

Field Scout Soil EC Meter



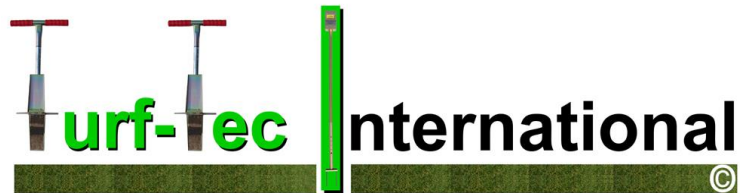
The Field Scout Direct Soil EC probe permits instant, accurate measurement of salts directly in the soil as well as water or nutrient solutions. Use this portable EC meter and probe to measure soil salinity directly on golf greens, fairways, and athletic fields right on the spot, without conducting tedious soil sampling and soil preparation.

You can test different levels in the soil profile with the eight-inch-long probe. You can also use the probe to fine-tune your fertility program. Measurement can be made directly in the soil without pulling soil cores. Turf managers can monitor for high salt levels on golf course greens and determine when to flush (leach) salts before turf quality declines. Check your water quality or nutrient solutions using the same probe.



Resolution 0.01 mS/cm. Accuracy $\pm 2\%$.
Automatic temperature compensation.
Includes case, calibration standards, and battery.

Field Scout Soil EC Meter - ECM1-N



EC Meter Instructions - ECM-1-N

Introduction

Congratulations on the purchase of your FieldScout Direct Soil EC Meter. This instrument has been specifically designed for direct measurement of salts directly in the soil as well as water or nutrient solutions. This manual describes how to use your meter and keep it working accurately for many years. Please read it thoroughly to get effective performance from your meter. The salinity of the soil solution, irrigation water or fertilizer solution is an important parameter affecting the root zone environment. Any of these factors can have a significant effect on plant growth and physiology. The easiest way to monitor salinity is by measuring the electrical conductivity (EC). EC is strongly correlated to the salinity of the soil solution. EC measurement is also affected by temperature and, to a lesser degree, by soil moisture content.

Use this portable EC meter and probe to measure salinity directly in the soil without tedious soil sampling and preparation. Turfgrass managers can monitor for high salt levels on golf course greens and Sports Fields and determine when to flush (leach) salts before turf quality declines. The meter comes with the Field Scout Soil/Water EC probe. This single, stainless steel probe has a specially designed conical tip. It can measure liquid EC (water or nutrient solutions) or in-situ soil salinity. The probe automatically compensates for temperature.

EC Probe



Electrical conductivity (EC) is an important parameter in evaluating irrigation water and fertilizer solutions. Turf can be damaged if irrigated with water with a high conductivity. The quality of irrigation water has been classified into 5 separate categories (See Appendix 2). EC is also an indicator of the strength of fertilizer solutions. In greenhouse applications and other situations requiring frequent fertilization, EC should be checked regularly to ensure the plants are getting sufficient nutrients while avoiding the effects of salt toxicity.

See Appendix 1 for a list of preferred EC values for some common turfgrass varieties. Typically, younger seedling of turfgrass or newly planted sprigs will require lower EC than mature plants. The stainless-steel soil EC probe is designed to be inserted directly into soil. The sensing surface is composed of 2 pairs of electrodes on the probe tip. Additionally, the probe is narrow in diameter so it can be used effectively on golf greens and sports fields.

Because EC readings are affected by moisture content, it is important that soil moisture content does not differ significantly between readings. An easy way to achieve this condition is by taking measurements approximately 30 to 60 minutes after an irrigation. This should ensure the soil moisture level has approximately reached field capacity. The probe should be inserted in the root zone. The measurement region is at the tip of the probe. For turf, the root zone is approximately 2” - 4”. For vegetables and small plants, this is about 8” - 12”. Wait until the meter reading stabilizes before withdrawing the probe. Taking several measurements will allow a representative average to be computed.

Important: Do not touch the sensor tip with your fingers. The oils on the skin will affect the probe’s measurement accuracy.

Meter Settings

Accessing the Setup Screen

Power on the tester. Press the MENU/▼ button. The meter will briefly display the Key Info screen before transitioning to the Setup screen. Follow the instructions for the specific parameter that is to be modified. Pressing the Cal/Esc button will return you to the measurement screen.

Measurement Parameter

1. Press MENU/▼ to scroll to Measurement option. 2. Press HOLD. The display shows Cond, TDS, and Salinity.
3. Use the MENU/▼ button to toggle between Cond, TDS, and Salinity. Press HOLD to select desired option.
4. The display shows the selected parameter with a checkmark and returns to the Setup screen.

TDS Factor

1. Press MENU/▼ to scroll to Settings option.
2. Press HOLD. The display shows TDS factor and Backlight.
3. Use the MENU/▼ button to scroll to the TDS Factor option
4. Press HOLD. Current adjustment factor will be displayed.
5. Adjust the setting with the MENU/▼ button. Note that the setting can only be adjusted down. The value will flip to 1.00 after you scroll past 0.40.
6. Press HOLD to confirm the TDS factor setting. The display shows the TDS factor with a check mark then returns to the Setup screen.

Backlight

The backlight increases screen readability in low-light conditions.

1. Press MENU/▼ to scroll to Settings option.
2. Press HOLD. The display shows TDS factor and Backlight.
3. Use the MENU/▼ button to scroll to the Backlight option.
4. Press HOLD. The options are ON and OFF.
5. Use MENU/▼ to scroll to the desired option.
6. Press HOLD to select. The display shows the selection with a check mark and returns to the Setup screen.

Temperature units

1. Press MENU/▼ to scroll to Temp Set option.
2. Press HOLD. The display shows options
3. Press MENU/▼ to select Set °C/°F. Press HOLD.
4. Press MENU/▼ to select desired units and press HOLD to confirm. The display shows the selected unit with a check mark and returns to the Setup screen.

Temperature Calibration

1. Press MENU/▼ to scroll to Temp Set option.
2. Press HOLD. The display shows options.
3. Press MENU/▼ to select Temp Cal. Press HOLD.
4. The lower display shows the current measured temperature reading based on the last set offset. The upper display shows the current measured temperature reading based on the factory default calibration.
5. Dip the tester into a solution of known temperature and allow time for the built-in temperature sensor to stabilize.
6. Press MENU/▼ to adjust the temperature value or press HOLD to confirm the calibrated value as the new temperature value of the solution.

Note: To exit this program without confirming the calibration, press CAL/ESC.

Temperature Coefficient

1. Press MENU/▼ to scroll to Temp Set option.
2. Press HOLD. The display shows options
3. Press MENU/▼ to select Temp Coeff. Press HOLD.
4. Press HOLD to select Temp Coeff or MENU/▼ to adjust the Temp Coeff.
5. Press HOLD to confirm the Temp Coeff value. The new value is automatically confirmed with a checkmark.

User Reset

Resets the meter's calibration to the user's default settings. Temperature user calibration is not affected by the user reset function.

1. Press MENU/▼ to scroll to Reset option.
2. Press HOLD. The display shows options
3. Press HOLD to select User Reset.
4. The display automatically shows No and Yes. Use MENU/▼ to scroll to the desired option.
5. Press HOLD to confirm selection. Display shows User Reset option with a checkmark.

Factory Reset

1. Press MENU/▼ to scroll to Reset option.
2. Press HOLD. The display shows options
3. Press MENU/▼ to select Factory Reset. Press HOLD.
4. The display automatically shows No and Yes. Use MENU/▼ to scroll to the desired option.
5. Press HOLD to confirm selection. Display shows Factory Reset option with a checkmark.

Taking Measurements

The procedure below illustrates the general process for taking EC readings. When taking measurements in liquids, ensure that the tip is fully immersed and not touching the side of the container. Stir and let the reading stabilize. Information on measuring other media are given in subsequent sections.

1. If necessary, power on the tester.
2. The timer icon will blink during this time. Once the reading is stabilized, the timer stops blinking and will appear to indicate the stability of the reading.
3. Note the value or press HOLD to freeze the reading. To release the reading, press HOLD again.
4. Press and hold the power button for 5 seconds to turn off tester. If key is not pressed for 8 ½ minutes, the tester will automatically shut off to conserve batteries.

Probe Calibration

Conductivity, TDS, or Salinity

For best results, periodic calibration with an accurate standard is recommended prior to measurement. Prior to calibration, the tip of the probe should be cleaned with alcohol. The tester will retain one calibration value in each mode (conductivity, TDS, salinity) when the instrument is powered off. The conductivity value can be calibrated automatically or manually. The TDS and salinity values require manual calibration. The tester will begin in the measurement mode that was used when it was powered off. See Measurement Parameter Setting (p. 6) for how to change the desired parameter. **Note: It is strongly recommended that calibration be done with 1.41 mS/cm solution. Manual calibration is possible with other solutions, but there are EC concentrations for which even manual calibration cannot be done.**

Automatic Calibration (Conductivity only)

1. Power on the meter.
2. Completely immerse the tip in calibration standard.
3. Stir gently and press the CAL/ESC button to begin the calibration. The meter will briefly display the Key Info screen before transitioning to the Cal screen.
4. The display will show CAL in the upper left corner. The values for automatically recognized standards (84 µS/cm, 1413 µS/cm, and 12.88 mS/cm) will cycle beneath the meter value.
5. If the reading is within the calibration range of one of the standards, the cycling will stop, and a check mark icon is displayed at the top of the screen.
6. Press HOLD to accept the auto conductivity standard and finish the calibration.
7. Display returns to Measurement window.

Manual Calibration

When the conductivity reading is outside the calibration range of the automatic conductivity standards or when TDS or salinity is used, the tester will require manual adjustment.

1. Repeat steps 1 to 4 from "Automatic Calibration".
2. Wait until the display settles on a measured value. Press MENU/▼ to manually adjust the value to the desired reading.

Note: The adjustment will decrease only, however the adjustment will eventually cycle to the highest available value after decreasing by 40% of the initial value.

3. Press HOLD to accept and finish the calibration when the desired value is selected.

Note: To abort calibration, press CAL/ESC to escape.

4. Once the calibration is finished and user has accepted the changes, the Measurement window will show the calibrated reading.

Direct Soil EC Readings

Golf Course Greens/Sports Turf

For golf course greens and athletic fields, following irrigation or deep-soaking rain event the stainless-steel probe of the EC Meter can be inserted directly into the soil. By taking measurements at different soil depths, you can determine where the salts are concentrated in the soil profile. Soil moisture content will significantly influence the measured EC value. To ensure accurate measurements, it is recommended the readings be taken when soil moisture is close to field capacity by taking measurements approximately 30 to 60 minutes after irrigation. This should ensure the soil moisture level has approximately reached field capacity or use the Turf-Tec Moisture Sensor or Field Scout Moisture Sensor and record soil moisture readings along with EC Readings. If you are using this method, be sure the soil moisture is in the same range each time you check EC Readings with this unit.

Probe to the depth of the turf root zone. Measurements exceeding 0.7 mS/cm (approximately equivalent to 2.7 mS/cm in a saturated paste extract) will result in cool season turf grass stress.

Procedure

1. Be sure soil is at field capacity or record moisture content reading from the Turf-Tec Moisture Sensor in percent of soil moisture.
2. Press On/Off to power up the meter.
3. Insert Stainless steel probe tip into the soil to the desired depth.
4. Hold probe still as possible.
5. Wait for reading to stabilize (Stable 3 seconds)
6. Repeat for each one-inch increment.

Saturated Media Extract (SME) Measurements

Growth media used in most greenhouse operations is high in organic material and processed materials and low in mineral soil. These materials are easier to handle, are well aerated and have good moisture-holding properties but have limited ability to retain nutrients. Therefore, tests developed for field soils do not always yield meaningful results. Saturated Media Extract (SME) analysis has been shown to eliminate these problems. The samples should not be fired, sieved, or pulverized as this will affect the growth medium properties and alter the results. Traditionally, the soil solution from the saturated medium is extracted by a vacuum pump. However, the Field Scout Soil & Water EC Meter allows the saturated sample to be tested directly.

Procedure

- Moisten the media sample with distilled water to reach a consistent “saturated” moisture level. When saturated, the media should glisten and slide from the mixing spatula with little or no free water.
- Wait 15 minutes and add more water if needed. The sample should have the consistency of a paste with slightly more water than if the media was in a pot and fully irrigated.
- Press On/Off button to power up the meter.
- Insert the probe tip into the media and read the results.

Liquid Measurement/Other Functions

Water (Liquid) Measurements

The Field Scout Soil & Water EC Meter can also measure the EC of liquids. Simply dip the electrode tip into the solution and wait for the reading to stabilize (a stable reading occurs when the readout has not changed for 3 seconds).

Converting Meter Readings to PPM

To convert ms/cm to Parts per Million (PPM) simply take the meter reading and multiply it by 640. Example $2.75 \text{ mc/cm} \times 640 = 1760 \text{ ppm}$

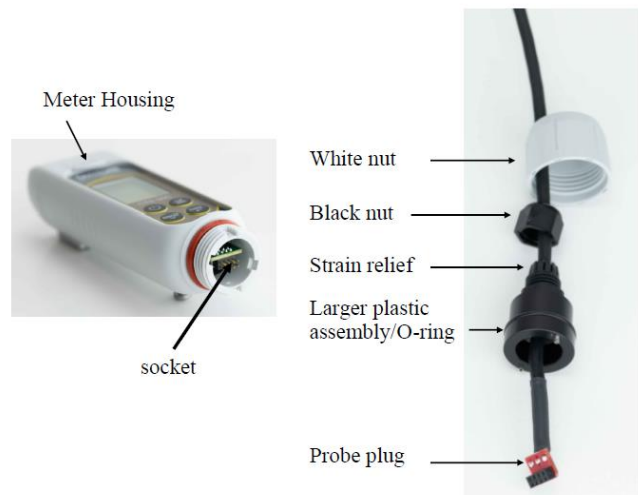
Sensor/Tip Replacement

If the probe cannot be calibrated, or if it does not hold the calibration for a reasonable amount of time, the probe or tip must be replaced. An “Temperature out of Range” message on the LCD may indicate a failed probe or simply that the probe has come unplugged from the meter.

I. Removing a direct-insert probe

The 8” probe do not have a replaceable tip. The re-placement procedure is outlined below.

1. Remove the black nut from the strain-relief where the cable feeds into the meter.
2. Remove the white nut on the cable end of the meter.



3. Detach the probe cable plug from the socket in the meter.
4. Remove the white nut and large O-ring.

II. Attaching a direct-insert probe

1. If you are connecting an 8" probe, slide the white nut over the probe and down the black cable. Skip to step 4.
2. If you are connecting a 24" probe, remove the strain relief from the larger plastic assembly.
3. Feed the cable and strain relief through white nut and re-connect the strain relief and the assembly.
4. Attach the probe plug to the socket in the meter housing.
5. Push the assembly onto the meter housing so the metal pegs on the assembly line up with the notches on the inner diameter of the meter opening. Be sure that the small O-ring sits at the base of the large plastic assembly.
6. While holding the assembly in place hand-tighten the nut to the strain relief.
7. Connect and tighten the white nut to the meter housing.

Battery Replacement

The meter uses four AAA 1.5 V batteries.

1. To remove the battery cover, see Figure 1. Clear the front catch then the back catch, before sliding the cover off.
2. To remove the battery plate, push the center tab towards the front of the tester as shown in Figure 2. Once unlocked, remove the plate to access the batteries.
3. Turn the tester upside down to remove the batteries. Each side uses two AAA batteries. Orient each battery with positive terminal facing downward.
4. To lock the battery plate, align the small tabs (Figure 3) into the guide ribs on the housing and then press down. See Figure 4.



Fig. 1: Removing battery cover

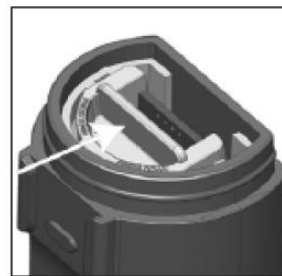


Fig. 2: Push to unlock

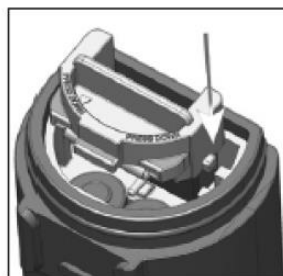


Fig. 3: Align tabs



Fig. 4: Push down to lock

Specifications

Range	0.0 to 200.0 μ S, 200 to 2000 μ S, 2.00 to 20.00 mS
Conductivity	
Resolution	0.1 μ S, 1 μ S, 0.01 mS
Relative accuracy	\pm 1% full scale
Normalization temp.	25.0°C (77°F)
Temperature co-efficient	0.0% to 10.0%
Calibration points	Up to 3 points
TDS	
Range	0.0 to 100.0 ppm, 100 to 1000 ppm, 0.10 to 10.00 ppt (TDS Factor 0.5)
Resolution	0.1 ppm, 1 ppm, 0.01 ppt
Relative accuracy	\pm 1% full scale
Calibration points	Up to 3 points
TDS factor	0.40 to 1.00 (selectable)
Salinity	
Range	0.00 to 10.00 ppt
Resolution	0.10 ppt
Relative accuracy	\pm 1% full scale
Calibration points	1
Temperature	
Range	0 to 60°C (32.0 to 140.0°F)
Temperature resolution	0.1°C / 0.1°F
Temperature accuracy	From 0 to 50°C (\pm 0.5°C / \pm 0.9°F + 1 LSD); from 50 to 60°C (\pm 1.0°C / \pm 1.8°F + 1 LSD)
General	
Display Graphics	Dot matrix 80 x 100 pixel
Auto off	8.5 minutes (from last key press)
Power requirement	Four AAA 1.5 V batteries
Battery life	>150 hours
Water proofing	IP67
Environmental operating conditions	
Ambient temperature	5 to 45°C / 41 to 113°F
Relative humidity	5% to 85% noncondensing
Storage temperature	-20 to 60°C / -4 to 140° F
Storage humidity	5% to 85% noncondensing
Probe Dimensions	
Length	7.7 in (19.5 cm)
Diameter	0.30 in (0.8 cm)

Appendix 1 Classification of Irrigation Water

Excellent	EC < 0.25 mS/cm
Good	0.25 mS/cm < EC < 0.75 mS/cm
Permissible	0.75 mS/cm < EC < 2.0 mS/cm
Doubtful	2.0 mS/cm < EC < 3.0 mS/cm
Unsuitable	EC > 3.0 mS/cm

Categories of irrigation water quality based on electrical conductivity. (USDA Tech Bulletin 962)

Appendix 2

Interpreting EC Readings from Turf Grass

When taking direct-insert EC readings in turf grass with the Field Scout meter, it is often helpful to convert the measurement to the equivalent Saturated Media Extract (SME) value. This conversion will vary for different soils. For sandy soils, the expression: **SME = 2.7FS + 0.8** provides a good approximation. FS refers to the reading taken by the Field Scout meter. This equation is the basis for table 1. Table 2 lists a variety of grass species and the range of EC values (converted to SME) they can tolerate.

FS	SME	FS	SME	FS	SME
0.1	1.1	1.1	3.8	2.1	6.5
0.2	1.3	1.2	4.0	2.2	6.7
0.3	1.6	1.3	4.3	2.3	7.0
0.4	1.9	1.4	4.6	2.4	7.3
0.5	2.2	1.5	4.9	2.5	7.6
0.6	2.4	1.6	5.1	2.6	7.8
0.7	2.7	1.7	5.4	2.7	8.1
0.8	3.0	1.8	5.7	2.8	8.4
0.9	3.2	1.9	5.9	2.9	8.6
1.0	3.5	2.0	6.2	3.0	8.9
0.1	1.1	1.1	3.8	2.1	6.5
0.2	1.3	1.2	4.0	2.2	6.7
0.3	1.6	1.3	4.3	2.3	7.0
0.4	1.9	1.4	4.6	2.4	7.3
0.5	2.2	1.5	4.9	2.5	7.6
0.6	2.4	1.6	5.1	2.6	7.8
0.7	2.7	1.7	5.4	2.7	8.1
0.8	3.0	1.8	5.7	2.8	8.4
0.9	3.2	1.9	5.9	2.9	8.6
1.0	3.5	2.0	6.2	3.0	8.9

Table 1: Conversion from Field Scout direct readings (FS) to equivalent Saturated Media Extract (SME) values.

(Reference 9:3. PACE Turfgrass Research Institute. San Diego, CA)

Appendix 3

Preferred EC Values for Selected Turfgrasses

Sensitive <3 mS/cm	Moderately Sensitive 3 -6 mS/cm	Moderately Tolerant 6 -10 mS/cm	Tolerant >10 mS/cm
Annual Bluegrass	Annual Ryegrass	Bent cv. Seaside	Alkaligrass
Colonial Bluegrass	Chewings Fescue	Perennial Ryegrass	Bermudagrass
Kentucky Bluegrass	Creeping Bentgrass	Tall Fescue	Seashore Paspalum
Rough Bluegrass	Hard Fescue	Buffalograss	St. Augustine grass
Centipedegrass	Bahiagrass	Zoysiagrass	

Relative tolerance of turfgrasses to soil salinity measured by the SME Method ("Salinity in Turfgrass", Harivandi M.A. Butler J.D., Lin w. 1992).

Note: The values on this table refer to measurement of a saturated media extract (SME) . Use table 1 to convert from direct-insert readings to SME.

LIMITED WARRANTY OF TURF-TEC INTERNATIONAL PRODUCTS

Turfgrass Products Corporation - dba - Turf-Tec International ("Seller") warrants to the final purchaser, that all Turf-Tec International tools will be free from defects in material or workmanship for a period of one year from date of purchase. SELLER'S SOLE OBLIGATION AND YOUR EXCLUSIVE REMEDY under this Limited Warranty and, to the extent permitted by law, any warranty or condition implied by law, shall be the repair or replacement of parts, without charge, which are defective in material or workmanship and which have not been misused, carelessly handled, or improperly repaired by persons other than Turf-Tec International. To make a claim under this Limited Warranty, you must return the complete tool, transportation prepaid, to Turf-Tec International after contacting Turf-Tec International and receiving a return authorization number. Please include a dated proof of purchase with your tool. ANY IMPLIED WARRANTIES SHALL BE LIMITED IN DURATION TO ONE YEAR FROM DATE OF PURCHASE. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING BUT NOT LIMITED TO LIABILITY FOR LOSS OF PROFITS) ARISING FROM THE SALE OR USE OF THIS PRODUCT.

Hold Harmless Agreement

The seller shall protect, defend, indemnify and hold the purchaser and their respective assigns and their attorneys, accountants, employees, officers and directors harmless from and against all losses, costs, liabilities, claims, damages and expenses of every kind and character, as incurred, resulting from or relating to or arising out of the inaccuracy of results, injury of user, injury of sports participant, turfgrass loss, warranty, covenant or any agreement made by the seller in this agreement.