SCREENING EFFICIENCY TESTER

Model 271

Operating Manual

11/1/05

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1.0 INTRODUCTION

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. The Model 271 Screening Efficiency Tester shown in Figure 1 is a portable, battery-powered instrument designed to evaluate the shielding effectiveness of the suit 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.

Figure 1 Model 271 Screening Efficiency Tester

The Screening Efficiency Tester is based on the principle of applying an 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. Figure 2 shows the screening efficiency of a conductive fabric in both db and bargraph indication.

Figure 2 Measuring 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 pick-up. 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 attenuation afforded by different materials from foil to nonshielding.

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

2.0 DESCRIPTION

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 24” (60cm) 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 on the right side of Figure 3, 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.

Figure 3: Transmitter

The receiver, shown on the left side of Figure 3, detects, processes and displays the signal on an 2-line alphanumeric, LCD display. A RED LED indicates the transmitter has been activated. The display indicates the intensity of the signal using a bargraph 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.

3.0 OPERATION

Operation of the Model 271 is very simple. Using the following procedure will provide accurate and consistent measurements:

3.1 Setup

1. Remove the receiver, transmitter and interconnect cable from the carrying case.
2. Connect the interconnect cable to the transmitter and receiver.
3. Place the receiver onto the transmitter. Push the Red POWER button. This turns on the instrument. Power is applied only to the receiver at this point. The display will read **Push CAL sw to calibrate.**

3.2 Calibration

1. Push the Blue momentary CAL switch. Power is applied to the transmitter while this button is depressed. The display will quickly read **Offset is 0 mV. (**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**)** Otherwise, the display will read.**CAL COMPLETE Push to TEST.**
2. Push and hold the Black TEST button. The display will read **Testing in progress** then it will read **Release to read** It will then display **POOR** and the bargraph will only display the first bar. After approximately 2 seconds **POOR** will be replaced by **–18.1db**. This is the minimum screening efficiency that can be measured.
3. Fold a piece of aluminum foil to form a double layer and large enough to cover the entire transmitter base. This will approximate the thickness of actual suit fabric.
4. 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.
5. Push and hold the momentary TEST button. Power is applied to the transmitter. The display will quickly read **Testing in progress** and then will read **GOOD** and the bargraph will read full scale. After 2 seconds **GOOD** will be replaced with a db reading that should be in the range of **-90db.**
6. Note or record the reading. This is the maximum screening efficiency that can be obtained. All other readings should be equal to or less than this reading. Repeat the measurement 3 times using the above procedure. The 3 measurements should be within approximately 2 db of each other.
7. Calibration may be performed anytime by simply repeating the above procedure.

NOTE

If the offset is greater than 50mV try moving the instrument to another location. The offset may be caused by external noise pickup.

3.3 Material testing

1. Remove the foil from the assembly and replace it with the fabric or suit to be tested. When testing suits the transmitter is placed inside the sleeve and legs when these areas are to be measured. Repeat the measurements 3 times. The 3 measurements should be within approximately 2 db of each other.

If measurements are inconsistent repeat the calibration procedure and retest. Make sure the test fabric covers the test cell and is flat. **DO NOT TEST SEAMS.** If the receiver is offset by a seam this could result in erroneous readings.

4.0 MAINTENANCE and CALIBRATION

4.1 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. Refer to Figure 4 and follow the procedure below.

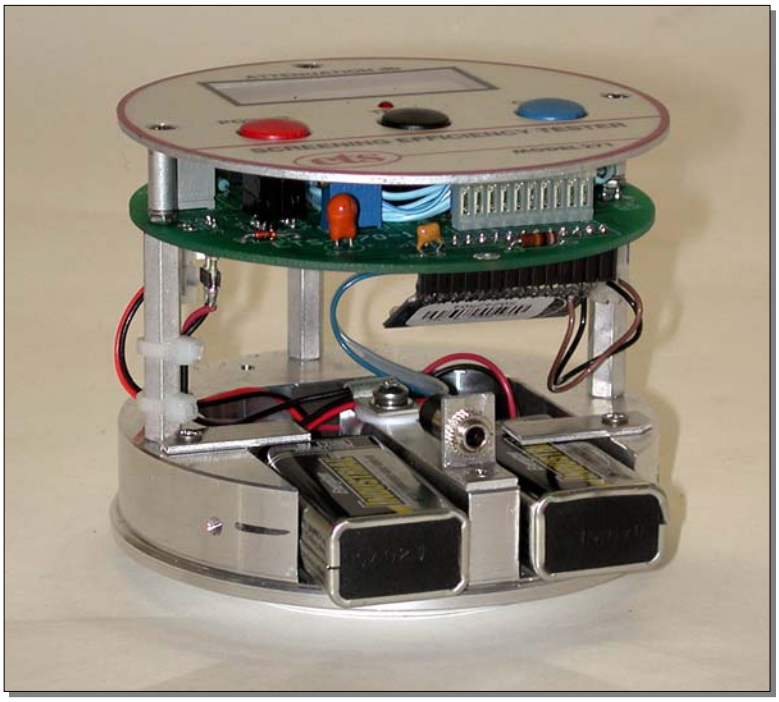

Figure 4: Battery replacement

1. Remove the 3 thumb-screws securing the outer shell to the receiver base.
2. Pull the outer shell off the base. Placing a little pressure on the top panel will assist in removal.
3. The batteries are located in respective recesses in the base and are electrically connected using standard 9-Volt battery clips. Remove the batteries and disconnect the clips.
4. Replace **both** batteries and reinstall into the recesses.
5. Replace the outer shell. Make sure the hole in the side lines up with interconnect cable jack.
6. Tighten the screws.

4.2 Calibration and Repair

The instrument is functionally self-calibrating. However, annual calibration to verifiy 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.

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5.1 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. Glenside, 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.