RAD ELEC

SPER-1E

Operator's Manual

Version 3.0.0
17 December 2025

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Introduction

The SPER-1E voltage reader is part of Rad Elec's family of SPER (Surface Potential Electret Reader) instruments and is used to measure the voltage (surface potential) of an electret. Its updated hardware and software provide higher sensitivity and more reliable operation than earlier models. A built-in microprocessor enables different capabilities through firmware variations, allowing multiple configurations of the SPER-1E reader. This manual describes the operation of the standard (basic) SPER-1E model.

SPER stands for Surface Potential Electret Reader.

The SPER-1E is a high-precision, non-contact voltmeter and should be handled with care. When not in use, store the reader in its carrying case.

The carrying case contains a desiccant to help protect the reader from moisture. As the desiccant absorbs moisture, the crystals gradually change color. Rad Elec recommends checking the desiccant regularly to monitor this color change. When needed, the desiccant can be renewed by placing it in an oven at approximately 225 °F (110 °C) for a few hours. Detailed instructions are printed on the desiccant canister.

The voltage reader should be calibrated annually. During calibration, Rad Elec performs routine maintenance on the reader, replaces the batteries, and verifies the readings using several known and traceable voltage ranges. At the end of this process, Rad Elec certifies the voltages of the reference electrets associated with the reader and issues a calibration certificate. Calibration request forms are available on Rad Elec's website. Please note that there is a charge for this service.

Although the detailed procedure for reading an electret is described later in this manual, the principle is straightforward. Using the SPER-1E voltage reader, the surface voltage of an electret is measured before and after a radon test. As the electret ion chamber is exposed to radon, the surface voltage decreases. This decrease in surface voltage is proportional to the time-integrated concentration of radon in the environment.

Schematics and Design

All SPER-1E models share the same external appearance. The front of the reader is shown in Figure 1. At the top is the **display**, where user prompts, data, and results are shown. Below the display is the **electret receptacle**, with the **shutter** shown in the closed position. The **shutter handle** is located at the lower right; gently pulling it toward you opens the shutter and either powers up the instrument or starts a reading.

The sensor behind the shutter is very sensitive and easily damaged. Keep the shutter closed except when performing readings. Do not touch, or allow any object to touch, the sensor board behind the shutter.

The right side of the reader includes several connection interfaces, shown in Figure 2. Next to the shutter handle is the RS-232 serial port. Moving to the right are a PS/2 port, a USB connector, and the power jack. On the SPER-1E model, the USB and PS/2 ports are not enabled.

The power jack allows you to use an external power supply for units that are used primarily in the lab and do not need to be portable. It can also be used to extend battery life. An optional external power supply is available from Rad Elec. Using external power does not prevent you from using batteries, and there is no conflict if both are used at the same time.

Figure 1: Front Schematic

The right side of the reader includes several connection interfaces, shown in Figure 2. Next to the shutter handle is the RS-232 serial port. Moving to the right are a PS/2 port, a Mini-USB connector, and the power jack. On the standard model, the

Mini-USB and PS/2 ports are not enabled, so please do not connect anything to them.

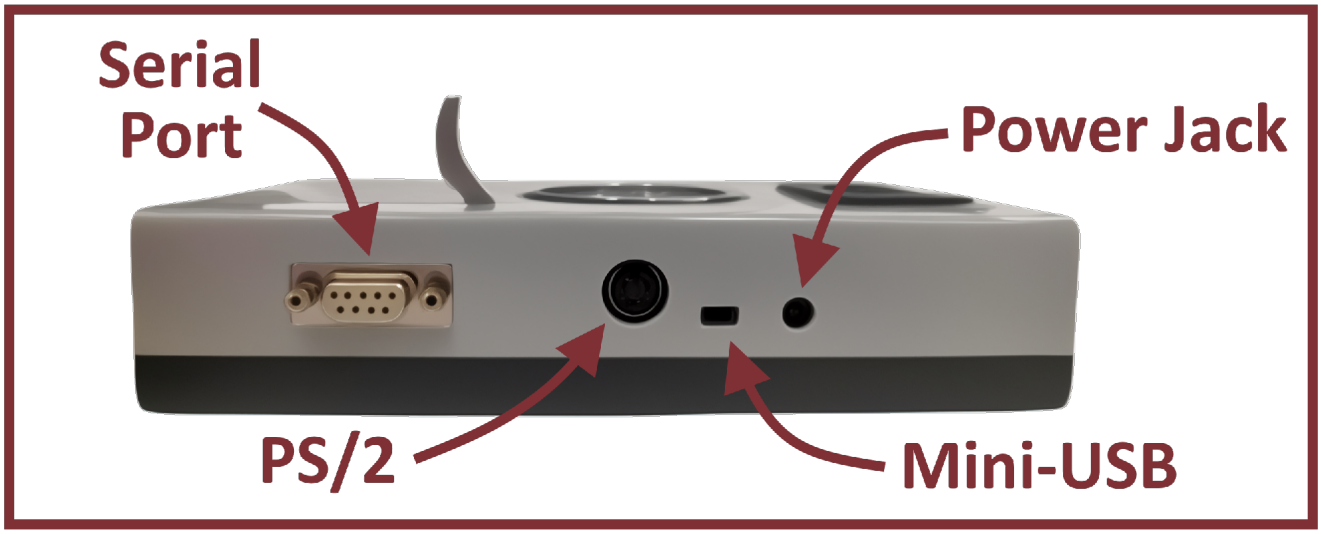


Figure 2: Side Schematic

Both the Mini-USB and PS/2 ports are not enabled on the SPER-1E reader. Please do not connect anything to them.

Handling and Maintenance

The SPER-1E is a high-precision, non-contact voltmeter designed as a laboratory-grade instrument and should be handled with care. It is supplied with a cushioned carrying case, and the reader should be stored in this case when not in use.

Desiccant Maintenance

A desiccant canister is located in the bottom of the carrying case to help keep the instrument dry. The silica gel crystals are visible through the window in the top of the canister: they appear blue when dry and turn pink or white as they absorb moisture. When the crystals appear pink, remove the canister from the case and bake it in an oven according to the instructions printed on the dessiccant; typically this is at a temperature of approximately 225 °F (110 °C) for a few hours. Afterwards, allow it to cool to room temperature in the oven before returning it to the case.

When not being used, please store the SPER-1E voltage reader in its carrying case.

Proper maintenance of the desiccant helps ensure that the SPER-1E is stored in a sufficiently dry environment for reliable operation.

SPER-1E Calibration

Annual calibration of the SPER-1E is recommended. When sending the unit to Rad Elec for calibration, include both the reader and its Reference Electret Set. Rad Elec will perform routine maintenance on the reader, replace the battery, calibrate the instrument, certify the Reference Electret Set, and issue a Reader Calibration Certificate. There is a charge for this service. Please use the Reader Calibration form available on Rad Elec's website when sending your reader in for calibration.

Please include your reference electrets and zeroing electret when sending your reader for calibration.

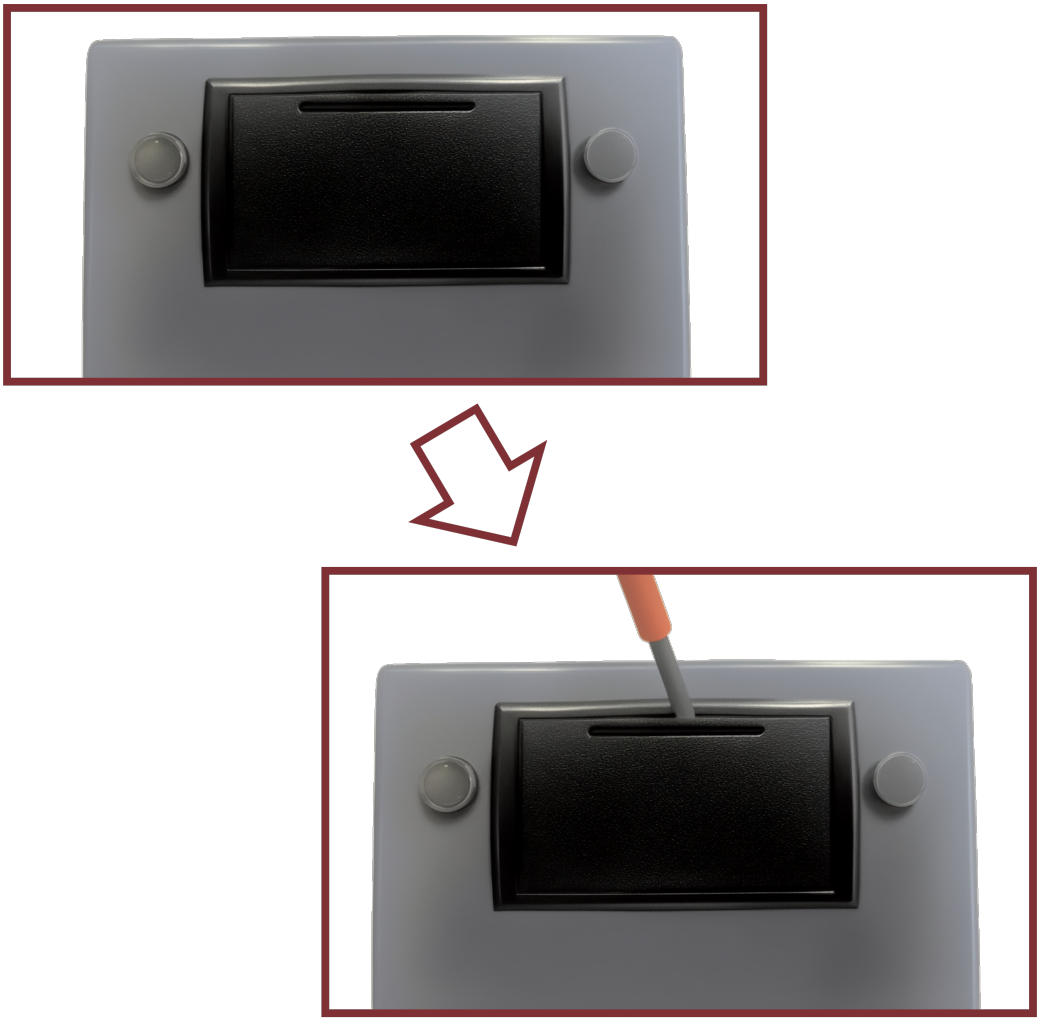
In most cases, the reader does not need calibration more than once a year. However, its voltage response should be checked weekly for stability using the Reference Electrets. See the section "Using the Reference Electrets" for details.

Changing the Batteries

The SPER-1E is powered by two AA alkaline batteries. When the batteries need to be replaced, the display will show BATT LO, indicating that the batteries are low..

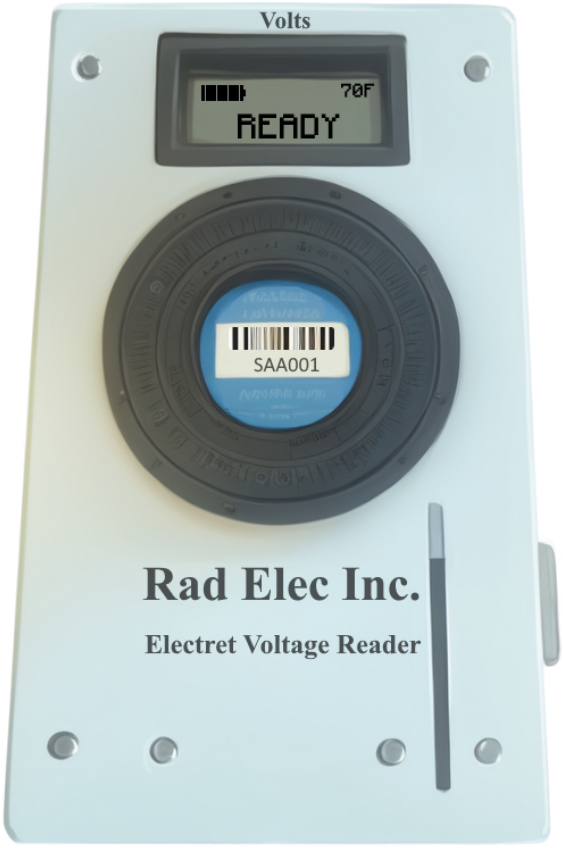
The battery compartment is located on the back of the reader. At the top of the battery door, there is a small slit directly above a longer opening. Insert a small flathead screwdriver into the small slit, gently push toward the larger opening, and lift the lid up to open the compartment.

Remove the old batteries and insert two new AA alkaline batteries, following the polarity diagram inside the battery compartment. Close the lid securely before using the reader again.



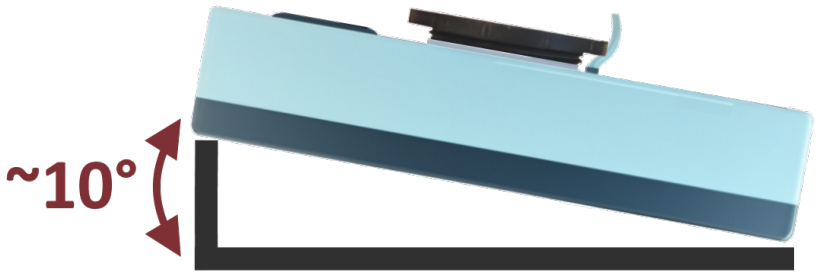
How to Measure Electret Surface Voltage

Understanding and employing the proper technique to measure an electret's surface voltage is arguably the most important part of conducting a successful electret ion chamber measurement. Overall, there are a few key points to keep in mind: measure the electret voltage several times in order to ensure an accurate reading, and employ an appropriate (and consistent) technique.



1. Remove the electret from its keeper cap or ion chamber, and place it face down onto the circular receptacle located on the SPER-1E reader. Pull the slide on the reader in order to turn it on, and let it warm up for a few seconds. When booting up, the SPER-1E will display some diagnostic information (such as the battery condition and the room temperature in Fahrenheit). After this diagnostic information is shown, the screen will display "READY".

2. Rotate the electret so that the serial number is parallel (and aligned) with the "Electret Voltage Reader" label etched onto the SPER-1E. For consistency, Rad Elec recommends keeping the reader in its case. Prop it up against the foam inside the case so that it sits at about a 10° angle. This ensures that gravity will pull the electret ever-so-slightly towards you, to remain consistent.



3 Place a keeper cap over the electret, which will cover the serial number. Gently place an index finger on top center of the keeper cap, and pull the slide with your other hand. When pulling the slide, your movement should be relatively consistent. Gently release the slide once a number appears on the screen.

4 The number that appears in the center of the SPER-1E screen is the current voltage of the electret. The battery condition is shown in the upper left of the screen, and a tiny three digit number in the upper right corner represents the time (in milliseconds) that it took to fully pull the slide.

5 After waiting a few seconds, repeat the measurement by pulling the slide again. When learning to read electrets, Rad Elec recommends repeating this process four or five times.

Typically it should take between 300 and 500 milliseconds to fully pull the reader slide.

6 Remove the electret from the SPER-1E reader, and protect it by replacing its keeper cap or returning it to an appropriate chamber that has an on/off mechanism. If additional electrets need to be read, repeat steps #1 through #5 in order to obtain the desired number of readings.

7 Congratulations! You've read an electret's voltage. The SPER-1E reader will automatically turn off after a few minutes of inactivity.

Reference Electrets

Reference electrets are an important part of ensuring that your SPER-1E voltage reader is accurately measuring the surface voltage of your electrets. Two reference electrets (comprising a pair) in addition to a specialized "zeroing" electret are assigned to every voltage reader, and are recertified every time the voltage reader is calibrated. The reference electrets are specialized low voltage electrets that are extremely stable, and whose voltages are traceable to the SPER-1E reader's calibration certificate. The purpose of these reference electrets is to confirm that the SPER-1E voltage reader is functioning within its calibrated parameters.

Reference electrets are never to be used for radon testing.

The reference electrets are **not to be used for radon testing**; their sole purpose is to ensure that your voltage reader is measuring voltages properly. The reference electrets should measure within ±3 volts of their certified voltages. The zeroing electret should measure within ±3 volts of zero.

A weekly record of the reference and zeroing electrets should be maintained and used as a part of your QA/QC (Quality Assurance and Quality Control) Plan. Record the voltage readings of the reference and zeroing electrets as you would a regular electret. Always keep the reference and zeroing electrets in their protective keeper caps when not being read. If the weekly readings remain within the aforementioned acceptable limits (±3 volts) you can be confident that your SPER-1E voltage reader is functioning correctly.

To ensure your voltage reader is measuring accurately, the reference and zeroing electrets should remain within ±3V of their certified voltages.

When reading the reference electrets, if one – but not both – of the electrets deviates significantly (greater than 3 volts) from its certified voltage, then it can be inferred that the SPER-1E reader is still functioning properly. It is likely that one of the reference electrets discharged due to either an

accidental touch or from environmental particulates (such as dust or fiber). If this occurs, clean the electret with nitrogen (or an oil-free air compressor) and monitor it over the next several days until it becomes stable. If a reference electret drops below 100 volts, it should be exchanged for a new reference electret.

Routine readings of the reference and zeroing electrets allow you to be confident in your radon tests!

However, when reading the reference electrets, if both electrets deviate significantly from their certified voltages (greater than 3 volts), the SPER-1E voltage reader may need to be calibrated or repaired. Please contact Rad Elec, and we will be happy to assist with resolving this matter.

The reference and zeroing electrets should not be relied upon as a replacement for actual calibration. These electrets provide only one point of reference for the SPER-1E reader, and should not be construed as a method of calibration in and of themselves. During the official calibration process, the SPER-1E voltage reader is calibrated over a much wider voltage range.

Nevertheless, the reference and zeroing electrets do not serve as replacement for calibration.

Diagnosing Problems with the Reader

The voltage readings are fluctuating. How can I ensure stable readings?

If you are sure that you are using a proper reading technique (as explained earlier in the manual), then the next step is to ensure that the electret receptacle is clean. The electret receptacle is the circular metal housing on the SPER-1E voltage reader where the electret sits. It may become dirty and prevent solid contact with the electret, so you should clean it with a cotton swab that has been dabbed with rubbing alcohol.

Use the cotton swab to wipe around the electret receptacle on the SPER-1E, cleaning any debris off the surface. Afterwards, blow off the receptacle with nitrogen and make sure that no lint or fibers are left behind. **Do not open the shutter and expose the interior of the reader while cleaning the electret receptacle.**

Following the tips above should allow you to make reproducible readings. If your readings are still fluctuating, make sure that the reader hasn't been sitting outdoors in the heat or cold, and bring it into a climate-controlled area where the humidity is less than 75%. Please try to keep the reader inside its protective case, and gently bake the desiccant every few months to ensure that it is minimizing the humidity inside the protective case.

"BATT LO" appears on the screen.

This means that it's time to replace the batteries. Gently turn the SPER-1E over, and locate the battery panel. You will likely need to release the panel with a flat screwdriver. Remove the old batteries, and replace them with two new AA alkaline batteries.

Nothing appears on the display.

Pulling the slide/handle should turn on the reader. If it doesn't turn on, the batteries may either be dead or missing. If replacing the batteries does not fix the issue, please contact Rad Elec. Your reader will need to be repaired.

The voltage reader does not turn off after two minutes.

This symptom indicates a defect in the switch that is responsible for automatically turning off the reader. Although the reader can still be used, the batteries will not last long. It should be sent to Rad Elec for repairs.

"ER FAST" appears on the display.

This usually means that the shutter handle was pulled too quickly. Wait a few seconds, and try to gently pull the slide again. The motion to pull open the slide should be relaxed and steady; this maneuver should take approximately half of a second from start to finish. After the shutter handle reaches the bottom of its track, and the voltage appears on the display, you can gently release the slide so that it returns to its resting position.

When reading a reference electret, its voltage differs by greater than ±3 volts from its certified voltage.

If only one reference electret deviates from its certified voltage, then the reader is perfectly fine. If both electrets deviate from their certified voltages, then the reader may have been dropped (or experienced significant mechanical trauma). In this scenario, you may try replacing the batteries in order to see if it makes a difference, but the SPER-1E will likely need to be sent to Rad Elec for repairs. Please contact Rad Elec.

"ERSLIDE" appears on the display.

This means there was an error when pulling the slide / shutter handle. To correct this, gently pull the slide back. Hold the slide in the open position while the display shows READING. When the voltage value appears on the display, release the slide.

"ER OPEN" appears on the display.

This means the slide / shutter handle was held open too long. To correct this, release the slide and allow it to return to the closed position. Pull the slide again to start a new reading. Once the reading appears on the display, gently (yet promptly) release the slide to avoid this message.

"ER SLOW" appears on the display.

This means the slide / shutter handle was pulled too slowly. Wait a few seconds, and try to pull the slide again a little faster. The motion should be relaxed, steady, and should take approximately 500 milliseconds (half a second) from start to finish.

"ER WAIT" appears on the display.

This means that the memory has not yet cleared from the previous reading. Wait a second before pulling the slide / shutter handle between readings.

The desiccant in my protective case has changed color.

This means that the desiccant has absorbed a large amount of humidity, and needs to be revived. This can be done by placing it in an oven at a low temperature (usually around 225 °F / 110 °C) for several hours. The specific instructions are written on the the metal desiccant canister.

The SPER-1E voltage reader is making a high-pitched whistling sound.

This sound indicates that the slide has not returned back to its resting position. This can sometimes happen because the metal-to-metal slide rail is binding the slide movement. Try gently moving the slide handle back and forth, which will usually unbind it and allow the slide to return to its home position.

It is important to gently wiggle the slide back to its resting / home position, or else the reader will remain powered on and drain the batteries.

Uh-oh. Something weird is happening with my reader, and it's not described in this section.

That's OK! Please send us an email at info@radelec.com, or call our office at +1.800.526.5482. We'll be happy to help diagnose the situation, and determine if the reader needs to be sent in for repair.

Frequently Asked Questions

How should I store the SPER-1E reader?

A protective case is provided with each SPER-1E reader. Alongside the reader, this case has enough space to hold a desiccant, two reference electrets, and zeroing electret. This protective case is the perfect place to store, ship, and travel with your SPER-1E voltage reader. Rad Elec recommends storing the reader in its protective case when it is not being used, in order to keep it dry and clean. This practice is especially important when the environment has elevated humidity.

Do I need to "zero" my SPER-1E voltage reader every time I turn it on?

No. Nevertheless, frequent reference and zeroing electret readings help to ensure that your equipment is functioning properly.

How often do I need to read my reference electrets?

We recommend reading your reference electrets at least once per week, although some states or programs may require you to read them before each session.

How often should I replace the batteries in the voltage reader?

Not very often. If the battery is low, you will notice the battery icon on the display gradually being reduced.

When the battery voltage gets low enough, a "BATT LO" warning will appear when you turn on voltage reader. This means that you should replace the two AA alkaline batteries at your earliest convenience. This can be accomplished easily by turning the reader over, and gently releasing the battery panel with a flat head screwdriver. Also, Rad Elec will replace your batteries as part of the annual calibration service.

How often should my voltage reader be calibrated?

Your reader should be calibrated annually, along with your reference and zeroing electrets. There is a calibration sticker on the back of your reader, which will let you know when its next calibration is due.

The calibration form can be found on our website in the Customer Forms section.

SPER-1E Technical Specifications

This section contains the technical specifications for the SPER-1E voltage reader. Its purpose is to provide a succinct yet detailed summary on the voltmeter's dimensions, measurement components, and the I/O and user interfaces.

Physical

Dimensions	4.35" x 7.44" x 1.6" (110.5 mm x 189 mm x 40.5 mm)
Material (body)	high-impact ABS
Mass (w/ batteries)	22.3 oz (633 g)

Measurement Components

Electrode (electric field)	High purity Cu
Electret Receptacle / Shutter	6061 aluminum
Mass (w/ batteries)	22.3 oz (633 g)

Error

Electret Voltage Measurement	± 1 Volt Full Scale

Typical Operating Conditions

Temperature	32 to 104 °F (0 to 40 °C)
Relative Humidity	≤ 75% (non-condensing)
Use Location	Indoors
Max Altitude	≤ 17,000 ft (5180 m)
Pollution Degree	2

User Interface

Display Type	7 Digit Alphanumeric LCD
Electret Voltage Reading	≤ 1600 Volts
ON	Shutter Handle
OFF	Auto-off after 2 minutes inactivity
BATT LO	Battery voltage ≤ 2.25 V
ER FAST	Shutter handle pulled too fast
ER OPEN	Shutter held open too long
ERSLIDE	Error when opening shutter
ER SLOW	Shutter handle pulled too slow
ER WAIT	Previous reading not yet clear

I/O Interfaces

Mini-USB	Not enabled / Do not use
PS/2	Not enabled / Do not use
RS-232 / Serial	Outputs electret voltage reading

Power Supply

Input	90 ~ 264 VAC
Output	6 VDC, 2.5 A
Barrel Connector	0.05" ID x 0.14" OD x 0.39" L (1.35 mm ID x 3.5 mm OD x 10 mm L)
Polarity	Positive Center
Batteries	2 x AA 1.5 VDC Alkaline

Included Accessories

Reference Electrets (2)	Stable 250 V potential (typ.)
Zeroing Electret	0 V potential (for meter zeroing)
Desiccant Canister	Silica gel
Carrying Case	Cushioned, high-impact ABS

If the SPER-1E is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

Afterword

If you've made it this far, thank you for taking the time to read the SPER-1E Voltage Reader Operator's Manual. This instrument is a key part of the E-PERM® radon measurement system, and it's important to us at Rad Elec that you have clear, practical guidance for operating it with confidence.

We are committed to improving both our equipment and our documentation. If you have suggestions that could make this manual clearer or the SPER-1E easier to use, please let us know — we value feedback from the people who work with our instruments every day.

If you'd like to learn more about the usage, applications, and research behind electret ion chambers and the E-PERM® system, we encourage you to visit the Publications and Manuals section of our website.

Please contact us via email (info@radelec.com) or phone (+1.800.526.5482) if you have any questions, concerns, or brilliant ideas for how we can serve you better.