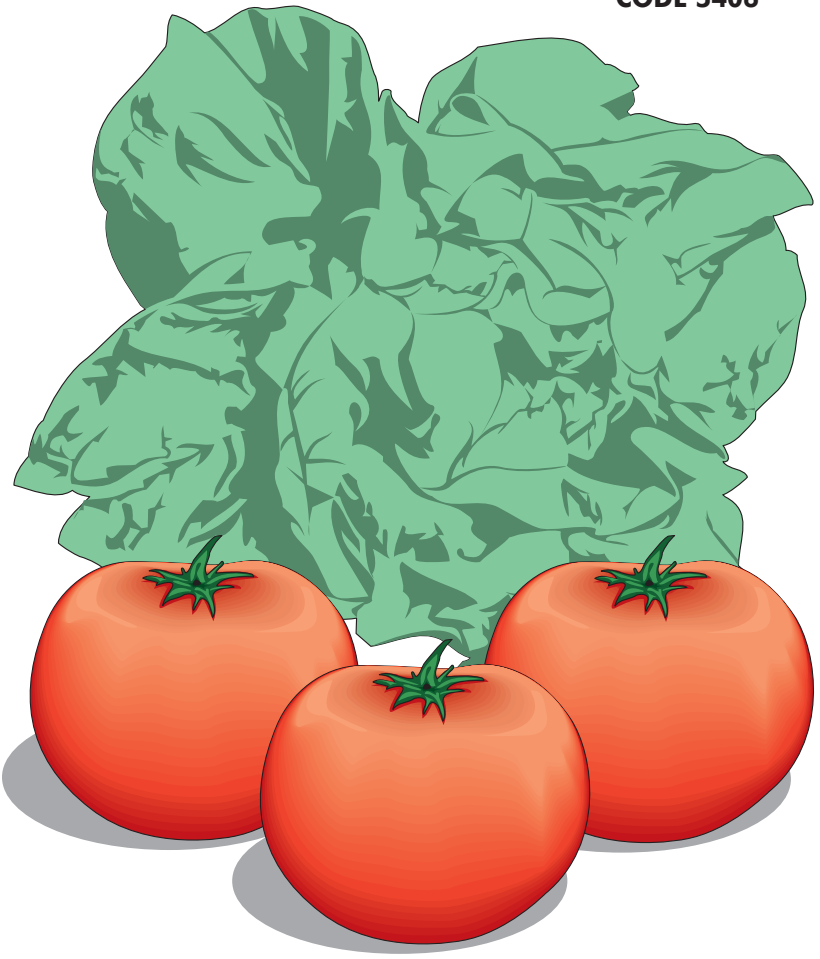
Hydroponics
TEST KIT

MODEL AM-41
CODE 5406



LaMotte

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WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision

CONTENTS LIST

QUANTITY	CONTENTS	CODE
30 mL	Ammonia Nitrogen Reagent #1	4797WT-G
30 mL	*Ammonia Nitrogen Reagent #2	*4798WT-G
10 g	*Nitrate Reducing Reagent	*V-6279-D
2 x 60 mL	*Mixed Acid Reagent	*V-6278-H
50	*Sulfate Turb Tablets	*6456-H
15 mL	*Inhibitor Solution	*9258-E
15 mL	*TEA Reagent	*3921-E
30 mL	Calcium-Magnesium Inhibitor Reagent	3922-G
30 mL	*Sodium Hydroxide Reagent w/Metal Inhibitors	*4259-G
100	Calcium Hardness Indicator Tablets	T-5250-J
30 mL	*Calcium & Magnesium Buffer	*5126-G
30 mL	*CM Indicator Reagent	*6522WT-G
60 mL	Standard EDTA Reagent	5254-H
60 mL	*Hydrochloric Acid, 1.0N	*6130WT-H
30 mL	*Sodium Hydroxide, 1.0N	*4004WT-G
60 mL	*Hydroculture pH Indicator	*5132-H
60 mL	*Hydroculture VM Phosphorus Reagent	*5138-H
30 mL	Charcoal Suspension	5638-G
30 mL	*Ferric Iron Test Solution	*5116PS-G
10 g	*Iron Reagent Powder	*5275-D
250 mL	Deionized Water	5115PT-K
5 g	*Tetraphenylboron Powder	*6364-C
6	Test Tubes, 5 mL, glass, w/caps	0230
1	Graduated Cylinder, 10 mL, glass	0416
1	Spoon, 0.1 g, plastic	0699
2	Test Tubes, 5 & 10 mL, glass, w/caps	0820
2	Test Tubes, 10 mL, glass, w/caps	0822
1	Pipet, glass, w/cap	0341
1	Direct Reading Titrator, 0-500 Range	0383
1	Test Tube, 5.2 mL, glass, w/cap	0645
1	Pipet, 1.0 mL, plastic	0354

QUANTITY	CONTENTS	CODE
4	Test Tubes, 5-10-12.9-20-25 mL, glass, w/caps	0608
1	Filter Paper	0465
2	Funnels, plastic	0459
2	Pipets, plain, plastic	0352
2	Spoons, 0.05 g, plastic	0696
1	Spot Plate, plastic	0159
1	Tablet Crusher	0175
1	Double Tube, Potassium, w/cap	0780
1	Brush, test tube	0514
1	Ammonia Nitrogen Comparator, 1-8 ppm	4796
1	Nitrate-N Comparator, 0.25-10 ppm	3109
1	Sulfate Comparator, 0-200 ppm	7779
1	Hydroculture pH Comparator, 4.8-7.6	5304
1	Phosphorus Comparator, 3-30 ppm	5305
1	*Plant Nutrition Studies*	1596
2	Dispenser Cap	0692

***WARNING:** Reagents marked with a * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents see MSDS CD or www.lamotte.com. To obtain a printed copy, contact LaMotte by email, phone or fax.

To order refill reagents or test kit components, use the specified code numbers.

Read the LaMotte Direct Reading Titrator Manual and the Octet Comparator Manual before proceeding.

DILUTION PROCEDURE

If the test result in the nitrate, phosphate, potassium, ammonia nitrogen or sulfate test is greater than the highest comparator value it is necessary to perform a dilution. Dilutions are made with Deionized Water (5115PT).

Amount of Sample	Dilute To	Multiply Result By
1.0 mL	2.0 mL	2
1.0 mL	5.0 mL	5
1.0 mL	10.0 mL	10
1.0 mL	20.0 mL	20
1.0 mL	25.0 mL	25

TEST PROCEDURES

pH

A pH value of 7.0 indicates a neutral solution. Values above 7.0 indicate alkaline solutions, while values below pH 7.0 indicate acid solutions.

1. Fill test tube (0230) to 5 mL line with the sample.
2. Add 10 drops of *Hydroculture pH Indicator (5132). Cap and mix.
3. Insert test tube into the Hydroculture pH Comparator (5304). Match sample color to a color standard. Record as pH.

   NOTE: If the pH of the sample is not between 6.2 and 6.8, it must be adjusted to 6.5 before proceeding with the following tests. If the pH is below 6.2 add *Sodium Hydroxide, 1.0N (4004WT), one drop at a time, periodically checking the pH until it is brought into the range of 6.2 to 6.8. If the pH is above 6.8, add *Hydrochloric Acid, 1.0N (6130WT) in the same manner.

NITRATE NITROGEN

The Nitrate Nitrogen Comparator measures levels from 0.25 to 10 ppm. Most nutrient solutions will have to be diluted to bring them into this range. A 1 to 20 dilution is suggested (see Page 6).

NOTE: Place Dispenser Cap (0692) on *Mixed Acid Reagent (V-6278). Save this cap for refill reagents.

1. Fill test tube (0820) to the first line with the sample.
2. Dilute to second line with *Mixed Acid Reagent (V-6278). Cap and mix. Wait two minutes.
3. Use the 0.1 g spoon (0699) to add one level measure (avoid any excess) of *Nitrate Reducing Reagent (V-6279). Cap and invert the tube 50-60 times in one minute. Wait 10 minutes.
4. Insert test tube into the Nitrate-N Comparator (3109). Match sample color to a color standard. Record as ppm Nitrate Nitrogen.

   If the original sample was diluted, multiply the reading by 20. Record as ppm Nitrate Nitrogen.

PHOSPHORUS

The Phosphorus Comparator measures levels from 3 to 30 ppm. Most nutrient solutions will have to be diluted to bring them into this range. A 1 to 2 dilution is suggested (see Page 6).

1. Fill test tube (0230) to the line with sample.
2. Use the 1.0 mL pipet (0354) to add 1.0 mL of *Hydroculture VM Phosphorus Reagent (5138). Cap and mix. Wait 5 minutes.
3. Insert test tube into the Phosphorus Comparator (5305). Match sample color to a color standard. Record as ppm Phosphorus.

   If the sample was diluted, multiply the reading by 2. Record as ppm Phosphorus.

POTASSIUM

A turbidimetric method is used for the determination of potassium in the nutrient solution. It is suggested that the nutrient solution be diluted to a 1 to 5 ratio with deionized water to bring the sample concentration within the range of the test. A 1 to 5 dilution involves diluting 2 mL of the sample to 10 mL with Deionized Water (5115PT).

1. Remove the square inner tube and collar.
2. Fill the round tube to the first line (8 mL) with the diluted sample.
3. Dilute to the second line with Deionized Water (5115PT).
4. Add 2 drops of *Sodium Hydroxide Reagent w/Metal Inhibitors (4259). Cap and mix.

5. Use the 0.05 g spoon (0696) to add one level measure of *Tetraphenylboron Powder (6364). Cap and shake vigorously for 30 seconds until all the powder has dissolved. A white precipitate will form immediately. Allow the tube to stand for 5 minutes.
6. Shake the tube again. Remove cap and slowly insert the square tube with the collar. The square tube will slide up and down through the collar and will fill with liquid.

   Viewing from above, adjust the square tube into the turbid solution until the black dot on its base just disappears. Hold the round tube at the top to avoid blocking light.
7. Read result where liquid meets scale. Record as ppm Potassium. If sample was diluted, multiply by 5. Record as ppm Potassium.

   NOTE: Brush tubes thoroughly after each use.

AMMONIA NITROGEN

The Ammonia Nitrogen Comparator measures levels from 1 to 8 ppm. Most nutrient solutions will have to be diluted to bring them into this range. A 1 to 20 dilution is suggested (see Page 6).

1. Fill test tube (0230) to 5 mL line with sample.
2. Add 4 drops of Ammonia Nitrogen Reagent #1 (4797WT). Cap and mix.
3. Add 8 drops of *Ammonia Nitrogen Reagent #2 (4798WT). Cap and mix.
4. Insert test tube into the Ammonia Nitrogen Comparator (4796). Match sample color to a color standard. Record as ppm Ammonia Nitrogen.

   If sample was diluted, multiply by 20. Record as ppm Ammonia Nitrogen.

SULFATE

The Sulfate Comparator measures levels from 0 to 200 ppm. Most nutrient solutions will have to be diluted to bring them into this range (see Page 6).

1. Fill test tube (0822) to line with sample.
2. Add one *Sulfate Turb Tablet (6456). Cap and shake vigorously for at least one minute to dissolve the tablet.

3. Immediately insert test tube into the Sulfate Comparator (7779). Match the sharpness of the lines behind the sample to the sharpness of lines behind the standard. Record as ppm Sulfate.

   NOTE: Disregard any difference in color between the test sample and standards.

   NOTE: Thoroughly rinse and clean test tubes after each test.

IRON

A special spot test method detects low concentrations of iron that are present in the nutrient solutions. No dilutions are required, but it is suggested that a blank be used as a means of comparison with the test sample. The limit of detection is 0.25 ppm.

1. Use pipet (0352) to add 4 drops of sample to a depression on the spot plate (0159).
2. Use the 0.05 g spoon (0696) to add one measure of *Iron Reagent Powder (5275). Mix with the stirring rod (0519).
3. Add 2 drops of *Ferric Iron Test Solution (5116PS). Use tablet crusher (0175) to stir solution thoroughly. Solution will immediately turn red or pink if iron is present.

CALCIUM AND MAGNESIUM

The Schwarzenbach EDTA titration method, used to determine calcium and magnesium, involves two titrations. The first gives the combined calcium and magnesium content and the second gives only the calcium content. Magnesium is calculated from the difference between the two titration values.

Read the Direct Reading Titrator Instruction Manual before proceeding.

TITRATION A, CALCIUM AND MAGNESIUM

1. Fill the test tube (0645) to the line with the nutrient solution.
2. Add 5 drops of Calcium-Magnesium Inhibitor Reagent (3922). Swirl to mix. Wait 5 minutes.
3. Add 5 drops of *Calcium & Magnesium Buffer (5126). Swirl to mix.
4. Add 10 drops of *CM Indicator Reagent (6522WT). Swirl to mix. Solution will turn red.

5. Fill the Direct Reading Titrator (0383) with Standard EDTA Reagent (5254). Insert Titrator tip into the center hole of the titration tube cap.
6. While gently swirling the tube, slowly press the plunger to titrate until the color changes from red to blue.
7. Read the result where the plunger tip meets the scale. Record as Value A.

TITRATION B, CALCIUM

1. Fill the test tube (0645) to the line with nutrient solution.
2. Add 2 drops of *Inhibitor Solution (9258). Swirl to mix.
3. Add 2 drops of *TEA Reagent (3921). Swirl to mix.
4. Add 8 drops of *Sodium Hydroxide Reagent w/Metal Inhibitors (4259). Swirl to mix.
5. Add one Calcium Hardness Indicator Tablet (T-5250). Cap and shake until tablet disintegrates. Solution will turn red.
6. Fill the Direct Reading Titrator (0383) with Standard EDTA Reagent (5254). Insert Titrator tip into center hole of test tube cap.
7. While gently swirling the tube, slowly press the plunger to titrate until the red color changes to a clear blue which lasts for at least one minute.
8. Read the result where the plunger tip meets the scale. Record as Value B.

FINAL RESULTS

Calcium Content = 0.4 x Titration Value B = ppm Ca

Magnesium Content = 0.24 (Value A – Value B) = ppm Mg

EXAMPLE:

Titration Value A is 480 ppm $CaCO_3$

Titration Value B is 400 ppm $CaCO_3$

Calcium = 0.4 x 400 = 160 ppm Ca

Magnesium = 0.24 x (480 – 400) = 0.24 x 80 = 19.2 ppm Mg

PLANT TISSUE TESTING

As a supplement to the nutrient solution tests provided in this kit, additional tests can be conducted on fresh plant tissue, or an extract of the fresh plant tissue. These tests frequently allow verification of suspected nutrient deficiency or other abnormalities.

Fresh plant material should be obtained from the growing plants, both normal and questionable plants. It is important to test healthy plants at the same time that the tests are made on questionable plants, as the greatest value may be derived from the tests when they are used in a comparative manner. If plant parts are to be used, select small lots of leaf petioles, or succulent portions of the stem, in the plant part most affected by any observable symptom. Using a clean, sharp knife or razor blade, cut the material into fine bits of not more than to inch in length and thickness.

Use equal weights of plant material from health and unhealthy plants. A weighed sample is necessary because there is variation in the size of plant material used in the tissue analysis.

Algae cells may also be used for tissue analysis. Equal amounts of algae are filtered or centrifuged from the nutrient solution. The cells are ground up by the use of a glass homogenizer, weighed and put in the extraction tube.

1. Fill two test tubes (0608) to the 5 mL line with the weighed plant tissue.
2. Dilute to 20 mL with Deionized Water (5115PT). Cap and shake vigorously for 5 minutes.
3. Use the funnels (0459) and filter paper (0465) filter the tissue extract into clean test tubes (0608).

   NOTE: If excess turbidity or color is found in the extract add 3 drops of Charcoal Suspension (5638) to the extraction tube. Shake for 1 minute and refilter.
5. Test filtrate following the same procedure used to test a nutrient solution for a particular nutrient. The tissue extract is substituted by volume for the nutrient solution or an appropriate dilution of the nutrient solution.

DISCUSSION OF RESULTS: The results should be interpreted on a comparative basis. No definite values can be assigned for general application, since the magnitude of the results obtained on different species and under different growing conditions may vary significantly. Interpretations should be based on comparisons of the same species and age, and grown under the same general cultural conditions.

THE CHEMISTRY OF THE TEST REACTIONS

The following information pertains to the nature of the chemical tests used in this kit. Although the information is not totally complete, it does provide the teacher or student with the basic chemistry of the reagents and a description of the reactions as they are thought to occur.

CALCIUM-MAGNESIUM

*Calcium & Magnesium Buffer	Ammonia Buffer	*5126
*TEA Reagent	Triethanolamine	*3921
*CM Indicator	Eriochrome/Triethanolamine	*6522
Standard EDTA Reagent	Disodium Salt EDTA	5254
*Sodium Hydroxide Reagent	Sodium Hydroxide	*4259
Calcium Hardness Indicator Tablets	Calcon	5250
Calcium-Magnesium Inhibitor Reagent	CDTA	3922
*Inhibitor Solution	Sodium Sulfide	*9258

Ethylenediaminetetraacetic acid (EDTA) and its disodium salts form chelate complexes with metal cations. Calcium and magnesium complexes are colorless and the calcium-EDTA complex is more stable than the magnesium-EDTA complex.

The Eriochrome dye also forms complexes with calcium and magnesium; the magnesium-dye complex is more stable than the calcium-dye complex. In the pH range from 8.5 to 11.5 an aqueous solution of the dye is blue, while it's calcium and magnesium complexes are red. The Calcium & Magnesium Buffer is added to bring the sample within this pH range. CDTA is used to complex or mask interfering metals.

If EDTA titrant is added the calcium, and then the magnesium is extracted from their dye complexes. After sufficient EDTA is added to complex all of the magnesium as well as the calcium, the solution will turn blue.

CALCIUM

At a pH of about 12, Calcon indicator forms a red complex with calcium. A sodium hydroxide solution is required to bring the pH within the desired range. The sodium sulfide and TEA are used to complex or mask interfering metals. EDTA combines with calcium before it combines with magnesium and is capable of extracting calcium from the Calcon complex and thus, restores the blue color of Calcon. Magnesium does not change the color of Calcon at this pH.

SULFATE

*Sulfate Turb Tablets		*6456

The single tablet reduces the pH and precipitates sulfate as barium sulfate ($BaSO_4$). The sulfate level in ppm is determined turbidimetrically.

IRON

*Ferric Iron Test Solution	KCNS (thiocyanate)	*5116PS
*Iron Reagent Powder	Sulfamic Acid	*5275

Ferric (Fe^{+3}) ions react with the thiocyanate ions in an acid solution to yield a red or pink color which is ferric thiocyanate.

NITRATE

*Mixed Acid Reagent	Acid Salt Solution	*V-6278
*Nitrate Reducing Reagent	Cadmium Reduction Mixture	*V-6279

The Nitrate (NO_3) is reduced to the Nitrite (NO_2) by the cadmium reagent and forms nitrous acid with the salt solution. The nitrous acid produces a red dyestuff through a diazotization process.

AMMONIA

Ammonia Nitrogen Reagent #1	Stabilizer-Rochelle Salt (potassium and sodium tartrate-APHA Solution)	4797WT
*Ammonia Nitrogen Reagent #2	Nessler's Reagent (anhydrous mercuric iodide, anhydrous potassium iodide, and Nessler's Reagent [anhydrous mercuric iodide, anhydrous potassium iodide, and sodium hydroxide])	*4798WT

Ammonia Reagent #1 is added to prevent precipitation of residual calcium and magnesium ions in the presence of the alkaline Nessler's Reagent. *Ammonia Reagent #2 is then added to the sample. If ammonia is present a yellow color is developed which is probably oxidimercuric ammonium iodine (NH_2Hg_20I).

pH

*Hydroculture pH Indicator Solution	Methyl Red, Bromthymol Blue in 95% alcohol	*5132

The pH indicator is a mixture of organic dyes that exhibit different colors a various pH levels.

PHOSPHORUS

*Hydroculture VM Phosphorus Reagent	Ammonium Vanadate Molybdate in Sulfuric Acid Solution	*5138

The inorganic phosphate reacts with the molybdate solution to form a yellow phospho-molybdate compound.

POTASSIUM

*Tetraphenylboron Powder	Sodium Textraphenylborate	*6364
*Sodium Hydroxide Reagent	Sodium Hydroxide	*4259WT

A solution is made alkaline with sodium hydroxide. Potassium combines with sodium tetraphenylborate to form potassium tetraphenylborate which precipitates and causes the solution to become cloudy.

LaMOTTE COMPANY

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