot 10^{-6}$

The results show obvious differences in resistance values, although the same test material has been used. Therefore, resistivity is the best reliable index for material evaluation.

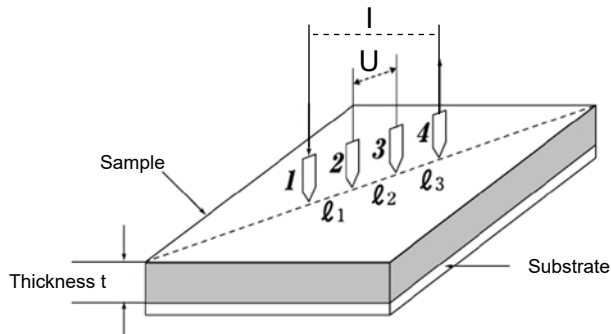
Each material has a unique resistivity value.



Resistance (R)

Ohm's law states that the current (I) through a conductor between two points is proportional to the potential difference (V) across the two points and inversely proportional to the resistance (R) between them.

$$\text{Resistance } R [\Omega] = \frac{U [\text{V}]}{I [\text{A}]}$$



Volume Resistivity (ρ_v)

Volume Resistivity (ρ_v) expresses the resistance per unit volume of a sample and is also called specific resistance. It is the term mostly used for material classification ($\Omega \cdot \text{cm}$). Each material has a unique characteristic value for volume resistivity.

$$\text{Volume Resistivity } \rho_v [\Omega \cdot \text{cm}] = R [\Omega] \cdot \text{RCF} \cdot t [\text{cm}]$$

Surface Resistivity (ρ_s)

Surface Resistivity (ρ_s) is the resistance per unit surface of a sample and is also called sheet resistance. In order to distinguish this from resistance, it is written $\Omega/\square$ or $\Omega/\text{sq.}$. Since surface resistivity varies with the sample thickness, it is often used to evaluate paint and thin films.

$$\text{Surface Resistivity } \rho_s [\Omega/\text{sq.}] = R [\Omega] \cdot \text{RCF} = \rho_v \cdot \frac{1}{t}$$

t : Materialdicke

Conductivity (σ)

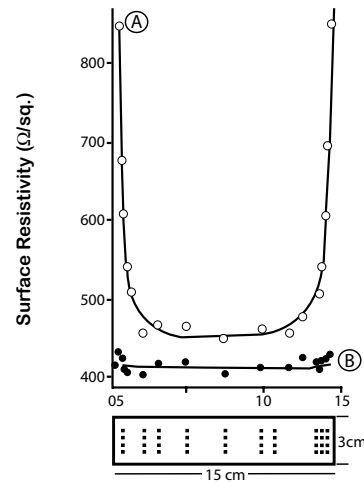
Conductivity (σ) is inversely related to volume resistivity. It is also called specific conductivity. The unit is S/cm.

$$\text{Conductivity } \sigma [\text{S/cm}] = \frac{1}{\rho_v}$$

Factors

Influence of Measuring Position, Sample Size and Thickness on Resistivity

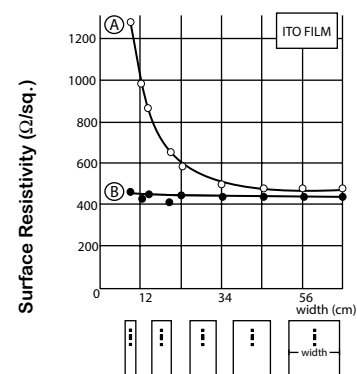
Measuring Position



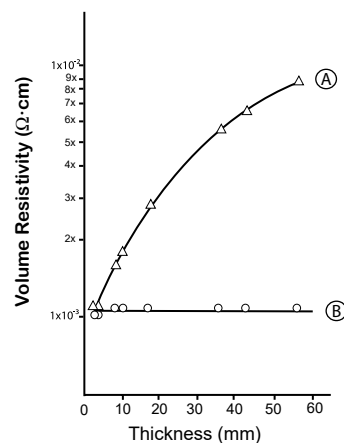
(A) shows graph with constant RCF (4.532)

(B) shows graph with variable RCF

Sample Size



Sample Thickness



Sample: isotropic graphite, Size: 7cm x 7cm
Measured with 4-pin probe at center of the sample

2- AND 4-TERMINAL METHOD

The multimeter (with 2 measuring tips) is an inexpensive and simple device for measuring voltage, current and resistance. However, the conventional 2-point method is unsuitable for material evaluation. The 4-pin measuring head of the Loresta measuring devices eliminates lead and plug connection resistances as well as contact resistances and thus enables much more precise resistance measurements.

In the 4-pin measurement, 4 needle-like electrodes are placed linearly on a measurement object. To determine the resistance, a constant current is measured between the two outer pins (1 & 4) and the potential difference between the two inner pins (2 & 3).

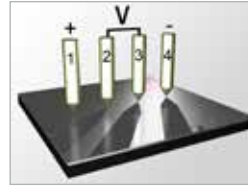
By multiplying the measured resistance R (in Ω) by the material thickness (t) and the correction factor (RCF), the volume resistivity is obtained. With the 4-pole measurement, only the placement of the measuring head on the measurement object is decisive, as the electrodes are already firmly integrated in the measuring head.



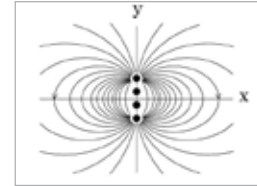
Multimeter with 2 Pins



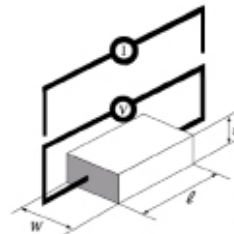
4-Pin Probe



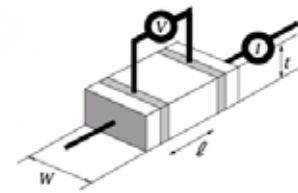
Placement on the measurement object



Electric Field Strength (4-Pin Probe)



2-Pol-Method



4-Pol-Method

RESISTIVITY CORRECTION FACTOR (RCF) - 4-PIN PROBE

The Resistivity Correction Factor (RCF) is changed with the sample shapes and sizes as well as measuring positions. In the 4-pin probe method, since the sample size or measuring position are not fixed, the electric energy distributed in the sample is changed with the sample size and the measuring positions.

If the sample size is small or the measuring position is near the sample edge, the peak of the electric field becomes higher to yield a high resistance. This is caused by the electric energy being contained in the sample.

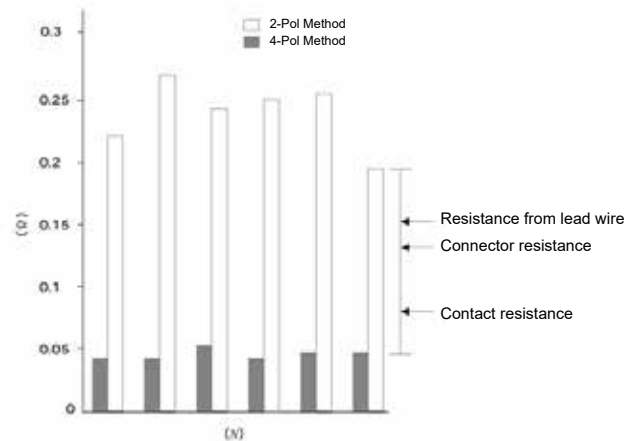
The Resistivity Correction Factor is used to obtain correct values for the volume or surface resistivity by forecasting such difference in the peak of the electric energy. The electric potential $\Phi(r)$ in an optional point in a sample and is calculated by solving a Poisson's equation under a specific condition.

Poisson'sche Equation

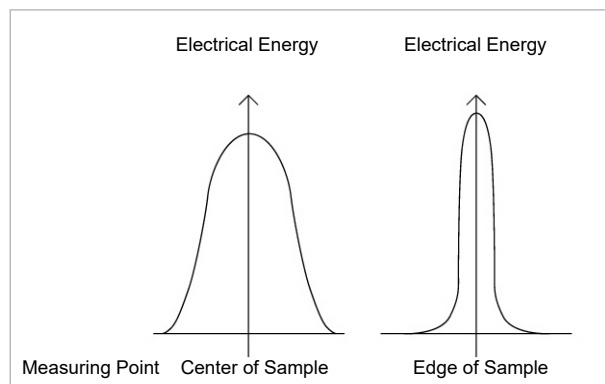
$$\Delta \Phi(r) = 2 \rho_v I [\delta(r-r_D) - \delta(r-r_A)]$$

The Loresta-GX II has a built-in software for calculating this factor and is able to derive the factor by simple input of the sample shapes (rectangular or disk) and size as well as the measuring position.

The Loresta-FX uses a fixed RCF which allows a sufficient precise measuring.



Comparison 2- and 4-Pol Method



Verteilung der elektrischen Energie in einem Messobjekt

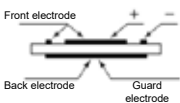
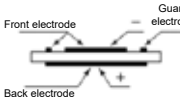
MEASURING METHOD FOR HIGH RESISTIVITY

When measuring high-resistivity material (standard value $R_x > 20\text{M}\Omega$), small current can not be applied stably. Therefore, the constant-voltage process of applying constant voltage and measuring leak current is used. The material condition of the surface is different from the one of the inside. It's necessary for material control that indicating condition by each index. The surface resistivity is results of surface condition and the volume resistivity is one of inside condition. They're defined according to JIS K 6911 or ASTM D257 standard.

The Measurement Systems of the Hiresta Series works with ring electrode probes. The probes have a concentric ring electrode.

Due to the small size of flowing current, a higher measuring voltage up to 1000V is needed. Low currents can be falsified very easy by external influences and leak currents, so a special guard technic is used. For that technic a third connection between measuring equipment and measuring object is required.

This additional connection has ground potential and ensures a common reference potential for shielding, without falsify the current measurement. The outer electrode works as the guard electrode and the current passed through the exterior of the detection electrode (the inner electrode) flows to the ground. Hiresta-UX can display the RCF by selecting the surface and volume directions and a probe type.

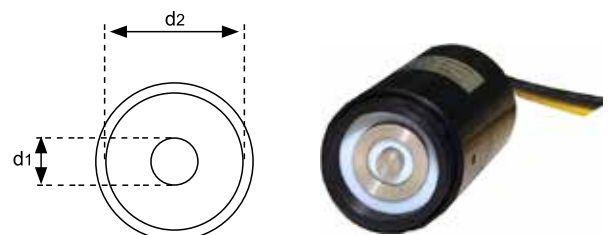
	ASTM-Method	Hiresta UX Method		
	ASTM D257	JBox X Type	Method 1	Method 2
Surface resistivity				
Volume resistivity				



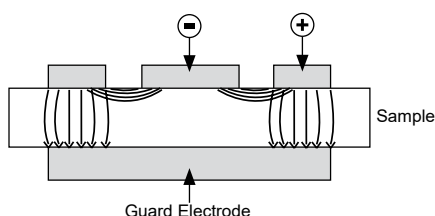
RESISTIVITY CORRECTION FACTOR (RCF) - RING ELECTRODE

The correction factors RCF (S) and RCF (V) of the ring electrode probe are determined by the electrode diameters. Correction factors of probes is registered previously in Hiresta-UX. Therefore the value can be called up automatically by selecting a probe type.

Probe	d2 (cm)	d1 (cm)	RCF _s	RCF _v
UR-SS	0.6	0.3	9.065	0.071
URS	1.1	0.59	10.09	0.273
UR	3.0	1.6	10.00	2.011
UR-100	5.32	5.0	100	19.63
UA	--	--	1.050	--
U-Type JBox	7.0	5.0	18.85	19.63



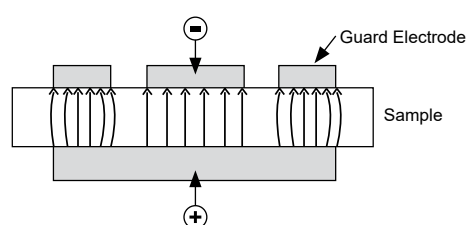
Measurement of Surface Resistivity



Surface Resistivity

$$\rho_s [\Omega/\text{sq.}] = R [\Omega] \cdot \text{RCF}_s$$

Measurement of Volume Resistivity



Volume Resistivity

$$\rho_v [\Omega \cdot \text{cm}] = R [\Omega] \cdot \text{RCF}_v \cdot \frac{1}{t}$$

t: sample thickness

HIGH RESISTIVITY
HIRESTA-UX

USE

R&D, Production Engineering, Quality Control
Related to ASTM D257 / ISO 2951 / JIS K 6911

APPLICATIONS

- antistatic materials
- Flooring materials
- Paper, packaging materials
- Paints, pastes, paints
- Fibers, clothes, fabrics
- Adhesives, greases
- Glass, concrete, ceramics
- Plastics, film materials, foils
- etc.

FEATURES

The Hiresta UX is specialised in measuring the resistance, the surface and volume resistivity of various substances and materials of all shapes and sizes in the high-resistance measuring range.

- 29 steps of applied voltage with Auto Sweep Function enables measuring voltage dependence of resistance value
- With the new Built-in Switch Box, volume resistivity can be measured just by connecting a „Resitable UFL“ (optional) to Hiresta UX
- Up to 2000 measurement results can be exported to USB memory stick
- The probe is designed to read fast and accurately with one touch

SPECIFICATIONS

Measuring method	Constant-voltage apply / Leak-current					
Range Switching	Automatic, Manual					
Display	7.5" TFT LC-Touch Display, 640 x 480 pixel					
Power Supply	AC 85-264V / 47-63Hz / 92VA					
Comparator	Maximum and Minimum values can be set manually					
Data Output	USB					
Dimensions	330mm x 270mm x 113mm (W x D x H) / Lid opened: 330mm x 270mm x 215mm (W x D x H)					
Weight	2,4 kg					
Standard Accessories	URS Probe RMH214, Probe Checker RMH327 (500 MΩ), Portection gloves					
Maesurement Range and Trueness	1 ~ 10V	10 ³ ~ 10 ⁹ [Ω]: ±2%	10 ¹⁰ [Ω]: ±3%			
	20 ~ 400V	10 ⁶ ~ 10 ¹⁰ [Ω]: ±2%	10 ¹¹ [Ω]: ±3%			
	500 ~ 900V	10 ⁷ ~ 10 ¹⁰ [Ω]: ±2%	10 ¹¹ [Ω]: ±3%	10 ¹² [Ω]: ±4%		
	1000V	10 ⁸ ~ 10 ¹⁰ [Ω]: ±2%	10 ¹¹ [Ω]: ±3%	10 ¹² [Ω]: ±4%	10 ¹³ [Ω]: ±5%	10 ¹⁴ [Ω]: ±12%

ACCESSORIES



RMJ360 - Fixer
for URS-Probe
(RMH214)

Probe	UR-SS	URS	UR	UR-100	UA
Application	smallest samples	standard	larger surfaces	Measurment Range 10 ¹⁵ Ω/sq.	thin samples
d2 (cm)	0.6	1.1	3.0	5.32	20mm pin distance
d1 (cm)	0.3	0.59	1.6	5.0	Ø2mm
Order No.	RMH215	RMH214	RMH212	RMH216	RMH211
Probe Checker	RMH328	RMH327	RMH326	RMH321	RMH325



Resitable UFL (RMJ354)
für Hiresta & Loresta



LOW RESISTIVITY LORESTA-GX II

USE

R&D, Production Engineering, Quality Control
Related to ASTM D 991 / ISO 2878 / ISO 1853 /
JIS K 7194 / JIS R 1637

APPLICATION

- Paints, pastes, paints, printing ink
- Plastics, rubber
- metallic thin films, metallised films
- amorphous silicon / silicon wafer
- antistatic materials
- EMC shielding materials
- ITO glass, coated glass
- passivated metals
- magnesium alloys
- Coated sheet metal, steel, aluminum
- etc.



Videolink

FRATURES

LORESTA-GX II has a expanded measuring range of $10^{-4} \sim 10^7 \Omega$. The probe enables one-touch direct reading of $[\Omega]$, $[\Omega/\text{sq.}]$, and $[\Omega \cdot \text{cm}]$. It has a special silicon mode for silicon wafer measurement and one-touch automatic measurement by new functions like Auto-Hold and Timer Mode. The accurate low resistivity meter based on 4 Terminal 4 Pin method. It ensures a high accuracy by MCP probes' spring contact method which keeps pin pitch, pressure and contact area on samples constant.

SPECIFICATIONS

Measuring Method	4-pin probe, constant-current method
Measuring mode	Auto-Function: Auto-Hold / Timer Mode - Special Silicon measuring mode
Display	7.5" TFT LC-Touch Display, 640 x 480 Pixel
Power Supply	AC 85-264V / 47-63Hz / 40VA
Interface of data output	USB
Dimensions	320mm x 285mm x 110mm (B x T x H) / bei geöffneter Abdeckung: Höhe 220mm
Weight	2,4 kg
Standard accessories	ASR probe RMH110 (4-pin probe, inter-pin distance 5mm, pin-head radius 0.37mm) Probe checker RMH304 (1.0 Ω)

		Power Supply							
		1A	100mA	10mA	1mA	100 μ A	10 μ A	1 μ A	0.1 μ A
Range	10 ⁻⁴	$\pm(2.0\% + 30\text{dgt})$							
	10 ⁻³	$\pm(2.0\% + 20\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$						
	10 ⁻²	$\pm(1.0\% + 5\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$					
	10 ⁻¹	$\pm(1.0\% + 3\text{dgt})$	$\pm(1.0\% + 3\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$				
	10 ⁰		$\pm(0.5\% + 3\text{dgt})$	$\pm(0.5\% + 3\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$			
	10 ¹			$\pm(0.5\% + 3\text{dgt})$	$\pm(0.5\% + 3\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$		
	10 ²				$\pm(0.5\% + 3\text{dgt})$	$\pm(0.5\% + 3\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$	
	10 ³					$\pm(0.5\% + 3\text{dgt})$	$\pm(0.5\% + 3\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$	$\pm(2.0\% + 20\text{dgt})$
	10 ⁴						$\pm(0.5\% + 3\text{dgt})$	$\pm(0.5\% + 3\text{dgt})$	$\pm(1.0\% + 5\text{dgt})$
	10 ⁵							$\pm(0.5\% + 3\text{dgt})$	$\pm(1.0\% + 3\text{dgt})$
	10 ⁶								$\pm(1.0\% + 3\text{dgt})$
	10 ⁷								$\pm(2.0\% + 5\text{dgt})$

LOW RESISTIVITY
LORESTA-FX

USE

R&D, Production Engineering, Quality Control

APPLICATION

- Conductive paints, pastes, paints, ink
 - Conductive plastics & rubber
 - metallic thin films, metallised films
 - Coated sheet metal, steel, aluminun
 - EMC shielding materials
- ITO glass, coated glass
 - passivated metals
 - magnesium alloys
 - antistatic materials
 - etc.

FEATURES

A manually adjustable correction factor is used to determine the specific resistances, which enables a sufficiently accurate calculation for process and quality control. A large LC display makes it easy to read the data. The data can be transferred directly to a PC via the USB-C port and the optional application software. The Loresta FX also stores up to 999 measurements internally and enables direct readout of [Ω], [Ω /sq.] and [Ω ·cm] at the touch of a button.



Videolink

SPECIFICATIONS

Measuring method	4-pin probe, constant-current method								
Measurement range [Ω]	10 ⁻²	10 ⁻¹	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶
Supplied voltage	100mA		10mA		1mA		100μA	10μA	1μA
Measuring accuracy	± 1.0% ± 20dgt.	± 1.0% ± 5dgt.	± 0.5% ± 5dgt.	± 0.5% ± 3dgt.					± 2.0% ± 5dgt.
Display	LCD dgt. = digits								
Power supply	AC 90-264V / 47-63Hz / Nickel-Hydrogen Battery								
Data output	999 measurements internal data memory USB-C connection (application software available separately)								
Dimensions	85mm x 228mm x 65mm (W x D x H)								
Weight	420 g								
Standard accessories	ASR Probe, Probe checker (1.0Ω)								

ACCESSORIES LORESTA-SERIES



Probe	ASR	ESR	LSR	QR	PSR	BSR	NSCR
Application	Standard	non-uniform samples	soft surfaces	small samples, thin films	small samples, thin films	large samples	hard surfaces
Inter-pin distance	5 mm	5 mm	5 mm	1.5 mm	1.5 mm	2.2 mm	1.0 mm
Pin-head radius	0.37 mm	Pin $\varnothing$ 2 mm	Pin $\varnothing$ 2 mm	0.26 mm	0.26 mm	0.37 mm	0.04 mm
Spring pressure	210 g/pin	240 g/pin	130 g/pin	70 g/pin	70 g/pin	210 g/pin	250 g/pin
Orderno	RMH501	RMH502	RMH503	RMH505	RMH504	RMH506	RMH507
Probe	RMH304	RMH304	RMH304	RMH313	RMH311		RMH312



POWDER RESISTIVITY MEASURING SYSTEM PD-600

USE

Research & Development, Quality Control, etc.

APPLICATIONS

Powder materials of carbon products:

Materials used for rechargeable battery electrodes, condensers and resistance material and insulating electronics / cokes / graphite / carbon black / carbon fiber / nano carbon, etc.

Lithium-ion battery materials:

Powders for Positive and Negative Electrodes, like LCO (Lithium Cobalt Oxide), NCM (Lithium Nickel Cobalt Manganese Oxide), LFP (Lithium Iron Phosphate)

Metal powder:

Materials used for battery electrodes, thin film materials such as copper powder or ITO powder, for circuit board materials, for example conductive paste and electro conductive paint.

Others:

Printer toner, magnetic material such as ferrite, food material, pharmaceutical related and automobile parts

SPECIFICATIONS

Measuring method	Constant-current / -voltage methods
Measuring Units	Low resistance (10^{-4} - $10^7 \Omega$) Loresta-GX II High resistance (10^3 - $10^{14} \Omega$) Hiresta-UX
Power supply	AC 90 - 240V / 50 - 60Hz
Max. Load	0,01kN - 20kN (~60Mpa)
Hydraulic unit	automatic
Probe unit	20mm (Ø) x 40mm (L)
Probe types	4-Pin Electrode (inner-pin distance 3mm) Ring Electrode (Ø 20mm)
Necessary Item	Window PC with Excel
Dimensions (W x D x H in cm)	
Main Unit	43 x 23 x 49 (42kg)
Hydraulic Pump	57 x 37 x 32 (29kg)



FEATURES

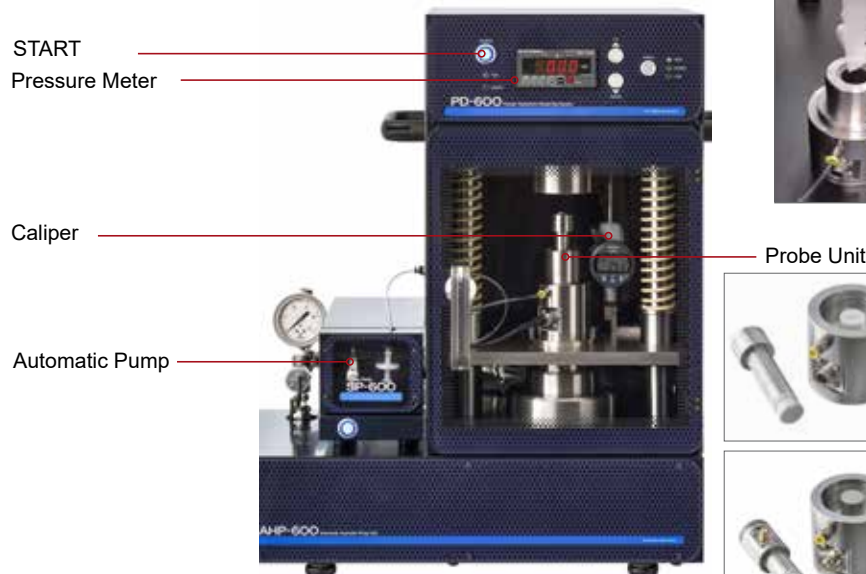
The Powder Measuring System MCP-PD600 contains a high precision pressure gauge for the measurement of conductive powders for maximum pressure of 20kN and is quickly attached to either the Loresta-GX II or Hiresta-UX unit.



Videolink

- Newly developed cylinder pump allows measuring from low load (0.01kN)
- 4-pin probe for precise measurement of low range resistivity / Ring probe for high range resistivity
- Improved powder filling performance with a new vacuum-pump.

DETAILS



PROBES



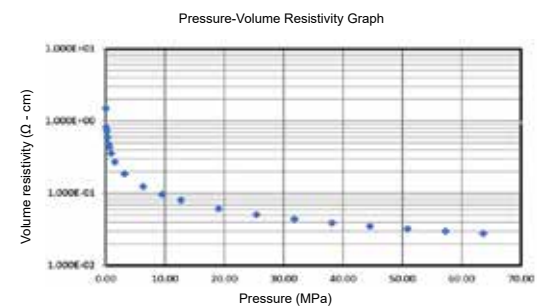
For Low Resistivity Measurement in addition with LORESTA-GX II (4 Terminal Method)



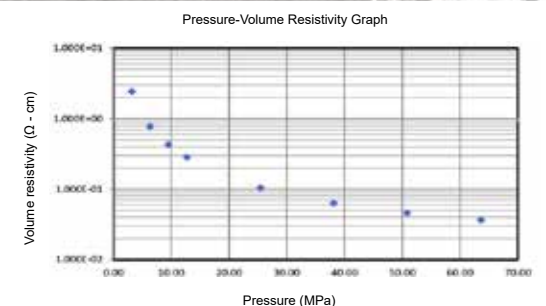
For High Resistivity Measurement in addition with HIRESTA-UX. (Ring Electrode)

TEST REPORT (EXAMPLE)

Sample CARBON BLACK									
No.	Load (kN)	Pressure (MPa)	Thickness (mm)	RCF	Resistance (Ω)	Resistivity (Ω -cm)	Conductivity (S/cm)	Density (g/cm³)	
1	0.01	0.03	11.60	1.460	OK	8.804E-01	1.491E+00	6.706E-01	1.388E-01
2	0.03	0.10	10.94	1.539	OK	4.869E-01	8.199E-01	1.220E+00	1.472E-01
3	0.05	0.16	10.40	1.610	OK	4.378E-01	7.332E-01	1.364E+00	1.548E-01
4	0.10	0.32	9.58	1.730	OK	3.639E-01	6.032E-01	1.658E+00	1.681E-01
5	0.15	0.48	9.03	1.819	OK	2.969E-01	4.878E-01	2.050E+00	1.783E-01
6	0.20	0.64	8.72	1.874	OK	2.663E-01	4.354E-01	2.297E+00	1.846E-01
7	0.29	0.92	8.21	1.972	OK	2.206E-01	3.569E-01	2.802E+00	1.963E-01
8	0.49	1.56	7.50	2.121	OK	1.713E-01	2.724E-01	3.671E+00	2.148E-01
9	1.00	3.18	6.47	2.372	OK	1.213E-01	1.863E-01	5.368E+00	2.448E-01



Sample IRON POWDER									
No.	Load (kN)	Pressure (MPa)	Thickness (mm)	RCF	Resistance (Ω)	Resistivity (Ω -cm)	Conductivity (S/cm)	Density (g/cm³)	
1	0.09	3.15	4.19	3.096	OK	1.875E+00	2.433E+00	4.110E-01	3.039E+00
2	1.99	6.33	4.02	3.155	OK	6.127E-01	7.777E-01	1.286E+00	3.166E+00
3	2.99	9.52	3.90	3.200	OK	3.442E-01	4.291E-01	2.330E+00	3.269E+00
4	3.99	12.70	3.78	3.241	OK	2.309E-01	2.827E-01	3.537E+00	3.371E+00
5	7.99	25.43	3.46	3.349	OK	8.970E-02	1.039E-01	9.624E+00	3.682E+00
6	11.97	38.10	3.23	3.424	OK	5.725E-02	6.330E-02	1.580E+00	3.994E+00
7	15.97	50.83	3.05	3.479	OK	4.331E-02	4.594E-02	2.177E+00	4.177E+00
8	19.99	65.63	2.91	3.520	OK	3.560E-02	3.647E-02	2.742E+00	4.376E+00





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Our engineers look forward to hearing from you and will be happy to help and advise you at any time.

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