SIGMATEST® 2.069

Eddy-current conductivity tester for non-ferrous metals

FOERSTER

- √ Portable eddy current test instrument for measurement of electrical conductivity of non-ferrous metals
- √ Determining physical and technological material properties
- √ Monitoring the condition of highly stressed parts
- √ Material-mix testing
- √ Sorting of metals and alloys
- √ Scrap sorting
- √ In-process inspection in industrial, metallurgical and metalworking plants
- √ Quality control inspection
- √ Aircraft maintenance inspection
- √ Determination of heat damage
- √ Verification of the age-hardening condition of aluminum used in aircraft construction

SIGMATEST® 2.069

®Registered trademark

Principle of Operation

The SIGMATEST® 2.069 is an eddy current instrument that measures the electrical conductivity of non-ferromagnetic metals based on the complex impedance of the measuring probe. The measuring range for the instrument is established by calibration. When unknown test pieces are measured, the instrument converts the complex impedance value to an electrical conductivity value. The electrical conductivity value is indicated on the instrument's LCD display.

New features of the SIGMATEST 2.069

The **SIGMATEST 2.069** is a battery operated, portable instrument that replaces the **SIGMATEST 2.068 D** and **EC** models. The instrument includes most of the features of the **SIGMATEST 2.068 D** with the following improvements:

- The **SIGMATEST 2.069** adds a new test frequency, 960 kHz. This higher frequency makes it possible to perform accurate electrical conductivity measurements on very thin test pieces.
- The **SIGMATEST 2.069** provides the possibility of assigning frequency specific values for the reference standards during calibration.
- When the probe is exchanged, it is no longer necessary to exchange the **EPROM**. Probe characteristics are now transferred via a compact flash (CF) card and probe characteristics are "remembered" for each probe that has been connected.
- More than 30 MB of non-volatile user memory allows for storage of a large amount of test data and test setups. Test data and test settings can be transferred from the instrument via the CF card.
- Remote control by an external PC is possible via the RS-232 interface.
- In addition to entering a material specific temperature coefficient for the test pieces, the user can now enter specific temperature coefficients for each of up to four calibration standards.
- The operator interface supports multiple languages

Characteristics of the SIGMATEST 2.069

- Fast and reliable determination of electrical conductivity at high accuracy.
- Large measuring range from 0.5 to 65 MS/m (1% to 112% IACS).
- Distance correction up to 500 μm (0.02 inch) for maintaining high accuracy when measuring on painted, coated, or dusty surfaces.
- Probe design ensures high measurement accuracy close to the edge of the material.
- The probe and probe cable can be replaced separately.
- Correction of electrical conductivity values as a function of variations in the test piece temperature is possible using either an internal or external temperature sensor and a user defined temperature coefficient.

Characteristics of the SIGMATEST 2.069
(continued)

- Five selectable test frequencies: (60/120/240/480/960 kHz)
- A user definable correction factor allows for correction of measured values to compensate for constant errors such as concave and convex test piece surfaces.
- Consistently high accuracy on test pieces of various thickness.
- Monitoring of test piece/probe temperature and automatic notification to recalibrate when the temperature varies by +/- 5 degrees C.

Applications Examples

- Material verification as a quality control inspection
- Determination of the extent of thermal treatment
- Determination of metal purity
- Monitoring of metal homogeneity
- Monitoring of strength and hardness
- Determination of the phosphorus content in copper
- Monitoring of the polarization for cast copper
- Monitoring of separation processes for Cu-Cr alloys
- Detection of heat damage in aircraft structures
- Segregation of scrap metals based on electrical conductivity
- Measurements possible at high material temperature by protecting the probe with ceramic wafers up to a thickness of 500 μm (0.02 inch)

Features of the SIGMATEST 2.069

Operating Modes

The **SIGMATEST 2.069** is capable of operating in either **TOUCH**, **CONTINUOUS,** or **TOUCH & STORE** modes.

In **TOUCH** and **TOUCH & STORE** modes, the **SIGMATEST 2.069** senses the test piece as the probe approaches the measurement point and automatically executes the measurement. The measured value is held on the LCD display until the next measurement is triggered.

In **CONTINUOUS** mode, the value displayed on the instrument's LCD continuously updates to indicate the instantaneous electrical conductivity value.

In **CONTINUOUS** mode, test data can be written to the user disk or compact flash card at a rate that can be selected by the user.

In **TOUCH** mode, electrical conductivity values can be written to internal disk or user compact flash card each time the operator presses the **STORE** button.

In **TOUCH & STORE** mode, each measurement value is automatically written to internal disk or user compact flash card.

Calibration Modes

The default calibration mode for the **SIGMATEST 2.069** is to measure 2-4 conductivity standards and to enter their corresponding electrical conductivity values through the operation keypad. The instrument then adapts its internal measurement function based on the calibration.

Traditionally only one value has been assigned for each standard with that value being an average based on the results from each of the independent operating frequencies. It has long been known that accuracy can be improved by assigning so called "frequency specific" electrical conductivity values to the standards.

In the past, frequency specific calibration could be performed if the frequency specific electrical conductivity values for the standards were known. When performing frequency specific calibration with the **SIGMATEST 2.068**, the calibration had to be repeated when the operator changed test frequencies. During the new calibration, the operator had to enter the frequency specific electrical conductivity values for the frequency that was selected.

An additional feature that has been added with the **SIGMATEST 2.069** is the possibility to perform a frequency specific calibration for all operating frequencies simultaneously. After this function has been selected from the **CALIBRATION** sub-menu, the operator is prompted to enter the frequency specific electrical conductivity values for each standard (provided on the certificate for the standard). The **SIGMATEST 2.069** then computes the measurement function for each frequency based on the frequency specific values (as opposed to one average value). By this method, the accuracy for each frequency is improved and the frequency can be changed without the need to recalibrate.

The temperature coefficients for the two piece calibration standard set that is supplied with the instrument are the default temperature coefficients used during calibration. If desired, the user can input material specific temperature coefficients for up to four calibration standards.

The SIGMATEST 2.069 "remembers"

When a calibration is performed and the values of the electrical conductivity standards are entered, the instrument "remembers" the values and recalls them during subsequent calibrations. This feature eliminates the need to reenter the values during each calibration.

When a new probe is connected to the **SIGMATEST 2.069**, the compact flash card containing the characteristic function for the probe must be inserted into the user slot. The instrument then reads and stores this function in memory. The next time the probe is connected, the instrument recognizes the probe by serial number and recalls the correct function from memory. This makes it unnecessary to manually reload a file (or in the case of the **2.068**, exchange an **EPROM**) each time the probe is exchanged. This feature is especially useful for those customers who use both 8mm and 14mm probes with the same instrument.

Alarm Limits

Multiple alarm limits can be selected. A unique beep tone can be assigned to each alarm limit.

User Memory

More than 30 MB of user memory exists internally. Test data and settings can also be copied or written to a removable compact flash card. The storage capacity of the compact flash card is a function of the card itself. The data on the compact flash cards are written as normal comma delimited ASCII text files and can be directly transferred to a normal PC via a CF card adapter.

Data Transfer to PC

Data can be transferred to a remote PC fitted with a compact flash card adapter. The data is written to the compact flash card in DOS readable comma delimited ASCII test format. The data files can be easily imported into a host of PC based applications programs for manipulation, analysis, documentation, and archiving.

Correction Factor

Variations in material geometry can produce a measurement error. One example is measurement on test pieces with curved (either concave or convex) surfaces. If the true conductivity value of the test piece is known, the error caused by the curvature of the surface can be corrected by inputting a correction factor. The measured value is multiplied by the correction factor and the corrected value is displayed on the LCD.

Temperature Compensation

The **SIGMATEST 2.069** compensates for temperature related electrical conductivity variations. A default temperature coefficient is installed in each instrument. In addition, the user can define a specific temperature coefficient to optimize the results for specific applications.

Temperature measurement is performed using either the temperature sensor that is integrated into the probe or by connecting an external temperature sensor. An external temperature sensor is recommended when the temperature of the test piece differs from the probe temperature.

Construction

Physical Construction

The **SIGMATEST 2.069** is a compact hand-held instrument that can be operated with either battery or line power. The instrument uses five AA size cells (either alkaline disposable or Nickel Metal Hydride rechargeable) for battery operation.

The batteries are installed in a removable case that can be connected to a charger (in the case of Nickel Metal Hydride batteries) separate from the instrument.

The **SIGMATEST 2.069** incorporates a handy membrane keyboard and a crisp, backlighted LCD display. The ergonomic instrument housing is easy to hold and lightweight. An optional canvas carrying bag protects the instrument and provides a shoulder strap for easy handling. Also available is a collapsible table top stand.

Connectors are provided for:

- The measuring probe
- The temperature probe
- The RS-232 connection to an external PC for remote control
- A compact flash card for test data and setting transfer

Probes

Three different measuring probes are available for the instrument:

- 14mm straight probe
- 14mm right angled probe
- 8mm straight probe

The instrument kits include one probe (as specified by the kit number), a probe holder (hand grip), a V-block for facilitating measurements on curved surfaces, and a probe cable.

Calibration Standards

The instrument kit includes a two piece conductivity standard set for calibration prior to measurement.

The electrical conducitivity values for the two piece standard set are approximately 4.4 MS/m (8% IACS) and 58 MS/m (100% IACS). Calibration using the included standards allows for measurement with high accuracy across the entire conductivity range. A certificate is provided for each standard stating the electrical conductivity values and verifying traceability to the German National Standards Laboratory (PTB) and to United States National Standards (NIST).

The two piece standard sets are stored inside the bottom cap of the instrument for protection and easy access. They can be easily removed from the bottom cap if necessary.

Power Supply and Battery Charger

An AC adapter is available for operation from the local AC mains supply. At the time of order, the plug required for adaption to the local mains supply is specified. The AC adapter is included in all SIGMATEST 2.069 kits.

An optional battery charger is available if the instrument is to be used in conjunction with rechargeable batteries.

When ordering, state the operating voltage and the destination country for the instrument so that the correct voltage adapter is delivered.

Technical Data - SIGMATEST 2.069

Feature	SIGMATEST 2.069
Measuring range	0.5 to 65 MS/m; 1 to 112% IACS
Absolute accuracy - instrument only	+/- 0.5% of measured value
Resolution	from 0.001 to 000.1 (4 significant digits)
Distance correction	Up to 500 μm (0.020 inch)
Test frequencies	60/120/240/480/960 kHz
LCD display	16 grayscale LCD display 320 x 240 pixels LED back-lighted
Keypad	Membrane keypad with 21 keys; 6 keys with dedicated functions, three "softkeys" with functions controlled by software, 11 data entry keys
Interfaces	• 7 pin LEMO socket for probe • 9 pin D connector for RS-232 • Connector for power supply unit • 4-pole Fischer socket for temperature sensor
Operating time with one full set of batteries w/ backlight off (alkaline or Nickel Metal Hydride batter-ies)	~ 8 hours using 2300 mAH nimH rechargeable batteries @ 20°C ~ 5 hours using good quality alkaline batteries @ 20°C
Operating voltage	The power supply and battery charger can be adapted to the operating voltage in any country (110/220VAC)
User memory	• Internal disk: approximately 30 MB • Removable compact flash: determined by CF card capacity • CF cards up to 1 GB are available commercially
Environmental rating	In accordance with IP 54
Permitted ambient temperature	Unit: 0° to +50° C; 0° to +122° F Probe: 0° to +55° C; 0° to 130° F Material: 0° to +70° C; 0° to 160° F Measurement on higher temperature material Possible if probe protection/cooling measurements are implemented
Mass	Approximately 0.9 kg; 2 lbs. (with batteries)
Languages	English, Czech, German, French, Italian
Connectivity to PC	RS-232 or Compact Flash LAN adapter (optional accessory) for data evaluation, data storage, print-ing, and remote control.

SIGMATEST® 2.069 accessories

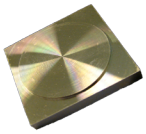
Several accessories are stored in a rugged case that has been designed for the SIGMATEST®

14 mm probe with handgrip

8 mm probe with handgrip

Calibration set

Conductivity standard



Operating instructions

14 mm right angle probe

Set down prism

Compact Flash card

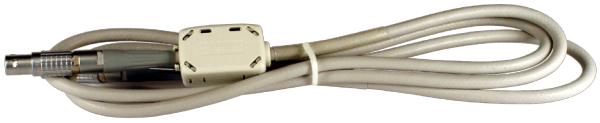
External temperature probe

Battery holder

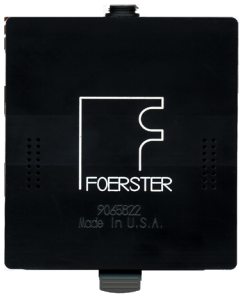
Compact Flash LAN adapter

Right angle probe cable

110/220 V power supply



Straight probe cable

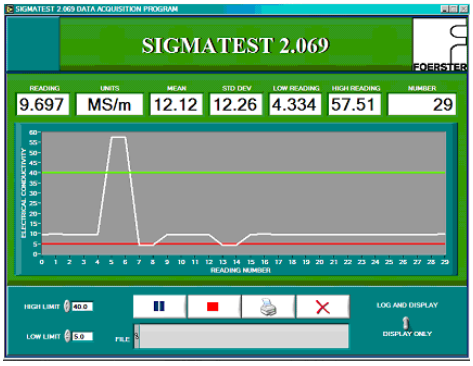


Battery charger

Other SIGMATEST® 2.069 accessories

Canvas carrying bag with straps

Collapsible wire stand

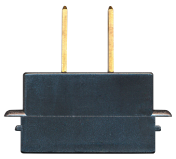


The SIGMATEST® Data Acquisition Software displays values (high, low, mean, last readings and standard deviation) on the PC screen, offers print screen possibility and eases electronic data storage

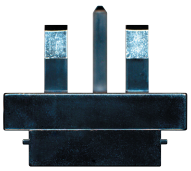
SIGMATEST 2.069

POWER SUPPLY PLUG ADAPTER OPTIONS

Description



Plug Adapter (USA/Japan)



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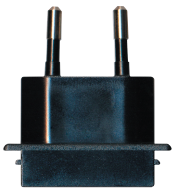
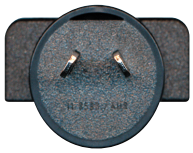


Plug Adapter (EU)

Plug Adapter (IEC)



Plug Adapter (Australia)