U S E R S M A N U A L

CARDY NITRATE NO_3^- METER

Catalog #2300

Spectrum

Technologies, Inc.

CONTENTS

This manual will familiarize you with the features and operation of your Cardy Nitrate Meter. Please read this manual thoroughly before using your meter. For customer support or to place an order call Spectrum Technologies, Inc. at (815) 436-4440 between 7:30 am and 5:30 PM CST
FAX: 815-436-4460
E-Mail: specmeters@aol.com.
Website: www.specmeters.com

Spectrum Technologies, Inc.
23839 W. Andrew Rd.

INTRODUCTION

Congratulations on the purchase of your Cardy Nitrate (NO_3^-) meter. This manual describes how to use your Cardy meter and how to keep it working accurately for many years. Read it thoroughly in order to make effective use of your meter.

Nitrogen is one of the most important elements required for plant growth. It is a key component in chlorophyll, the pigment in plants that harnesses the sun's energy to convert CO_2 into carbohydrates and makes plants green. Tools that provide increased management of N offer significant economic benefits to plant growers of all types. In addition, applying just the right amount of nitrogen at the right time can help safeguard the environment by reducing the amount of residual soil nitrate (NO_3^-) available to leach into ground water

The Cardy Nitrate meter presents a completely new concept in sample measurement. This self contained digital meter delivers high quality answers to nitrate level questions in soils, plants, and water- based solutions.

The replaceable flat sensor makes the measurement of small samples much more convenient. When replacement of the sensor is required, the sensor cartridge snaps in and out of the meter at a touch.

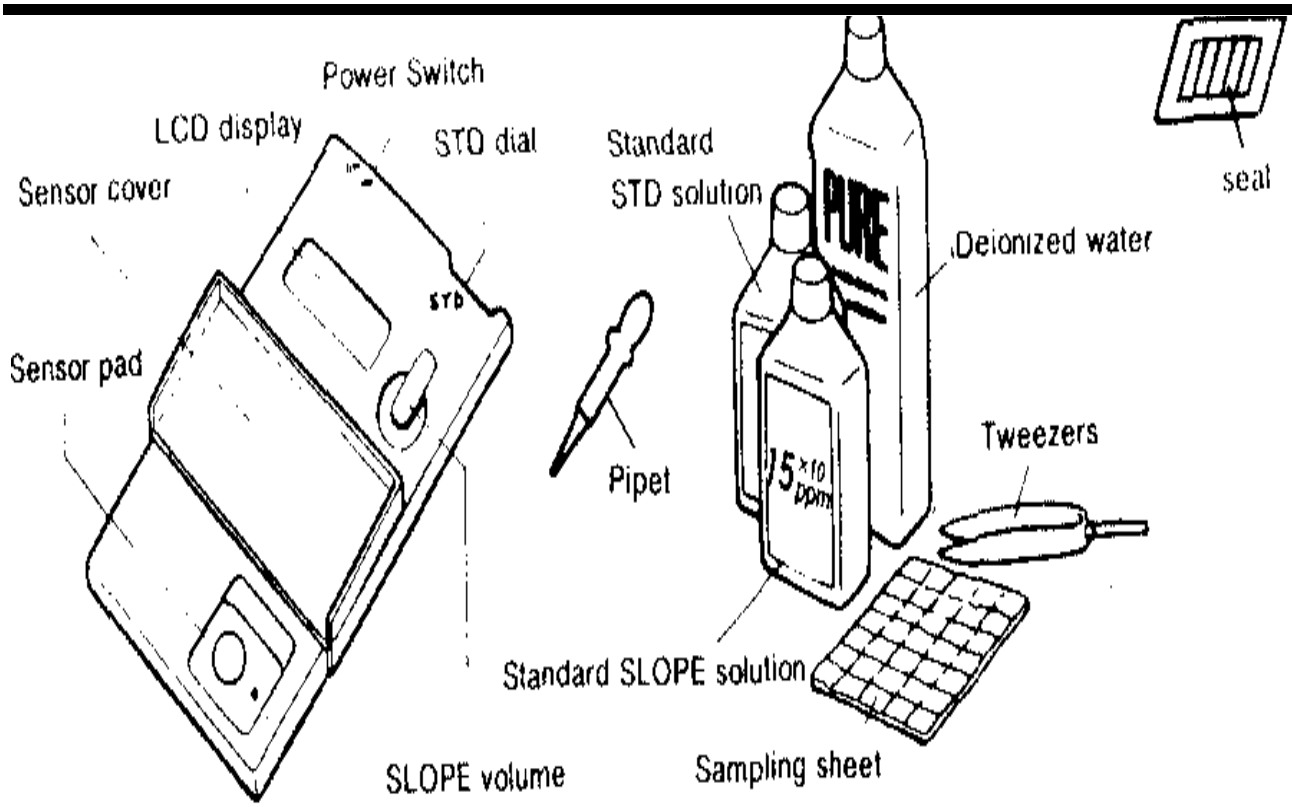
The readout of the measurement value is an LCD display. It a has a total display range of 0 - 9900 PPM. This is provided by three automatically switched ranges, the X 1 range (0-99 ppm), the X10 range 100-990 ppm), and the X 100 range (1000 - 9900 ppm). To get the final value you simply multiply the reading on the LCD display by the proper number, 1, 10, or 100, as indicated by the small arrow on the right side of the display window. The readout can represent either (NO_3^-) nitrate or nitrate-nitrogen (NO_3^- -N) depending on how the meter was calibrated.

SPECIFICATIONS

Principle	Ion electrode method
Readout	LCD digital display
Guaranteed Range	10^{-3} to 10^{-1} mol/l (meters can be used beyond this range)
Repeatability	±20% of indication value
Ambient Temperature	41 to 95° F (5 to 35° C)
Compensated Sample Temperature	At ambient temperature
Display Range	0 - 99 x 100 ppm (9,900 ppm)
Resolution	1ppm for 0 - 99 ppm 10ppm for 10-99 x 10 ppm 100ppm for 10 - 99 x 100 ppm
Power	2 - CR 2025 (lithium) user replaceable**.** Approximately 500 hours continuous use
Weight	1.4 oz (approximately 40 g.)
Calibration	2 - point calibration by STD/SLOPE controls using standard calibration solutions
Accessories	Sampling sheets, tweezers, pipet, seals, rinse bottle and carrying case

THIS EQUIPMENT HAS BEEN TESTED AND FOUND TO COMPLY WITH THE LIMITS FOR A CLASS B COMPUTING DEVICE PURSUANT O SUBPART J OF PART 15 OF FCC RULES.

METER COMPONENTS AND ACCESSORIES



METER FUNCTIONS

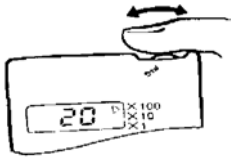
1. Power Switch - Turns the power ON or OFF

2. STD dial - calibrates the Cardy with Standard

3. SLOPE volume - Calibrates the Cardy to the SLOPE calibration solution.

4. LCD display - Expressed as ppm NO_3^-. Displayed by one of three automatically switched ranges.

X 1 (0 - 99 ppm)
X 10 (100 - 990 ppm)
X 100 (1000 - 9900 ppm)



5. Sensor pad - Ion-specific electrode principle: replaceable.

6. Sensor cover - protects the sensor during storage.

7. Battery box - contains two CR - 2025 lithium cells. A “B” shows up in the display if the batteries are low.

8. Tweezers - Use for handling sample sheet. Use the head of the tweezers for adjusting the SLOPE volume screw.

9. Sampling sheet - Use for measuring samples and calibrating meter. Assures that the solution bridges across the sensor pad properly.

10. Pipette - Use for depositing solutions on the sensor for measurement.

11. Standard Solutions - Use for calibrating the meter.

12 Yellow Seal - Use to cover the sensor (reference junction) when meter is idle for more than 30 days. The reference junction is positioned on the right side of the sensor pad.

SOIL TEST KIT ACCESSORIES

Description	#2329S* Starter Kit	#2329 Replenishment Kit
Std. Solution 450ppm $NO3^-$-N (30ml)	1	1
Extractant 20ppm $NO3^-$-N (1 Liter)	1	2
Cups - 8oz.	3	3
Measuring Spoon (29.5 cc)	1	1
Pipet	1	1
Filter Papers	15	30

Included with meter in item #2300

Handheld Plant Sap Press
(item #2725)

Hydraulic Plant Sap Press
(item #2720)

CARE FOR YOUR CARDY METER

1. If the sensor is new or has been inactive for over a month, drip 3 to 4 drops of either one of the standardizing solutions onto the sensor pad using a sampling sheet to "warm-up" the sensor for 20 to 30 minutes. The meter can be off. This improves sensor response time and reduces the drift of the readings.

2. A stable meter reading occurs when the value on the LCD display has not changed for a period of three (3) seconds.

3. Wait 30 to 45 seconds after the solution has been placed on the sensor pad when calibrating or making a reading. A functional sensor should reach a "stable" reading during that time.

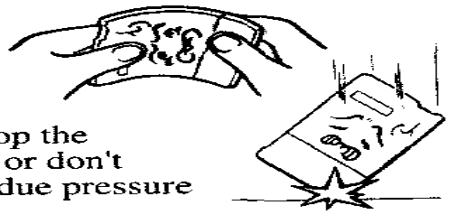
4. When measuring a sample, make sure that the sample is covering the two black round sensors in the sensor pad. The ion concentration cannot be measured if the electrodes are not covered by the sample.

5. Use clean tweezers to handle the sampling sheet.

6. In order to obtain measurement values of high repeatability, maintain identical conditions as much as possible.

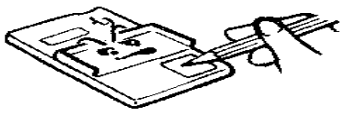
7. It is normal to see some liquid on a spot of the small electrode. Simply rinse and blot the electrode dry.

8. Any kind of soft wiping tissue or paper towel may be used to blot the sensor dry after rinsing.



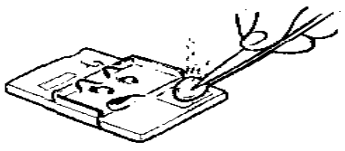
• Don't drop the CARDY or don't apply undue pressure

• Don't press the sensor pad with undue pressure

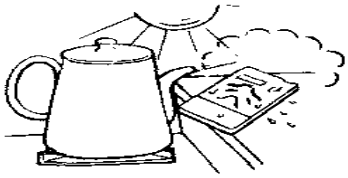


• Don't scratch the sensor pad

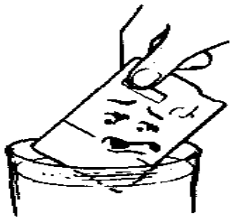
• Don't allow the CARDY to become wet



• Don't measure hot samples over 40 degrees



• Don't place the CARDY in direct sunlight, or in hot or humid places



• Don't put the CARDY directly into the solution in a beaker etc.

CALIBRATING SOLUTIONS

NO_3^- nitrate versus NO_3^--N nitrate-nitrogen

The sensor of the Cardy meter measures NO_3^- nitrate ion activity similar to the way a pH sensor measures H^+ ion activity. Decide whether you desire the meter LCD display to express the sample concentration as NO_3^- nitrate or NO_3^--N nitrate-nitrogen. (Note: this is similar to reflecting length as 6 in. or ½ ft.). Laboratory analysis and university guidelines are generally expressed as NO_3^--N nitrate-nitrogen.

To convert NO_3^--N nitrate-nitrogen to NO_3^- nitrate:

multiply or divide

NO_3^--N x 4.42 = NO_3^-

NO_3^--N / .226 = NO_3^-

Therefore:

2000 ppm NO_3^- nitrate = 450 ppm NO_3^--N nitrate-nitrogen

88 ppm NO_3^- nitrate = 20 ppm NO_3^--N nitrate-nitrogen

The following table shows the concentrations of the various calibration standards in each unit of measurement.

Description	Type	ppm NO_3^-	ppm NO_3^--N
#2338 450 ppm NO_3^--N *	STD	2000	450
#2339 20 ppm NO_3^--N *	SLOPE	88	20
#2336 450 ppm NO_3^--N **	STD	2000	450

**** For use with plant sap, water and nutrient solutions***

***** For use with soil samples***

CALIBRATION

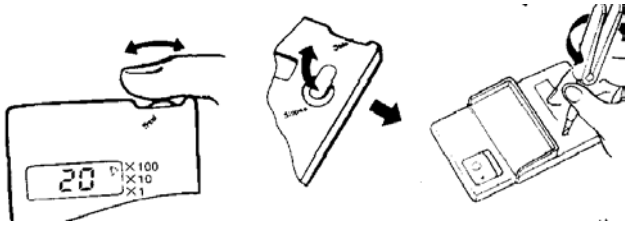
Important: The user must be consistent in calibrating the meter to either NO_3^- or NO_3^--N on both standards.

1. Turn the power ON.

2. Open the sensor cover, rinse the sensor pad with distilled water and blot the sensor pad clean with a piece of sampling sheet or tissue. Repeat rinsing and blot dry.

3. Place a piece of sampling sheet onto the sensor pad and drip 3 to 5 drops of the standard STD solution on it (or drip the solution directly onto the sensor pad). Be sure both dots (A&B as shown on pg 7) on the sensor pad are covered and there is a continuous bridge between them.

4. After the readout has stabilized (30 - 45 sec), adjust the STD dial until the display reads the value on the bottle (i.e. 45 x 10). Be mindful of the whether you are calibrating to units of NO_3^- or NO_3^--N.



5. After cleaning the sensor according to step 2, apply the SLOPE solution as in step 3. After the readout has stabilized, pull the rubber plug and use the driver end of the tweezers to adjust the SLOPE until the display reads value on the bottle (i.e. 20 x 1). Again, be mindful of the units.

6. Rinse the sensor and blot dry as in step 2. Repeat and blot dry.

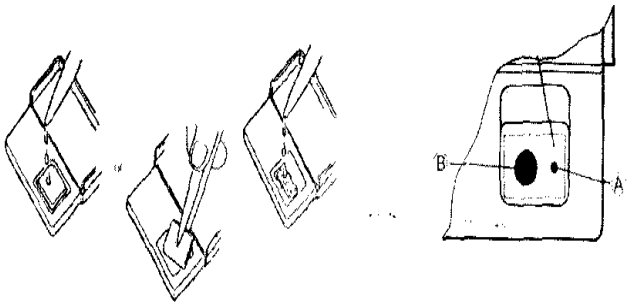
Note: If the meter is new or has not been used recently, repeat the calibration with both standards.

7. The meter's calibration can be checked when desired. Drip 3 to 5 drops of either calibration solution onto the sensor pad making sure both electrode dots are covered. Recalibrate if the display does not read ± 10% of the desired value.

8. Replace the slope adjusting plug.

MEASUREMENT PROCEDURE

1. Measurement can be aided by placing the sample onto a piece of sampling sheet. Using the pipette included in the case, transfer 3 to 5 drops of the pressed plant liquid onto the sensor pad. A sampling paper may also be placed on the sensor and saturated with the liquid.
Note: the plant sap press may be ordered from Spectrum Technologies, Inc., or your distributor.
2. After the value has stabilized (30 to 45 seconds), read the results from the display.



Note that the reading may be in units of NO_3^- or NO_3^--N depending on how the meter was calibrated.

3. Rinse the sensor pad with the distilled water and blot it dry with tissue or a paper towel. Repeat rinse and blot dry.

4. Repeat the procedure from the bulk sample 2-3 times and average the result to get a representative result.

Important: Do not make measurements with the meter (sensor) in direct sunlight.

MEASUREMENT OF SOIL NITRATE

Sample Collection

Collect at least 15 to 20 core samples from an area not exceeding ten acres by using a Z pattern. Areas having different soil types or management histories should be sampled separately. Sample the top 12 inches of soil. Some universities recommend sampling the top 24 inches in 12 inch increments. Contact your county extension agent for recommendations. Care should be taken to ensure that soil samples are not biased by the presence of rows or bands of fertilizer.

Sample Preparation

Samples should be dried within 24 hours of collection to minimize changes in NO_3^--N concentrations. Before drying, crumble the soil to avoid large clods that will be difficult to crush when dry. The samples should then be dried by spreading on a thin layer of newspaper at least 3 pages thick and placing overnight in a warm spot with good air movement. Soil will dry in a few hours if placed in a sunny location exposed to the wind. If dried indoors, 24 to 48 hours may be required. Indoor drying time can be reduced with the use of a fan. For oven drying, spread a thin layer of soil on a cookie sheet or pie plate. Place it in an oven set to no more than 250^{o}F with the door slightly ajar. Consider the soil dry when it crumbles rather than compacts under pressure. After drying, crush the soil by using a block of wood or other suitable device. Crush until the soil particles are the size of BB's or smaller. Sift with a flour sifter or other 10 mesh screen. Mix soil thoroughly.

Soil testing of mineral soil requires the Soil Test Kit. A starter kit is included with the Cardy NO_3^- meter #2300. Additional Soil Test Kits can be ordered as item #2329.

Important: Be sure you are using the soil standard solutions (item nos. 2335L and

2336) when calibrating the meter for soil tests. Do not use the calibration standards for water/plant sap (See **Calibration**, pg 6)

Measurement Procedure:

1. Measure 2 level measuring spoons (30 ml) full of dry soil into the soil sample cup.

2. Add 2 (30 ml) measuring spoons of the soil extractant to the soil.

3. Mix the soil and the solution by stirring with the spoon for at least 2 minutes, making sure the soil sample is thoroughly mixed with the distilled water. Let stand for 5 minutes

4. Fold a circular filter in half 'twice' and open it up to form a cone. Place it in the soil suspension as far as possible. The filtration will take place from the outside of the filter to the inside.

5. As soon as sufficient filtrate accumulates in the filter, use the small pipette to transfer the soil extract onto the sensor of the Cardy Meter.

6. Read the value from the digital display after it has stabilized (30 - 45 sec.). Subtract 20 from the display value. This accounts for the 20 ppm NO_3^- in the extractant solution. For lbs/acre, multiply by 4 for a sampling depth of 12 inches.

7. Rinse sensor and blot dry. Display should read close to "0" with distilled water on it, if not rinse again.

Moisture content	Sand	Clay sand	Sandy clay	Clay, Loess
Very dry	+8%	+15%	+17%	+23%
dry	+12%	+20%	+24%	+33%
Med-moist	+12%	+25%	+31%	+43%
moist	+14%	+30%	+38%	+53%
Very moist	+16%	+35%	+45%	+63%

Table 1: Estimated soil nitrate percentage correction for soils at various field moisture levels. Increase the value given by Cardy meter by the percentage shown in the table.

MEASUREMENT OF SOIL-LESS MEDIA

Sample collection

1. Collect just before plants are irrigated.
2. Avoid the top layer of media with no roots.
3. Collect root media from the bottom ⅔ of the pot.
4. Take samples from 10 or more plants distributed in the sample population.
5. When a sufficient amount of root media is collected, mix the sample.

Sample Preparation and Analysis
1:2 Extraction method

Measure a known volume of root media in a beaker or cup (usually 50 to 100 ml or ¼ to ½ cup). Fill firmly so it is compressed as it was in the pot. Be consistent when measuring. DO NOT lightly fill or heavily pack the beaker. Place the sample into a cup or beaker.

Add 2 equal volumes of distilled water into the cup, mix the sample and wait 10 minutes. Measure the nitrate after sieving out the large particles. The nitrate level can be read directly from the slurry.

Saturated media extract method

Place 300 to 500 ml (1 to 2 cups) of root media sample in a cup or beaker.

Slowly add distilled water, constantly stirring the sample with a spatula or knife. Add enough distilled water sot that the sample behaves like a paste with the surface glistening with water, but with no free water on the surface of the sample.

After 15 minutes, add more water if needed.

Extract the solution from the media using a pipet, buchner funnel, side arm, flask and vacuum pump or, for the flat electrode meters, a filter bag or sieve. Make any additional measurements (such as EC) using the extracted solution. Table 2 gives a general idea of the nitrate levels to look for in the extracted solution.

Media Type	ppm NO_3^--N in extract
Seedlings	40 - 70
Young pot and foliage plants	50 - 90
Pot and bedding plants-growing on	80 - 160
Roses, mums or snapdragons in ground or raised beds	120 - 200
Lettuce and tomatoes in ground beds	125 - 225
Celery transplants	75 - 125

Table 2: Interpretation of Greenhouse Soils: Desirable NO_3^- N concentrations in saturated media extract.

MEASUREMENT OF TISSUE SAP

Sample Collection:

When conducting a test on plant materials, the biggest source of error is due to sampling. This error results when a sample is not representative of the source. Follow these steps to gather and care for your sample:

1.) Do not sample plants which show obvious signs of nutrient deficiency or damage from disease, insects, or chemicals unless these plants are the subject of a study. Plants which have been under stress for a period of time may not give a true picture of the nutrient status of the field.

2.) The leaves or parts of leaves selected should be of the same age and relative position on the plant. The most recently matured leaves should be used. These are the leaves that have stopped expanding in size. The petiole or leaf stem of the leaf or appropriated plant material should be used for the test.

3.) A minimum of 25 petioles or leaves should be collected. This is enough to represent a five to ten acre field if the field is judged to be uniform. Chop up the petioles and mix and sub-sample these pieces for testing. Crops with small, dry petioles, such as strawberries require much larger samples to get enough sap compared to fleshy crops such as tomatoes. Store whole petioles, not leaves, at room temperature for up to 1½ hours or on ice for up to eight hours. Cold petioles should be warmed to room temperature before taking a measurement.

Measurement Procedure

1. Use a plant sap press to squeeze sap from the petioles. Use the sub-sample from step 3 of the **sample collection** procedure and place it in the press. Close the press and rotate so the holes face up. Center a sampling sheet over the holes. As the press is squeezed, the sap will saturate the sampling sheet. Make certain to press all the sap from the plant tissue in the press.

Note: the plant sap press may be ordered from Spectrum Technologies, Inc., or your distributor.

2. With the tweezers, transfer the saturated sampling sheet directly onto the sensor pad.

3. Wait for the reading to stabilize (30 to 45 seconds). Note that the reading may be in units of NO_3^- or NO_3^--N depending on how the meter was calibrated.

4. Rinse the sensor pad with the distilled water and blot dry. Repeat the rinse 2 to 3 times.

5. Repeat the procedure from the bulk sample 2-3 times. Average the result to get a representative result for the sample being measured.

Important: Do not make measurements with the meter (sensor) in direct sunlight.

MEASUREMENT OF GROUNDWATER AND NUTRIENT SOLUTIONS

Sample Measurement

Using a pipet, transfer several drops of liquid onto a sampling sheet on the sensor pad. Make certain that the liquid covers both dots on the sensor pad. After the display has stabilized (30 - 45 sec), read the results from the meter display.

For ground water, the acceptable nitrate levels are:

$\leq$ 45 ppm as NO_3^- nitrate or
$\leq$ 10 ppm as NO_3^--N nitrate nitrogen

Nutrient Solutions

Perform the measurement as indicated above. If the sample concentration exceeds 9900, the meter will display will read "--". Dilute the sample with distilled water at a ratio of 1:9 (1 part sample to 9 parts water) and re-measure. Multiply the meter reading by 10 to adjust for the dilution.

Petiole NO_3^--N Sufficiency Levels For Drip-Irrigated vegetables

(Source: UC-Davis)

Crop	Growth Stage	Petiole NO_3^--N concentration Dry Tissue	Fresh Sap
Broccoli	Mid growth	10,000 - 20,000	1000 - 1600
	Button formation	8000 - 15,000	800 - 1200
	Preharvest	5000 - 8000	600 - 1000
Cabbage	Cupping	*	1200 - 1500
	Early heading	*	1000 - 1200
	Mid heading	*	700 - 900
Canteloupe	Early flower	12,000 - 15,000	1000 - 1600
	Fruit bulking	8000 - 10,000	800 - 1000
	First harvest	4000 - 6000	700 - 800
Cauliflower	Mid growth	*	1000 - 1600
	Curd development	*	700 - 1000
	Preharvest	*	500 - 800
Celery	Mid growth	7000 - 10,000	600 - 800
	Preharvest	6000 - 10,000	400 - 600
Lettuce	Early head formation	7000 - 10,000	400 - 600
	Preharvest	6000 - 8000	300 - 500
Onion	Bulbs 0.5-1.5 in.	*	350 - 500
Pepper	Vegetative growth	7000 - 10,000	900 - 1200
	Early flower/fruit	5000 - 8000	700 - 1000
	Fruit bulking	5000 - 8000	700 - 1000
	Preharvest	5000 - 7000	700 - 900
Potato	Early vegetative	17,000 - 22,000	1300 - 1600
(Russet Burbank)	Mid tuber/bulking	11,000 - 15,000	900 - 1200
	Late tuber/maturation	6000 - 8000	550 - 700
Sweet Corn	Entire season	*	600 - 700
Tomato	Vegetative growth	10,000 - 14,000	700 - 900
	Early flower/fruit	9000 - 12,000	600 - 800
	Fruit bulking	6000 - 8000	500 - 700
	Preharvest	4000 - 7000	400 - 600
Watermelon	Early flower	12,000 - 15,000	1000 - 1600
	Fruit bulking	8000 - 15,000	700 - 900
	Fruit harvest	5000 - 8000	500 - 700

Petiole NO_3^--N Sufficiency Levels

(Source: University of Florida)

Crop	Growth Stage	NO_3^--N (ppm) Fresh Sap
Cucumber	First blossom	800 - 1000
	Fruits 3-inches long	600 - 800
	First harvest	400 - 600
Broccoli & Collards	Six-leaf stage	800 - 1000
	Just prior to harvest	500 - 800
	At first harvest	300 - 500
Summer Squash	First blossom	900 - 1000
	First harvest	800 - 900
Muskmelon	First blossom	1000 - 1200
	Fruits 2-inches long	800 - 1000
	First harvest	700 - 800
Tomato (field)	First buds	1000 - 1200
	First open flowers	600 - 800
	Fruit 1-inch diameter	400 - 600
	Fruit 2-inch diameter	400 - 600
	First harvest	300 - 400
	Second harvest	200 - 400
Bell Pepper	First flower buds	1400 - 1600
	First open flowers	1400 - 1600
	Fruits half-growth	1200 - 1400
	First harvest	800 - 1000
	Second harvest	500 - 800
Eggplant	First fruit (2-inches long)	1200 - 1600
	First harvest	1000 - 1200
	Mid harvest	800 - 1000
Potatoes	Plants 8-inch tall	1200 - 1400
	First open flowers	1000 - 1400
	50% of flowers open	1000 - 1200
	100% of flowers open	900 - 1200

Crop	Growth Stage	NO_3^--N (ppm) Fresh Sap
Annual Hill Strawberries (October planting)	November	800 - 900
	December	600 - 800
	January	600 - 800
	February	300 - 500
	March	200 - 500
	April	200 - 500
Watermelon	Vines 6-inches long	1200 - 1500
	Fruit 2-inches long	1000 - 1200
	Fruits half mature	800 - 1000
	First harvest	600 - 800

Optimum range of nitrate-nitrogen concentrations (dry weight and sap

Petiole NO_3^--N Sufficiency Levels For Potatoes (Source: Univ. Wiisconsin-Madison)

Growth Stage (days after emergence)	Norkotah, Norland, Atlantic, Kennebec	Shepody, R. Burbank, Snowden	Onaway Superior
dae	**Dry Weight Basis (% NO_3^--N)**		
30	2.5 - 2.8	2.0 - 2.3	2.3 - 2.5
40	2.3 - 2.5	1.7 - 2.2	2.0 - 2.3
50	1.8 - 2.3	1.2 - 1.6	1.5 - 1.9
60	1.3 - 1.9	0.8 - 1.1	0.9 - 1.2
70	0.8 - 1.1	0.5 - 0.8	0.4 - 0.6
	Sap Basis (ppm NO_3^--N)		
30	1900 - 2100	1600 - 1800	1800 - 1900
40	1800 - 2000	1600 - 1700	1600 - 1800
50	1400 - 1800	1000 - 1300	1200 - 1500
60	1110 - 1500	700 - 900	500 - 1000
70	700 - 900	500 - 700	400 - 600

Values from the Cardy can be converted to dry tissue calibration by using the equation:

%Dry Weight NO_3^--N = 0.00142 (ppm sap NO_3^--N) - 0.21

Petiole NO_3^--N Sufficiency Levels Russet Burbank Potatoes (Source: Univ. of Minnesota)

	Petiole NO_3^--N (ppm)	
Growth Stage	Dry Tissue	Fresh Sap
Early Vegetative/tuberization	17,000 - 22,000	1300 - 1600
Mid tuber growth/bulking	11,000 - 15,000	900 - 1600
Late tuber growth/maturation	6,000 - 8,000	550 - 700

Petiole NO_3^--N Sufficiency Levels

(Source: Michigan State University)

The following guidelines are based on one year's research results and will be revised as necessary based on future research findings. Readings taken on youngest fully extended petiole.

Carrots

	Adequate petiole sap nitrate concentration	
Carrot shoulder diameter (in.)	Nitrate-N (ppm)	Nitrate (ppm)
Prior to sizing	750+	3,300+
0.00 - 0.25	550+	2,420+
0.25 - 0.50	450+	1,980+
0.50 - 0.75	300+	1,320+
0.75 - 1.50	250+	1,100+
> 1.50	200+	880+

Celery

	Adequate petiole sap nitrate concentration	
Weeks after transplant	Nitrate-N (ppm)	Nitrate (ppm)
0 - 5	800+	3,520+
5 - 6	725+	3,190+
6 - 7	650+	2,860+
7 - 8	575+	2,530+
8 - 9	500+	2,200+
9 - 10	425+	1,870+
10 - 11	350+	1,540+
11+	275+	1,210+

Onions

	Adequate petiole sap nitrate concentration	
Growth Stage	Nitrate-N (ppm)	Nitrate (ppm)
Up to 5 leaves	800+	2,520+
5 to leaves	600+	2,640+
Bulb initiation	300+	1,320+
Bulb bulking	250+	1,110+

Pre-Sidedress Nitrate (PSNT) Soil Test Interpretation

University of Tennessee

<17	ppm NO_3^--N Low
17 - 25	ppm NO_3^--N Low
>25	ppm NO_3^--N Low

Rutgers Cooperative Extension

PSNT Soil Test Level (ppm NO_3^--N)	**Sidedress N Recommendation**
1 - 15	160
16 - 20	120
21 - 25	80
26 - 30	40
31+	0

University of Wisconsin

	Soil Potential*	
	Very High/High	Medium/Low
PSNT result (ppm N)	**N/application Rate (lbs/Acre)**	
<10	160	120
11 - 12	150	80
13 - 14	125	80
15 - 17	100	40
18 - 20	60	40
>21	0	0

** consult WMEX pub. A2809*

Pennsylvania Nitrogen Soil Test Recommendation (Lbs N/Acre)
(Source: Penn State University)

	Corn Yield Goal				
Soil Test Level (ppm NO_3^--N)	100	125	150	175	200
0 - 10	100	130	160	190	220
11 - 15	75	100	125	150	150
16 - 20	50	75	100	125	125
21 - 25	25	50	75	100	100
25+	0	0	0	0	0

Note: Check you county extension office for updates

SERVICE AND SUPPORT

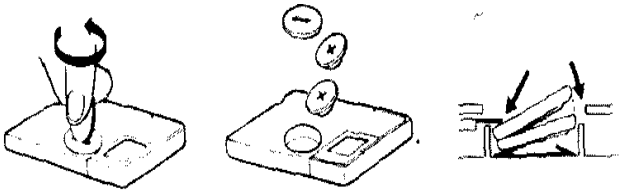
For technical service and support, call your distributor or Spectrum Technologies, Inc. at (815)436-4440.

When calling for technical support have a detailed explanation of the problem that you are experiencing. The more information you can provide, the faster and easier a technical support person will be able to assist you.

MAINTENANCE

Battery:

When the meter LCD display shows the battery symbol “B”, batteries need replacing. To replace batteries, turn the meter over and remove the circular battery cover. Release the cover by placing a coin in the slot and turning it in the direction shown to open. Place new batteries (CR2025) with the positive terminal up and under the metal tab. Replace the battery cover.



Replace both batteries at the same time. Do not throw old batteries into a fire. Do not leave old batteries in reach of children. If a child does accidentally swallow a battery cell, call a doctor immediately.

Sensor:

The field replaceable sensor has a life of approximately 150 - 300 measurements depending on the sensor age, frequency of use and maintenance. The sensor is worn out when a) the sensor will not calibrate to the “slope” standard (there is no more adjustment in the slope screw) or b) the meter drifts from its calibration standards when rechecking the two (2) point calibration. Repeat the calibration and check for drift.

Samples likely to damage the sensor pad include organic solvents, surface activators, cement, alcohol, strong acid, strong alkali, etc. The sensor pad is a thin, soft film. Do not handle in such a way that will scratch or damage the sensor.

If samples have a small amount of oil, it may be necessary to clean the sensor with a mild detergent solution.

To replace the sensor, turn the meter over and take the sensor off both hooks with the tweezers or a similar tool. Attach the new sensor to the meter properly until it makes a clear click sound.

WARRANTY

This product has been brought to you having passed severe quality control and inspections. Should any trouble occur during the course of normal use, the CARDY shall be repaired or replaced free of charge in accordance with the stipulations laid down herein. The term of this warranty shall be for three months from date of purchase. This warranty excludes batteries, sensor and accessories.

Warranty Stipulations:

1. The product shall be repaired or replaced free of charge should any trouble occur during the course of normal use if returned within the warranty period (three months from date of purchase). In which event, contact the dealer of purchase. Return CARDY with proof of date of purchase.

2. Expenses shall be incurred in the following instances within the warranty period. (Costs such as postage shall be borne by the customer)
a.) When the date of purchase and store name is not written on the warranty.
b.) When trouble or damage has been incurred due to misuse, abuse, and/or improper handling.
c.) When the CARDY has been repaired, modified and dismantled by persons other than a HORIBA designated agent or service shop.
d.) In the event of changes in external appearance (such as scratches or dirt caused during use) or battery fluid leakage.
e.) In the event of unsuitable movement, dropping or accidents such as fire, earthquake, floods or burglary.
f.) When replacing consumables and accessories.
g.) When cause of trouble lies not in the CARDY itself.
h.) When this warranty is not shown and when necessary particulars have not been written in the warranty.

Our obligation under this warranty is to repair or replace the CARDY free of charge in accordance with the conditions laid down herein. Accordingly, this warranty does not limit your specific legal rights. The warranty card must be completed and mailed promptly in order to register your CARDY under our warranty.

Product Return

If for any reason you are not satisfied, or the meter has failed and you need to return the product for service, you will need to contact Spectrum Technologies, Inc.

Before returning a failed unit, you must obtain a Returned Goods Authorization (RGA) number from Spectrum. You must ship the product(s), properly packaged against further damage, back to Spectrum (at your expense) with the RGA number marked clearly on the outside of the package. Spectrum is not responsible for any package that is returned without a valid RGA number or for the loss of the package by any shipping company.

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Fax (815) 436-4460
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