Screening Efficiency Tester
ETS Model 271 Operating Manual
D01677

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Revision History:

Revision A: Released 2005-11-01 Initial release

Revision B: Released 2020-09-30. Reformat

Products described in this manual are designed and assembled in the U.S.A. by

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I. IMPORTANT SAFETY INFORMATION

SAFETY INSTRUCTIONS

The equipment described in this Manual is designed and manufactured to operate within defined design limits. Any misuse may result in injury, electric shock, or discomfort to a person, incorrect readings, or damage to the equipment. The following rules should be observed for installation, use and maintenance. **Read the following safety instructions before operating the instrument.**

POWER

The unit may be operated as a battery powered device using two standard 9V rectangular batteries, or as a plug-in AC device using the supplied 18V wall adaptor. The highly efficient circuit design provides an operating life of about one (1) year under normal use for two 9 Volt alkaline batteries.

OPERATION

DO NOT OPERATE IN THE PRESENCE OF A PACEMAKER OR OTHER MEDICAL OR LIFESUSTAINING ELECTRONICS. The equipment produces a test signal which may cause malfunction of nearby electronic circuits.

DO NOT TOUCH OR COME IN CONTACT WITH THE EQUIPMENT WHILE IN USE. Voltages used in the equipment may cause serious discomfort, injury, or death. Power down and discharge all circuitry before contact.

DO NOT OPERATE WITH SUSPECTED EQUIPMENT FAILURES. If any odor or smoke becomes apparent turn off the equipment and unplug it immediately. Failure to do so may result in electrical shock, fire, or permanent damage to the equipment. Contact the factory for maintenance instructions.

DO NOT USE IN ANY MANNER NOT SPECIFIED OR APPROVED BY THE MANUFACTURER. Unapproved use may result in damage to the equipment or present an electrical shock or fire hazard.

BATTERY CAUTION. Rectangular 9V batteries should be kept individually packaged to keep terminals from shorting to metal items or to other batteries.

II. DESCRIPTION OF COMPONENTS

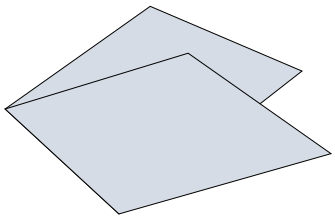
Included:

Item	Qty.	Description
Carrying case	1	Sturdy ABS case with foam insert keeps everything in its place and guards against shock.
Transmitter & Receiver	1	Cylindrical units containing electronics, batteries, and electrodes.
Spare batteries	2	Standard alkaline rectangular 9 volt batteries (2 installed plus 2 spares)
Cable TX-RX	1	Connecting cable for transmitter & receiver.
Power Adapter	1	Wall-plug-in 18V power module., 100-260VAC input, 8.1W output with attached cable and molded plug. ETS part # 0111-00001A

The Model 271 Screening Efficiency Tester is a complete, portable, battery-powered, microprocessor-driven instrument supplied in a sturdy carrying case. It is designed to evaluate the shielding effectiveness of material in both the laboratory and in the field. It performs nondestructive testing on any part of a suit or test fabric to measure the screening efficiency, in decibels (dB), relative to the screening efficiency of a good shield such as aluminum foil. The higher the absolute reading the better protection the suit affords.

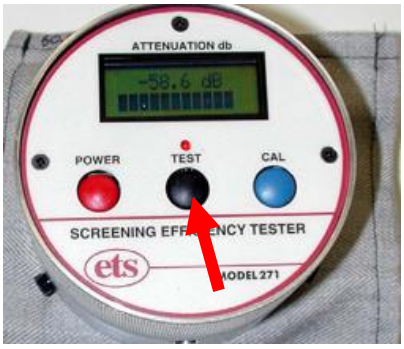
III. SETUP GUIDE

	**Step 1 – Remove from carrying case** Remove the receiver, transmitter, and interconnect cable from the carrying case. Connect the interconnect cable between the transmitter and receiver. Place the receiver onto the transmitter.
	**Step 2 – Power ON** Push the Red **POWER** button. This turns on the instrument. Power is applied to the receiver and the display. The display will read **Push CAL sw to calibrate.**
	**Step 3 – Initial checkout** Push <u>and hold</u> the Blue momentary **CAL** switch. The display will read **Offset is XX mV.** If offset is less than 50 mV, the display will read **CAL COMPLETE Push to TEST.** Release the CAL button.
NOTE: **If the offset is greater than 50mV try moving the instrument to another location. The offset may be caused by external noise pickup.**	**Step 4 – Check Offset.** If the offset is greater than 50mV the display will read **CPU detects bad CAL data** for 2 seconds, then will switch back and read **Push CAL sw to calibrate** again. (Repeat step 3)
	**Step 5 – Make a reading.** With no sample inserted, push <u>and hold</u> the Black **TEST** button. The display will read **Testing in progress** then it will read **Release to read.**

	**Step 6 – Check low end reading.** Since there is no shielding, the display will read **POOR** and the bar graph will only display the first bar. After approximately 2 seconds **POOR** will be replaced by **–18.1 dB**. This is the minimum screening efficiency that can be measured. Repeat 3 times.
	**Step 7 – Prepare a test shield** Fold a piece of aluminum foil to form a double layer large enough to cover the entire transmitter base. This will approximate the thickness of actual suit fabric. Place the receiver over the foil and press down with sufficient force to allow the foil to take the shape of the test cell. Then release the pressure.
	**Step 8 - Check high end reading.** Push and hold the momentary **TEST** button. The display will read **Testing in progress** and then will read **GOOD.** The bar graph will read full scale. After 2 seconds **GOOD** will be replaced with a dB reading that should be in the range of **-90dB.** Repeat 3 times.
NOTE: If the unit displays mesurements outside these dB limits or if it is not possible to get 3 readings within 2 dB of each other, contact te factory for assistance.	**Step 9 – Reading Stability** The 3 repeated readings should be within 2 dB of each other. The ~18 dB reading and the ~90 dB reading represent the maximum range of the instrument and test results should be between these limits.

The Model 271 is now ready to provide accurate and consistent measurements. Calibration may be performed anytime by simply repeating the above procedure.

IV. QUICK START GUIDE

	**Step 1 – Turn on the instrument** Push the Red POWER button. This turns on the instrument.
	**Step 2 – Insert Sample** Place the fabric sample or suit to be tested in between the transmitter and receiver as shown. When testing suits, the transmitter may placed inside the sleeve or leg. DO NOT TEST SEAMS. If the receiver is offset by a seam this could result in erroneous readings.
	**Step 2 – Make a reading** Press TEST to make a reading. Repeat the measurements 3 times. The 3 measurements should be within approximately 2 dB of each other.
	**Step 3 – Check for consistency** If measurements are inconsistent, repeat the calibration procedure and retest. Make sure the test fabric covers the test cell and is flat.

V. FUNCTIONALITY

The Model 271 Screening Efficiency Tester is a completely integrated microcomputer-based instrument that can be used in both laboratory and field applications. The instrument consists of two sections: a transmitter and a receiver. Both transmitter and receiver are housed in rugged 4.0" (10 cm) diameter aluminum housings and are powered by a pair of 9-Volt alkaline batteries located in the receiver. A 36" (90cm) long, 3-conductor cable with 2.5mm stereo plugs on each end connects the transmitter to the receiver to provide switched power and ground. The instrument is housed in a dust/waterproof carrying case that measures 10.8"x9.85"x4.5" (27.5x25x1.5 cm). This manual plus a set of spare batteries are also contained in the case.

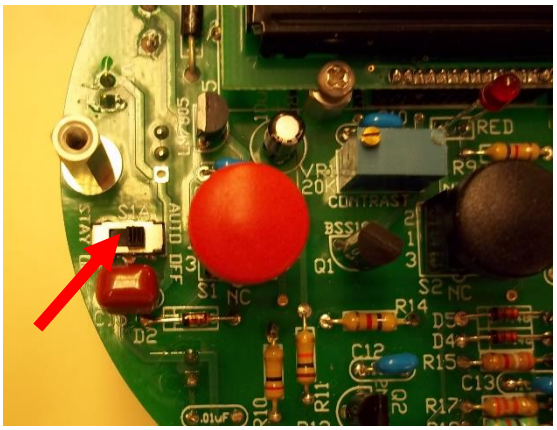
The transmitter, shown below, generates a 5 kHz signal with peak-to-peak amplitude of 400 Volts. The recessed transmitting electrode with unique spiral design allows perfect alignment with a similar receiving electrode. The electrodes are covered with a 10 mil, polycarbonate insulator.

The receiver detects, processes, and displays the signal on a 2-line alphanumeric, LCD display. A RED LED indicates the transmitter has been activated. The display indicates the intensity of the signal using a bar graph that interprets the signal as to whether the material is a POOR, MARGINAL, EFFECTIVE or GOOD shield. After 1.5 seconds the description switches over to show the actual screening efficiency in dB. All controls and displays are located on the receiver top panel. The receiver weighs approximately 1.5 lb. (.68kg).

The Red POWER push-push button turns the Tester on and off. The Blue CAL momentary push button calibrates the instrument by establishing a zero reference. The Black TEST momentary push button performs the actual screening efficiency measurement. The alphanumeric display prompts the operator on the measurement procedure.

The Model 271 features an auto shutoff capability. This places the unit in “sleep” mode if no activity is detected after approximately 15 minutes. To perform a test, simply depress the **TEST** or **CAL** button and the unit will “wake up”. When not being used the instrument should always be completely turned off using the **POWER** switch.

For applications where this feature is not required an internal switch disables the time-out and power on/off will be totally controlled by the **POWER** switch To access this switch remove the outer shell (see changing batteries) It is located left of the **POWER** switch.



When battery voltage is low the display automatically displays **Low Battery**.

VI. OPERATIONAL DETAILS

Conductive suits are worn by power company personnel for protection while performing maintenance on live wire transmission lines. The suit shields personnel from low frequency electric fields emitted by the lines. During the life of the suit, the conductive fibers woven into the fabric begin to break down, especially at wear points such as the seat, knees and elbows, thus reducing the effective protection the suit provides to the wearer.

Model 271 Screening Efficiency Tester

The Screening Efficiency Tester is based on the principle of applying an alternating electric field to one side of the conductive fabric (parallel to the fabric surface) and measuring its intensity on the other side. The higher the screening efficiency or conductivity of the fabric, the weaker the electric field that can penetrate and be measured on the other side of the conductive fabric. The Model 271 shows the screening efficiency of a conductive fabric in both dB and bar graph indication.

Display of screening efficiency

This approach provides a non-contact measurement that is able to equally measure fabric that has either a buried or a surface conductive layer. The unique electrode design enables at least 70% of the fabric surface under the device to be exposed and assessed.

The basic theory of measuring the screening efficiency of conductive fabrics is based on first measuring the output voltage of the receiver with a piece of aluminum foil placed between the transmitter and receiver. This reading is used as a reference to base or gauge the screening efficiency of the conductive fabric. This approach was chosen over using free air (no fabric or foil placed between electrodes) as the reference level. The free air reference may be dependent on the level of electrical noise pickup. The Tester measures over the range from –18.1 to –91.9 dB. Aluminum foil provides an excellent shield and should measure >–90 dB while no shielding will measure –18.1 dB.

System calibration is established by setting a known transmitter signal output and then injecting a signal back into the receiver that is attenuated by exactly 20dB .

The measurement range is divided into the following 4 screening efficiency categories:

POOR	<-30dB
MARGINAL	-30 to -40dB
EFFECTIVE	-40 to -50dB
GOOD	>-50dB

The table below illustrates the typical attenuation afforded by different materials from foil to non-shielding.

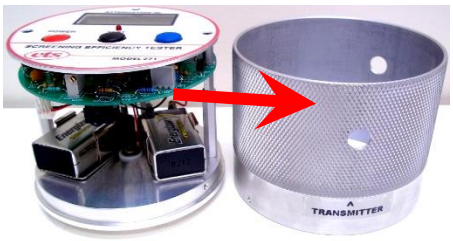
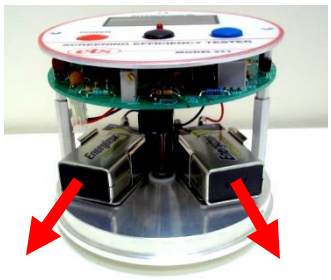
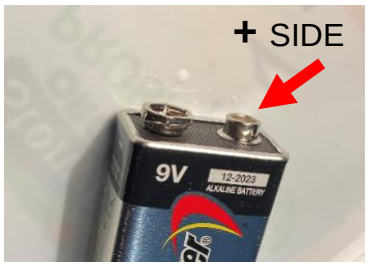
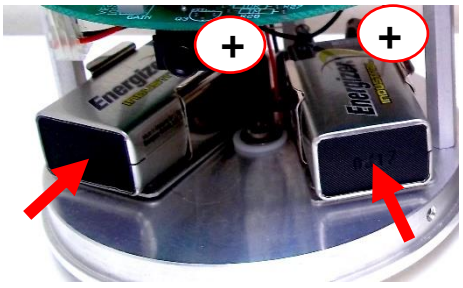
MATERIAL		CLASS	SCREENING EFF. DB
Foil		GOOD	-91.9
Conductive Fabric			
Washed	2X	EFFECTIVE	-42.7
	4X	MARGINAL	-39.9
	8X	MARGINAL	-38.4
	12X	MARGINAL	-37.0
	20X	MARGINAL	-35.3
Worn suit		MARGINAL	-36.9
ESD (non screening)		POOR	-18.1

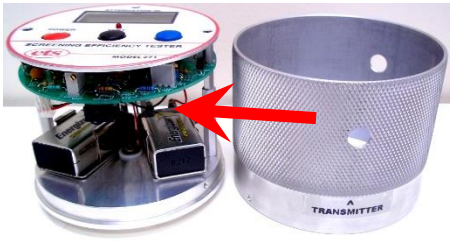
VII. MAINTENANCE and CALIBRATION

7.1 Battery Replacement

The Model 271 Screening Efficiency Tester operates from 2, 9-Volt Alkaline batteries connected in series to provide 18 Volts to both drive the transmitter and to power the receiver. The interconnect cable provides switched power and common ground to the transmitter. Turning on the transmitter only when required extends battery life considerably. Under normal use the Model 271 should be able to perform at least 500 measurements with fresh, alkaline batteries. When the batteries are low the display will read **Low Battery**. If the battery voltage is too low the unit will not turn on.

When replacing batteries, replace both at the same time and with the same type.

	**Low Battery Indication**
	**Step 1 – Remove outer shell** Remove the 3 thumb-screws securing the outer shell to the receiver base. Pull the outer shell off the base. Placing a little pressure on the top panel will assist in removal.
 	**Step 2 – Remove batteries** The batteries are located in respective recesses in the base and are electrically connected using standard 9-Volt battery clips. Slide the batteries out of the clips, taking note that the right side of each battery is the “+” side.
	**Step 3 – Install 2 new batteries.** Replace **both** batteries at the same time with new batteries of the same type. Slide into the clips with the **+** side to the right., and push firmly to click into the connectors.

	**Step 4 - Replace the outer shell**. Make sure the holes in the side of the shell line up with interconnect and power cable jacks. Tighten the screws.

7.2 Calibration and Repair

The instrument is functionally self-calibrating. However, annual calibration to verify and adjust frequency, output voltage and receiver gain (attenuation) is recommended.

The Model 271 contains no user serviceable parts. Call ETS for assistance. To return a unit for calibration or service first contact ETS at 215-887-2196 to obtain a Return Authorization number.

VIII. WARRANTY

Electro-Tech Systems, Inc. warrants its equipment, accessories and parts of its manufacture to be and remain free from defects in material and workmanship for a period of one (1) year from date of invoice and will, at the discretion of Seller, either replace or repair without charge, F.O.B. Perkasie, Pennsylvania, USA, similar equipment or a similar part to replace any equipment or part of its manufacture which, within the above stated time, is proved to have been defective at the time it was sold. All equipment claimed defective must be returned properly identified to the Seller (or presented to one of its agents for inspection). This warranty only applies to equipment operated in accordance with Seller's operating instructions.

Seller's warranty with respect to those parts of the equipment which are purchased from other manufacturers shall be subject only to that manufacturer's warranty.

The Seller's liability hereunder is expressly limited to repairing or replacing any parts of the equipment manufactured by the manufacturer and found to have been defective. The Seller shall not be liable for damage resulting or claimed to result from any cause whatsoever.

This warranty becomes null and void should the equipment, or any part thereof, be abused or modified by the customer of if used in any application other than that for which it was intended. This warranty to replace or repair is the only warranty, either expressed or implied or provided by law, and is in lieu of all other warranties and the Seller denies any other promise, guarantee, or warranty with respect to the equipment or accessories and, in particular, as to its or their suitability for the purposes of the buyer or its or their performance, either quantitatively or qualitatively or as to the products which it may produce and the buyer is expected to expressly waive rights to any warranty other than that stated herein.

ETS must be notified before any equipment is returned for repair. ETS will issue an RMA (Return Material Authorization) number for return of equipment.

Equipment should be shipped prepaid and insured in the original packaging. Otherwise, the equipment must be packed in a sufficiently large box of double wall construction with substantial packing around all sides. The RMA number, description of the problem along with the contact name and telephone number must be included in formal paperwork and enclosed with the instrument. Round trip freight and related charges are the owner’s responsibility.

ELECTRO-TECH SYSTEMS, INC. WILL NOT ASSUME RESPONSIBILITY FOR ADDITIONAL COST OF REPAIR DUE TO DAMAGE INCURRED DURING SHIPMENT AS A RESULT OF POOR PACKAGING.